

**ST. JOSEPH'S COLLEGE (AUTONOMOUS)**

**BENGALURU-27**

**DEPARTMENT OF MICROBIOLOGY**

**SYLLABUS FOR UNDERGRADUATE COURSE**



Re-accredited with 'A++' **GRADE and 3.79/4 CGPA** by NAAC  
Recognised by UGC as College of Excellence

**For Batch 2018-2021**

**SUMMARY OF CREDITS**

<b>DEPARTMENT OF MICROBIOLOGY (UG)</b>					
<b>(2018-2021)</b>					
<b><u>Semester 1</u></b>	<b>Code Number</b>	<b>Title</b>	<b>Number of teaching hrs /week</b>	<b>Number of credits</b>	<b>Max marks for SE and duration of examination</b>
Theory	MB-118	Basic Microbiology & Microbiological techniques	04	04	70-2.5Hrs
Practical	MB-1P <sub>1</sub>	Basic Microbiology & Microbiological techniques	03	01	35-3Hrs
<b>Total Number of credits:</b>				<b>05</b>	
<b><u>Semester 2</u></b>	<b>Code Number</b>	<b>Title</b>	<b>Number of teaching hrs /week</b>	<b>Number of credits</b>	<b>Max marks for SE and duration of examination</b>
Theory	MB-218	Biophysics, Biochemistry and Microbial diversity	04	04	70-2.5Hrs
Practical	MB-2P <sub>1</sub>	Biophysics, Biochemistry and Microbial diversity	03	01	35-3Hrs
<b>Total Number of credits:</b>				<b>05</b>	
<b><u>Semester 3</u></b>	<b>Code Number</b>	<b>Title</b>	<b>Number of teaching hrs /week</b>	<b>Number of credits</b>	<b>Max marks for SE and duration of examination</b>
Theory	MB-318	Microbial physiology, growth and control of microorganisms	04	04	70-2.5Hrs
Practical	MB-3P <sub>1</sub>	Microbial physiology, growth and control of microorganisms	03	01	35-3Hrs
<b>Total Number of credits:</b>				<b>05</b>	
<b><u>Semester 4</u></b>	<b>Code Number</b>	<b>Title</b>	<b>Number of teaching hrs /week</b>	<b>Number of credits</b>	<b>Max marks for SE and duration of examination</b>
Theory	MB-418	Microbial Genetics, Molecular Biology	02	02	35- 75 Minutes
Theory	MBOE-4118	Microbial Diseases: Causes, Prevention and Cure	02	02	35- 75 Minutes
Practical	MB-4P <sub>1</sub>	Microbial Genetics, Molecular Biology	03	01	35-3Hrs
<b>Total Number of credits:</b>				<b>03</b>	
<b><u>Semester 5</u></b>	<b>Code Number</b>	<b>Title</b>	<b>Number of teaching</b>	<b>Number of</b>	<b>Max marks for SE and</b>

			<b>hrs /week</b>	<b>credits</b>	<b>duration of examination</b>
Theory	MB-5118	Immunology and Medical Microbiology	03	03	70-2.5Hrs
Practical	MB-5P <sub>1</sub>	Immunology and Medical Microbiology	03	01	35-3Hrs
Theory	MB-5218	Agricultural and Environmental Microbiology	03	03	70-2.5Hrs
Practical	MB-5P <sub>2</sub>	Agricultural and Environmental Microbiology	03	01	35-3Hrs
<b>Total Number of credits:</b>				<b>08</b>	
<b><u>Semester 6</u></b>	<b>Code Number</b>	<b>Title</b>	<b>Number of teaching hrs /week</b>	<b>Number of credits</b>	<b>Max marks for SE and duration of examination</b>
Theory	MB-6118	Food and Fermentation Technology	03	03	70-2.5Hrs
Practical	MB-6P <sub>1</sub>	Food and Fermentation Technology	03	01	35-3Hrs
Theory	MB-6218	Microbial technology	03	03	70-2.5Hrs
Practical	MB-6P <sub>2</sub>	Microbial technology	03	01	35-3Hrs
<b>Total Number of credits:</b>				<b>08</b>	

## DEPARTMENT OF MICROBIOLOGY

Semester	I
Paper Code	MB-118
Paper Title	<b>Basic Microbiology and Microbiological Techniques</b>
Number of teaching hrs per week	04
Total number of teaching hrs per semester	60
Number of credits	04

### Objective of the Paper:

This paper introduces the students to the history, scope and the diversity of Microbiology. It gives an overview of the microbial world and also techniques to visualize and keep microbes in check. This paper acts as the first step to gain insight about the basics of the vast field of Microbiology.

### UNIT – I

#### History and Scope of Microbiology:

##### a. Theories of origin of life

Scope and relevance of Microbiology as a modern science

Branches of Microbiology

2

##### b. Contribution of Scientists to the field of Microbiology:

Antony Von Leewenhoek, Francisco Redi, Edward Jenner, Louis Pasteur, Joseph Lister, Robert Koch and Alexander Flemming.

2

##### c. Microscopic examination of Microorganisms

Light Microscopy-Bright field, Dark field, Fluorescence and Phase contrast

Electron microscopy (TEM and SEM)

7

### UNIT – II

#### General Characteristics of Microorganisms

##### a. Introduction to prokaryotic and eukaryotic cells:

Comparative study of cellular organization of prokaryotes and eukaryotes

1

##### b. Bacteriology :

Overview of a bacterial cell (morphology, ultra structure and function)

Structure and function of flagella, pili and capsule, cell wall (gram positive and gram negative), cell membrane, mesosomes, ribosomes, and genetic material.

Plasmid- types and functions.

Inclusion bodies and reserve food materials.

Endospore – structure, function, sporulation and germination.

Reproduction in bacteria: asexual and sexual, horizontal gene transfer.

**Bacteria with unusual properties:**

Mycoplasma

Actinomycetes

14

**c. Phycology**

General characteristics and importance.

Overview of cyanobacterial cell (Ultrastructure and functions)

2

**UNIT - III**

**d. Mycology**

Overview of fungal cell -ultra structure of Hyphal and yeast form.

Structure and function of cell wall, cell membrane, flagella, cell organelles.

Reproduction in fungi: asexual and sexual

6

**e. Virology**

Structure, Reproduction, and Significance of:

Bacterial viruses - T4, Plant virus- TMV, Animal virus - HIV.

Cultivation of viruses.

**f. Protozoology**– General characters and type study- Paramecium (structure and reproduction).

**g. Infectious particles**- Prions & Virioids (general characteristics and diseases.)

11

**UNIT – IV**

**Microbiological techniques**

**a. Staining Techniques:**

Simple staining (Negative staining)

Differential staining (Grams and Acid fast staining)

Structural staining (endospore, flagella and capsular staining) and fungal staining

3

**b. Sterilization techniques:**

i) Factors affecting antimicrobial activity:-

Environment, organisms, physiological status of the organisms, inoculums concentration, intensity of concentration of the antimicrobial agent, temperature and time of action as factors affecting antimicrobial activity.

ii) Physical methods:

Moist heat (Pasteurization)

Moist heat under pressure (Autoclave)

Dry heat (incineration, hot air over)

Filtration- membrane filter, HEPA filter

Radiation (UV- rays, X- rays, ultrasonic rays)

- iii) Chemicals (alcohols, formaldehyde, phenol, halogens and heavy metals):  
 Characteristics of an ideal antimicrobial chemical agent  
 Evaluation of antimicrobial chemical agents- agar plate techniques, Phenol co-efficient methods.

12

**NOTE: 6 hours of self-study assigned from the above units.**

**REFERENCES:**

1. Jacquelyn G.Black, (2008), Microbiology Principles and explorations, JohnWiley& sons Ltd
2. Prescott, Harley & Klein's,(2008), Microbiology, Mac Graw Hill Higher education.
3. James T Staley; (2007)Microbial Life; SinauerAssocites;.
4. Michael J Pelczar, JR. E.C.S Chan, Noel R. Krieg; Microbiology, TATA McGraw-Hill publication.
5. Douglas B Murphy; Fundamentals of light microscopy and electronic imaging; John Wiley and Sons.
6. Rajeshwarareddy; General Microbiology.

**BLUEPRINT**

Code number: **MB 118**

Title of the paper : **Basic microbiology and Microbiological techniques.**

Total marks for which the questions are to be asked (including bonus questions)	Number of Hrs	Chapter number
19	11	Unit I
27	17	Unit II
27	17	Unit III
23	15	Unit IV
<b>Total</b>	<b>96</b>	<b>60</b>
<b>Maximum marks for the paper (Excluding bonus question)= 70</b>		

## Practical I

### MB 1P<sub>1</sub> – Basic microbiology and Microbiological techniques (11 sessions 3hr/week)

1. Safety measures in laboratory.
2. Study of compound and binocular microscopes.
3. Study of instruments- Autoclave, hot air oven, LAF, incubator, membrane filter, colony counter.
4. Preparation of media – NB, NA.
5. Isolation and identification of bacteria.
6. Pure culture techniques – pour plate, spread plate and streak plate (Simple, Continuous, Quadrant) methods.
7. Aseptic transfer techniques.
8. Staining of bacteria – Gram's, Negative, Endospore and Capsule Staining.
9. Permanent slides – *Aspergillus*, *Penicillium*, *Rhizopus* and *Anabaena*.

Semester	II
Paper Code	<b>MB-218</b>
Paper Title	<b>Biophysics, Biochemistry and Microbial diversity</b>
Number of teaching hrs per week	04
Total number of teaching hrs per semester	60
Number of credits	04

**Objective of the Paper:** This paper enables students to learn about the Bio molecules present in microbial cells and the techniques used in their biophysical and biochemical analysis. It also deals with the study of the diversification of microorganisms.

## UNIT - I

### **Biophysics**

- a.** Scope and development of Biophysics **1**
  
- b.** Properties and dissociation of water  
Structure, properties, hydrogen bonding, water as a solvent and ionization of water **3**
  
- c.** pH and Buffers pH –  
pH- concept and pH scale; Buffers- concept.  
Henderson- Hasselbalch equation, Biological buffer systems **3**
  
- d.** Isotopes and Radioactivitiy  
Nature of radioactivity, Atomic structure and stability, Types of radioactive emissions, Rate and half life of disintegration. Applications of radioisotopes in the biological sciences, safety measures and Autoradiography. **4**

## UNIT - II

### **Analytical techniques**

- Principle and applications of Chromatography (Paper chromatography, Thin layer chromatography, Column chromatography), Centrifugation and Electrophoresis (agarose gel electrophoresis and SDS-PAGE), Spectrophotometry. **7**



## UNIT - III

### Bio molecules

Amino acids and Peptides- Classification and Properties (titration curve of amino acids).	3
Proteins – Classification of proteins based on structure and functions, Structural organization of proteins (Primary, Secondary, Tertiary and Quaternary structures)	4
Nucleic acids – Experiments to elucidate nucleic acids as genetic material, DNA (Watson and Crick model, types of DNA and its functions), Structure and function of mRNA, tRNA and rRNA	4
Vitamins – Water soluble and Fat- soluble vitamins(Dietary source and deficiency disorders)	3
Carbohydrates – Structure, Properties and Classification.	4
Lipids – Structure, Properties and Classification.	3

## UNIT – IV

### Enzymology

Introduction to enzymes, Classification, Enzyme kinetics (Michelis Menten Equation)	
Factors influencing enzyme activity, co-enzymes and co-factors,	
Mechanisms of enzyme regulation	7

## UNIT – V

### Microbial Diversity

a. Microorganisms and microbial ecology – Classification based on temperature, pH, oxygen requirement, salt concentration and pressure (with adaptation strategies for each parameter)	4
b. Microbial associations (Parasitism, symbiosis, commensalism, antagonism, predator and competition).	4
c. Microbial systematics Bacterial Classification Bergey's manual.	
1. Brief account on- Numerical taxonomy, chemotaxonomy and genetic analyses.	4
2. Fungal classification – Alexopolus	1
3. Viral Classification – Baltimore	1

**NOTE: 6 hours of self-study assigned from the above units.**

### REFERENCES:

1. Michael M Cox, David L Nelson; Lehninger, Principles of Biochemistry; 5<sup>th</sup> edition; Worth Publishers, Inc
2. Jain and Jain; Biochemistry
3. Wilson and Walker; Principles and Techniques of Biochemistry and Molecular Biology.
4. Upadhyaya; Biophysical chemistry

5. James T Staley; (2007)Microbial Life; Sinauer Associates
6. Atlas and Bartha; Microbial Ecology.
7. Jacquelyn G.Black, (2008), Microbiology Principles and explorations, JohnWiley& sons Ltd
8. Prescott, Harley & Klein's,(2008), Microbiology, Mac Graw Hill Higher education.

### BLUEPRINT

Code number: **MB 218**

Title of the paper: **Biophysics, Biochemistry and Microbial diversity**

Total marks for which the questions are to be asked (including bonus questions)	Number of Hrs	Chapter number
18	11	Unit I
11	07	Unit II
34	21	Unit III
11	07	Unit IV
22	14	Unit V
<b>Total</b>	<b>96</b>	<b>60</b>
<b>Maximum marks for the paper (Excluding bonus question)= 70</b>		

## **Practical II**

### **MB2P<sub>1</sub> – Biophysics, Biochemistry and Microbial diversity (11 sessions 3hr/week)**

1. Study of instruments: Centrifuge, pH meter, Spectrophotometer.
2. Preparation of buffer – citrate and phosphate buffer.
3. Estimation of reducing sugars by DNSA method.
4. Estimation of Protein by Lowry's method.
5. Estimation of DNA by Diphenylamine (DPA) method.
6. Estimation of RNA by Orcinol method.
7. Paper chromatography of amino acids.
8. Isolation and identification of fungi.
9. Study of microbial interactions - antagonism (Bacteria v/s Bacteria, Bacteria v/s Fungi, Fungi v/s Fungi).

Semester	III
Paper Code	<b><u>MB-318</u></b>
Paper Title	<b>Microbial physiology, growth and control of microorganisms</b>
Number of teaching hrs per week	04
Total number of teaching hrs per semester	60
Number of credits	04

**Objective of the Paper:** This paper enables students to understand the nutritional requirement, growth pattern and metabolism of the microorganisms. In addition it deals with the mode of action and use and abuse of antibiotics against microbes.

## UNIT - I

### Microbial nutrition and growth

- a. Nutritional requirements: Macronutrients, Micronutrients and trace elements. Nutritional types - Phototrophs, Chemotrophs, Autotrophs and Heterotrophs. 2
- b. Factors affecting growth 2
- c. Bacterial growth curve and calculation of generation time. 3
- d. Continuous culture system – chemostat and turbidostat. 2
- e. Synchronous cultures. 2
- f. Methods of determining microbial growth by cell number, cell mass and cell number. 4
- g. Introduction to the concept of cultivation of microorganisms: Media and types of media.
- h. Isolation of pure cultures by streaking method. 3
- i. Maintenance and preservation of bacterial and fungal cultures. 2

## UNIT – II

### Bioenergetics and Metabolism:

#### A. Bioenergetics:

Entropy, enthalpy, free energy, ATP-its role in metabolism, other energy rich compounds, oxidation-reduction reactions, Electron carriers. 3

#### B. Metabolism:

a. Overview of metabolism. 1

b. Carbohydrate metabolism:

(i) Catabolism:

- Glycolysis, Pentose phosphate pathway, TCA, ETC.

- Fermentation reactions in microorganisms: (lactic acid, mixed acid, butanediol, butyric acid,

propionic acid.)	
- Breakdown of starch, glycogen, cellulose, lactose, maltose, cellobiose and sucrose.	<b>10</b>
(ii) Anabolism:	
- Gluconeogenesis	
- Photosynthesis (Cyclic and non cyclic); CO <sub>2</sub> fixation (C <sub>3</sub> and C <sub>4</sub> )	
- Biosynthesis of Peptidoglycan.	<b>8</b>
c. Lipid metabolism:	
(i) Catabolism:	
- Oxidation of saturate fatty acids – $\beta$ oxidation pathway	
(ii) Anabolism:	
- Biosynthesis of straight chain even carbon saturated fatty acid (palmitic acid)	<b>4</b>
d. Amino acid metabolism:	
(i) Catabolism:	
- Overview of catabolism of amino group.	
- Nitrogen excretion and urea cycle.	
(ii) Anabolism:	
- Overview of aminoacid biosynthesis.	<b>4</b>

### **UNIT - III**

#### **Antibiotics and other chemotherapeutic agents:**

a. Definition and classification of antibiotics.	<b>1</b>
b. History of chemotherapy	<b>1</b>
c. Antibiotic chemotherapeutic agents: Mode of action of: Penicillins/Cephalosporins/Streptomycin/Tetracyclines/Erythromycin/Chloramphenicol/ Polymyxin and Bacitracin/ Antifungal – Nystatin, Griseofulvin, Amphotericin B)	<b>5</b>
d. Determining the effectiveness of chemotherapeutic agents	<b>1</b>
e. Development of Resistance to antibiotics.	<b>2</b>

**NOTE: 6 hours of self-study assigned from the above units.**

#### **REFERENCES:**

1. Joanne M. Willey, Linda M. Sherwood and Christopher J. Woolverton (2008); Prescott, Harley and Klein's Microbiology, 7<sup>th</sup> edition, Mc Graw Hill Higher education.
2. David L. Nelson, Michael M. Cox; Lehninger Principles of Biochemistry, 5<sup>th</sup> edition, W.H. Freeman and Co., New York.
3. Albert G. Moat, John W. Foster and Michael P. Spector (2009); Microbial Physiology, 4<sup>th</sup> edition, Wiley Publications.
4. Gerard J. Tortora, Berdell R. Funke and Christine L. Case; Microbiology: An Introduction, 9<sup>th</sup> edition, Pearson Education Inc.



## BLUEPRINT

Code number: **MB 318**

Title of the paper: **Microbial physiology, growth and control of microorganisms**

Total marks for which the questions are to be asked (including bonus questions)	Number of Hrs	Chapter number
32	20	Unit I
48	30	Unit II
16	10	Unit III
<b>Total</b>	<b>96</b>	<b>60</b>
<b>Maximum marks for the paper (Excluding bonus question)= 70</b>		

## **Practical – III**

### **MB3P<sub>1</sub>: Microbial Physiology, Growth and Control of microorganisms (11 sessions 3hr/week)**

1. Isolation and identification of bacteria from various samples.
2. Nutritional requirement – Growth on various carbon and nitrogen sources.
3. Bacterial growth curve (Spectrophotometric method) and generation time.
4. Lineargrowth of fungi
5. Counting of yeast cells by using a haemocytometer
6. Use of Micrometer and calibration, measurement of yeasts/ fungal spores
7. Biochemical tests used for the identification of bacteria, IMViC, fermentation of carbohydrates (any three), starch hydrolysis, TSI, Gelatin liquefaction, catalase and oxidase test.
8. Evaluation of antibiotic sensitivity test (disc diffusion method)



Semester	IV
Paper Code	<b><u>MB-418</u></b>
Paper Title	<b>Microbial Genetics and Molecular Biology</b>
Number of teaching hrs per week	02
Total number of teaching hrs per semester	30
Number of credits	02

**Objective of the Paper:** This paper helps student understand the basic molecular genetics in microbial systems.

### UNIT – I

- a. History and scope of Genetics 2
- b. General structure of DNA and Forms of DNA (A, B, Z and H) 2
- c. Structure and types of RNA 2
- d. Genetic organization in prokaryotes and eukaryotes 2

### UNIT – II

- a. DNA replication in prokaryotes: Messelson and Stahl's experiment, Models of DNA replication and Mechanism of DNA replication. 4
- b. Mutations: Types of mutations, Spontaneous mutations and induced mutations, physical and chemical mutagens. Mutations for economic benefit. 4
- c. DNA repair: Photoreactivation and nucleotide excision repair. 1
- d. Transposition in prokaryotes: structure of IS and Tn elements in prokaryotes and mechanism of transposition. 2
- e. Gene transfer mechanisms in bacteria: Transformation, Conjugation and Transduction 3

### UNIT – III

- a. Central dogma of molecular biology 1
- b. Transcription in prokaryotes: Promoters, RNA polymerase and mechanism of transcription 3
- c. Translation in prokaryotes: Mechanism of translation. 2
- d. Regulation of gene expression in prokaryotes: Operon concept and Lac operon. 2

**NOTE: 3 hours of self-study assigned from the above units.**

## REFERENCES:

1. Jeremy W. Dale and Simon F. Park; Molecular Genetics of bacteria, John Wiley and Sons.
2. Benjamin Lewin; Genes VIII, Pearson Prentice Hall.
3. David Freifelder (2000); Molecular Biology, 2<sup>nd</sup> edition, Narosa Publishing House, New Delhi.
4. David L. Nelson, Michael M. Cox; Lehninger Principles of Biochemistry, 5<sup>th</sup> edition, W.H. Freeman and Co., New York.
5. James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levin and Richard Losick (2004); Molecular Biology of the Gene, 5<sup>th</sup> edition., Pearson, Benjamin Cummings and CSHL press.
6. T. A Brown (2010), Gene Cloning and DNA analysis, 6<sup>th</sup> edition, Wiley and Blackwell publishers.

## **BLUEPRINT**

Code number: **MB418**

Title of the paper: **Microbial Genetics and Molecular Biology**

Total marks for which the questions are to be asked (including bonus questions)	Number of Hrs	Chapter number
13	08	Unit I
22	14	Unit II
13	08	Unit III
<b>Total</b>	<b>48</b>	<b>30</b>
<b>Maximum marks for the paper (Excluding bonus question)= 70</b>		

## **Practical - IV**

### **MB 4P<sub>1</sub> – Microbial Genetics and Molecular Biology**

**(11 sessions 3hr/week)**

1. Physical and chemical mutagenesis
2. Determination of mutagenicity of chemicals by AMES test.
3. Study of Bacterial Conjugation.
4. Isolation of bacterial genomic DNA.
5. Agarose gel electrophoresis of Genomic DNA.
6. Demonstration of SDS-PAGE (Sodium dodecyl sulphate-Polyacrylamide gel Electrophoresis).

**Semester – IV**  
**MBOE4118 – Microbial Diseases: Causes, Prevention and Cure**  
**(OPEN ELECTIVE)**

**Time: 30 Hours**

**Learning outcomes: Microbes** are tiny organisms, too tiny to see without a microscope, yet they are abundant on Earth. They live everywhere: in air, soil, rock, and water. Some live happily in searing heat, while others thrive in freezing cold. Some **microbes** need oxygen to live, but others do not. Though microscopic, one can't overemphasize the importance of microbiology. Society benefits from microorganisms in many ways. In contrary to those microorganisms also have harmed humans, animals, plants and so on, and disrupted society over the millennia. Microbial diseases undoubtedly played a major role.

This elective draws our relationship closer to microbes. This relationship involves not only the beneficial effects but also familiarize us with the harmful effects of certain microorganisms. Here we will bring to you the ways microbes affect our lives by causing diseases. We will also try and learn the measures to be taken to prevent the spread of microbial diseases and if affected to treat them

**UNIT – I**

Introduction to microbial biodiversity – distribution, abundance, ecological niche and types.

Definition of infection and disease.

Classification of infections; localized, generalized, endemic, epidemic, sporadic and pandemic.

Classification of diseases as communicable and non communicable with examples. **5**

**UNIT - II**

**Sources of infection:** - Air, humans, animals, insects, soil, water and food. **3**

**UNIT - III**

**Methods of transmission of infection:** - Contact, inhalation, ingestion, inoculation, insects, congenital, iatrogenic and laboratory infections. **2**

**UNIT - IV**

Causes prevention and treatment of infections /diseases.

HIV, Tuberculosis, Candidiasis and Malaria and currently relevant outbreaks **10**

**UNIT - V**

Hospital acquired infection, prevention and control (CDC) **2**

Disinfection: - types of disinfection procedures **1**

Vaccines and Immunization schedule **3**

Chemotherapy - Use and abuse **4**

## **REFERENCES:**

1. Jacquelyn G.Black, (2008), Microbiology Principles and explorations, JohnWiley& sons Ltd.
2. Prescott, Harley &Klein's,(2008), Microbiology, Mac Graw Hill Higher education.
3. Ananthanarayan and Paniker; Text book of Microbiology (2006); 8<sup>th</sup> Edition; Orient Longman publication, Hyderabad.
4. David Greenwood, Richard C.B. Slack and John. F. Peutherer; Medical Microbiology(2008), 7<sup>th</sup> Edition, Elsevier India Private Ltd., New Delhi.
5. Jawetz, Melnickand Adelbergs; Medical Microbiology (2010); 25<sup>th</sup> Edition; McGraw Hill Companies, USA.

Semester	<b>V</b>
Paper Code	<b>MB 5118</b>
Paper Title	<b>Immunology and Medical Microbiology</b>
Number of teaching hrs per week	3
Total number of teaching hrs per semester	45
Number of credits	3

**Objective of the paper:** To acquire fundamental knowledge of the basic principles of immunology and to understand how these principles apply to the process of immune function. The course also provides the conceptual basis for understanding pathogenic microorganisms and the mechanisms by which they cause diseases in the human body.

### **UNIT-I**

Immunity: Definitions, types (natural, acquired, active and passive).	<b>2</b>
Mechanisms of innate immunity.	<b>2</b>
Antigens: Definition, types of antigens, factors influencing antigenicity.	<b>2</b>
Immunoglobulins: Definition, structure, types, properties and functions of immunoglobulins.	<b>4</b>
Production of monoclonal antibodies and their applications.	<b>4</b>
Antigen and antibody reactions: General features of antigen and antibody reactions. Precipitation, agglutinations, complement fixation, ELISA, opsonization	<b>6</b>

### **UNIT-II**

Cells and organs of the immune system: Structure and function.	<b>4</b>
Immune response: AMI and CMI	<b>1</b>
Complement system: Properties, components, pathways and functions.	<b>1</b>
Hypersensitivity: Types (I, II, III, IV), mediators of hypersensitivity reactions, mechanism of mast cell degranulation and detection of Type I hypersensitivity.	<b>2</b>

### **UNIT-III**

Major histocompatibility complex (MHC): Structure and function.	<b>1</b>
Transplantation immunology: Types, graft acceptance, genetic basis of graft rejection. Mechanism and manifestations of graft rejection.	<b>2</b>
Vaccines: Definition, types- conventional, purified molecules and recombinant with examples.	<b>2</b>

## UNIT-IV

### Medical Microbiology

Infection: Definition, primary, nosocomial, inapparent, atypical. Sources of infection, methods of transmission of infection. Factors or mechanisms of microbial pathogenesis. Types of infectious diseases. 4

## UNIT-V

### a. Normal human flora 1

**b. Important groups of pathogenic microorganisms:** (classification, culture and biochemical characters, antigenic structure, pathogenicity, pathogenesis, clinical and lab diagnosis, epidemiology, prophylaxis and chemotherapy)

### Bacterial

- a. Enterobacteriaceae (*Salmonella*)
- b. Gram +ve cocci (*Staphylococcus*)
- c. *Vibrio*
- d. *Mycobacterium tuberculosis*
- e. *Pneumococcus*

### Protozoan

- a. *Plasmodium*
- b. *Entamoeba*

### Fungal

- a. *Candida*
- b. Systemic Mycoses-Aspergillosis

### Viral

- a. Hepatitis B
- b. HIV
- c. Dengue

10

**NOTE: 4 hours of self-study assigned from the above units.**

### REFERENCES:

1. Ananthanarayan and Paniker; Text book of Microbiology (2006); 8<sup>th</sup> Edition; Orient Longman publication, Hyderabad.
2. Charles A. Janeway Jr. Paul Travers, Simon Hunt, Mark Walport (2001) Immunobiology, 5<sup>th</sup> Edition Garland Publishing Inc, London.
3. David Greenwood, Richard C.B. Slack and John. F. Peutherer; Medical Microbiology(2008), 7<sup>th</sup> Edition, Elsevier India Private Ltd., New Delhi.
4. Jawetz, Melnick and Adelbergs; Medical Microbiology (2010); 25<sup>th</sup> Edition; McGraw Hill Companies, USA.
5. Kuby J; (2000), Immunology, 4<sup>th</sup> Edition; W.H. Freeman and Company, New York.

# **BLUEPRINT**

Code number: MB **5118**

Title of the paper: Immunology **and Medical Microbiology**

Total marks for which the questions are to be asked (including bonus questions)	Number of Hrs	Chapter number
36	17	Unit I
17	8	Unit II
11	5	Unit III
8	4	Unit IV
24	11	Unit V
<b>Total</b>	<b>96</b>	<b>45</b>
<b>Maximum marks for the paper (Excluding bonus question)= 70</b>		



## Practicals – V

### MB 5P1- Immunology and Medical Microbiology

(11 sessions: 3hr/ week)

1. Blood grouping.
2. WIDAL and VDRL.
3. Pregnancy (hCG) test and Coagulase test.
4. ODD (Ouchterlony Double Diffusion).
5. RID (Radial Immuno Diffusion).
6. ELISA.
7. Isolation of bacteria on selective media from skin, ear, nasal, and throat. Visualization of organisms by Gram's staining and motility.
8. Antibiotic sensitivity testing for the identified pathogens.
9. Spotters: AFB, *Staphylococcus*, *Plasmodium*, *Entamoeba*, *Candida*, *Aspergillus* & HIV

Semester	<b>V</b>
Paper Code	<b>MB 5218</b>
Paper Title	<b>Agricultural and Environmental Microbiology</b>
Number of teaching hrs per week	3
Total number of teaching hrs per semester	45
Number of credits	3

**Objective of the paper:** This paper deals with the impact of the occurrence and use of microorganisms in agriculture and environment highlighting both beneficial and detrimental effects.

## **Agricultural Microbiology**

### **UNIT-I**

Diversity of soil flora, rhizosphere, Mycorrhiza

Role of microorganisms in humus formation

Biogeochemical cycles: Carbon, Nitrogen, Phosphorus, Sulphur

Role of microorganisms in iron oxidation (Microbial leaching) **8**

### **UNIT-II**

#### **Plant pathology**

Classification of plant diseases based on symptoms (with one example of each)  
Downy mildew, Rust, Citrus Canker and Tobacco Mosaic Disease-Epidemiology of plant diseases.

General methods of plant diseases control

a) Avoidance

b) Chemical control and acquired resistance

c) Biological control **5**

### **UNIT-III**

**Bioinoculants:** **6**

Biochemistry of symbiotic and non-symbiotic nitrogen fixation and phosphate Solubilization

Production of Bioinoculants- (*Rhizobium*, *Azotobacter*, *Azospirillum*, PSM's, BGA, *Azolla* and AMF) Methods of application, Comparison with chemical fertilizers

**Biopesticides-** *Bacillus thuringiensis*, *Trichoderma*, Viruses-NPV, GPV, CPV – introduction and mode of action **2**

### **Anaerobic Digesters**

Raw materials, organisms involved and their activity, Biochemical mechanism of gas production, application of biogas **2**

Biodegradation of herbicides (2,4-D ) and pesticides ( DDT ) and Biodeterioration **3**

## **Environmental Microbiology**

### **UNIT-IV**

#### **Air Microbiology**

Microflora of air, methods of air sampling- Impingers: Portion impinger, Per-impinger, Lemon sampler, Capillary impinger, Bead impinger, All glass impinger and Impactors: Slit sampler, Cascade impactor, Hirst trap, Andersons' sampler, Vertical cylinder pollen trap, Burkad seven days volumetric sampler, Rotorod air sampler. Air Pollution, Biological Indicators of Pollution, Air Sanitation and Air-Borne Infections **5**

### **UNIT-V**

#### **Water microbiology**

Bacteriology of potable and recreational water

Bacteriological analysis of water, indices of fecal pollution-WHO recommendation in water analysis

Detection of bacterial pathogens

Analysis of water - Physico-chemical and biological parameters

Waste water & municipal water treatment method: primary, secondary and tertiary treatment **2**

### **UNIT-VI**

a. Biodegradation of organic matter (lignin, cellulose, hemicellulose and pectin) **2**

b. Bioremediation - Bioremediation and waste management. An emerging Biotechnology Using microorganisms, need and scope of bioremediation. **2**

**NOTE: 4 hours of self-study assigned from the above units.**

### **REFERENCES**

1. Atlas R.N. and Bartha. R. 1993. Microbial Ecology-Fundamentals and Applications, 3 ed.
2. Atlas Ronald, M., Bartha, and Richard (1987). Microbial Ecology 2nd Edition.
3. Maier, Pepper and Gerba, 2000. Environmental Microbiology, Academic Press.
4. Martin Alexander, 1997. Introduction to Soil Microbiology.

5. Mitchel, R. (1992). Environmental Microbiology. Wiley – John Wiley and Sons. NewYork.
6. Mitchell. R. 1974. Introduction to environmental microbiology.
7. RS Mehrothra , Plant Pathology, 4<sup>th</sup> edition, Tata McGraw hill
8. Subbha Rao, M.S. 1995. Soil microorganisms and plant growth
9. Vijaya Ramesh, Environmental Microbiology.

## **BLUEPRINT**

Code number: **MB 5218**

Title of the paper: **Agricultural and Environmental Microbiology**

Total marks for which the questions are to be asked (including bonus questions)		Number of Hrs	Chapter number
	17	08	Unit I
	11	05	Unit II
	27	13	Unit III
	12	05	Unit IV
	21	10	Unit V
	08	04	Unit VI
<b>Total</b>	<b>96</b>	<b>45</b>	
<b>Maximum marks for the paper (Excluding bonus question)= 70</b>			

## PRACTICAL-VI

### MB 5P<sub>2</sub>- Agricultural and Environmental Microbiology (11 sessions: 3hr/ week)

1. Isolation and study of soil microorganisms
2. Study of *Rhizobium* from legume root nodules
3. Isolation and identification of Actinomycetes
4. Identification of leaf spot of groundnut, Blast of rice, Downy mildew of grapes, Red rot of sugarcane, Tobacco mosaic, Citrus canker, TLC, Sandal spike.
5. Fungi type study- *Penicillium*, *Cladosporium*, *Rhizopus*, *Trichoderma*, *Fusarium*, *Aspergillus*, Yeast, *Alternaria*.
6. Isolation and identification of microorganisms from water and air.
7. Potability of water
8. Determination of BOD
9. Determination of COD
10. Air samplers – spotters (rotorod, hirst trap, vertical cylinder trap and Anderson's sampler)

Semester	<b>VI</b>
Paper Code	<b>MB 6118</b>
Paper Title	<b>Food and Fermentation Technology</b>
Number of teaching hrs per week	3
Total number of teaching hrs per semester	45
Number of credits	3

**Objective of the paper:** Food Microbiology paper deals with the role of microorganisms in food preparation, its processing, control of microbial activity which causes spoilage of food and infections in humans. Fermentation Technology deals with exploitation of microbes in production of various industrial products, their process of preparation and design of bioreactors.

### **Dairy Microbiology UNIT – I**

- a. Definition, composition and types of milk – skimmed, toned and whole
- b. Sources of microbial contamination of milk, microflora in raw milk  
Microbiological analysis of milk  
Rapid Platform Tests, Dye reduction tests – MBRT and Resazurin Test.  
Total bacterial count, Brucella ring test and Test for Mastitis
- c. Spoilage of milk  
Succession of microorganisms in milk  
Colour and flavor detects, Sweet curdling, Stormy fermentation, Ropiness, Biochemical fermentation
- d. Pasteurization of milk  
Methods of pasteurization – LHT, HTST, UHT.  
Tests for determination of efficiency of pasteurization- Alkaline Phosphatase and Lactoperoxidase tests

**5**

### **UNIT – II**

**Milk products :** Long term preservation of milk (preparation of milk powder, condensed, sweetened milk, sterilized [tetrapack] milk.  
Butter – Types and production  
Cheese – Types and production (Cheddar and Cottage)

**5**

Yoghurt – Types and production

Other traditional fermented milk products – names and organisms associated (tabulation only)

## **Food Microbiology**

### **UNIT – III**

**Food spoilage:** Chemical and physical properties of food affecting microbial growth – pH, water activity, redox potential, nutrients, antimicrobial compounds.

Sources of spoilage and spoilage of cereals, meat, fruits, vegetables and canned foods

Change in colour and flavor, degradation of carbohydrates, proteins and fats, change in organoleptic properties.

5

### **UNIT – IV**

**Food preservation:** Principles of food preservation

Use of chemical preservatives, Canning, Freezing and Dehydration, Use of Radiations Food sanitation and control

4

### **UNIT – V**

**Microbial food infection and food poisoning**

6

a. *Staphylococcus aureus*

b. *Clostridium botulinum*

c. *Bacillus cereus*

d. *Clostridium perfringens*

e. *Salmonella*

Organisms causing food infection, their sources and prevention

Mycotoxins – Aflatoxin B1, G1 – structure, detection, mode of action and detoxification.

## **FERMENTATION TECHNOLOGY**

### **UNIT – VI**

History, scope and development of industrial microbiology

Fermenter: Basic structure, construction and types (Stirred, airlift and fluidized)

2

Control of process parameters – temperature, pH, O-R potential, aeration, agitation, contamination.

2

Isolation, screening and maintenance of industrially important microorganisms

2

Culture collection and Types of Culture Collection Centres.

1

Types of industrial fermentation process: batch, continuous, surface, submerged and SSF.

2

Raw materials, media components and formulation, antifoaming agents, precursors, Inducers, inhibitors and buffering agents.

3

Sterilization of media and raw materials

1

Strain improvement methods (Mutation, Recombination and r-DNA technology).

2

Inoculum preparation – bacteria and fungi	1
Down-stream processing – filtration, centrifugation, cell disruption, chromatography, solvent extraction	3
Quality control assurance	1

**NOTE: 4 hours of self-study assigned from the above units.**

**REFERENCES**

1. Adams, M.R and Moss, MO. 1995. Food Microbiology. The Royal Society of Chemistry, Cambridge.
2. Casida, J.F. 1968. Industrial Microbiology, Wiley Eastern Ltd., New Delhi.
3. Cruger, W. and Crueger, A. 2000. Biotechnology: A Text Book of Industrial Microbiology, Second Edition, Panima Publishing Corporation, New Delhi. ifuga
4. Dubey. R.C. and Maheswari. D.K. A Textbook of Microbiology, 1999. 1 ed.
5. Frazier, W. C. and Westhoff D.C.. Food Microbiology 5th ed.
6. Fundamentals of Dairy Microbiology by Prajapati.
7. James. M. Jay, 1992, Modern food microbiology 4ed.
8. Stanbury, P.F., Whitaker, A. and Hall, S.J. 1995. Principles of Fermentation Technology, Second Edition, Aditya Book (P) Ltd., New Delhi.

**BLUEPRINT**

Code number: **MB 6118**

Title of the paper: **Food and Fermentation Technology**

Total marks for which the questions are to be asked (including bonus questions)	Number of Hrs	Chapter number
11	05	Unit I
11	05	Unit II
12	05	Unit III
08	04	Unit IV
13	06	Unit V
42	20	Unit VI
<b>Total</b>	<b>96</b>	<b>45</b>
<b>Maximum marks for the paper (Excluding bonus question)= 70</b>		



## **PRACTICALS – VII**

### **MB 6P<sub>1</sub> – Food and Fermentation Technology**

**(11 sessions: 3hr/ week)**

1. Enumeration of bacteria by SPC and DMC
2. MBRT and Resazurin tests
3. Estimation of lactic acid and fat content in the milk
4. Estimation of lactose in milk whey
5. Production and detection of aflatoxins from fungi
6. Isolation and identification of bacteria and fungi from fruits and vegetables
7. Isolation and identification of bacteria and fungi from fermented and stored foods.
8. Estimation of total and volatile acidity in non-alcoholic beverages
9. Alcohol estimation (Alcoholometry)
10. Spotters - Study of fermentors, aflatoxin and food borne pathogens
11. Industrial visit

Semester	<b>VI</b>
Paper Code	<b>MB 6218</b>
Paper Title	<b>Microbial Technology</b>
Number of teaching hrs per week	3
Total number of teaching hrs per semester	45
Number of credits	3

**Objective:** The first part of the paper gives a broad insight of rDNA technology including the tools, vectors, construction of rDNA molecule, strategies for transferring the rDNA into host cells, screening using advanced techniques and basic concepts of bioinformatics. The second half basically deals with the products obtained from wild and genetically modified microorganisms and the role of Intellectual Property Rights and its significance.

### UNIT – I

**27 hours**

- a. **History and fundamentals of r-DNA technology** **1**  
 Tools for rDNA technology -DNA manipulative enzymes: Restriction enzymes, Ligases and other DNA modifying enzymes  
**2**
- b. **Gene cloning vectors: Salient features**, Plasmids – properties and types- pUC, Ti, SV40, pET Phage DNA-insertional and replacement vectors (Lambda) **4**
- c. ***In vitro* construction of r-DNA molecules:** Isolation of passenger DNA from bacteria (gene of interest) and isolation of vector DNA (Bacteria).  
 Cutting of DNA molecules- Physical methods, enzymatic methods & Joining of DNA molecules - Homopolymer tails, Linkers, Adapters. **3**  
 Polymerase chain reaction (PCR) and its applications. **1**
- d. **Transformation of r-DNA into target host organisms:** Calcium chloride mediated gene transfer, *Agrobacterium* mediated DNA transfer, Electroporation, Microinjection, Liposome fusion, Microparticle bombardment. **5**
- e. **Screening and selection of recombinant host cells:** Insertional inactivation, *In situ* colony/ DNA hybridization and Immunological techniques, Blotting techniques-(DNA, RNA, protein) **2**  
 Construction of gene libraries: Genomic and cDNA libraries. **2**  
 Gene editing and applications – knockout, knockdown and over expression **2**
- f. **Bioinformatics:**  
 Introduction to data curation (how to look at pubmed and human genome database) **1**  
 Sequence alignment – Definition and steps (eg of nucleotide blast and protein blast)  
 Multiple sequence alignment (ensemble database), Sequence analysis (comparing given sequence to a standard sequence) **3**

**UNIT – II****18 hours**

- |  |   |
|--|---|
| a. Production of chemicals – Fermentative production of alcohol and alcoholic beverages (wine), organic acids (citric acid), organic solvents (acetone/butanol), vitamins (B12), antibiotics (penicillin) and enzymes (amylase). | 7 |
| b. Production of single cell proteins ( <i>Spirulina</i> ) and oils and their applications   | 2 |
| c. Production of recombinant therapeutics : vaccine (Hepatitis, Rota) and hormones (Insulin)   | 2 |
| d. Recent trends in diagnostics: biosensors and biochips   | 2 |
| f. Development of transgenic plants (insecticidal and delayed fruit ripening)  | 2 |
| g. DNA fingerprinting in forensics   | 1 |
| h. Environment: GEMs in bioremediation.- <i>Pseudomonas putida</i>   | 1 |
| i. Intellectual Property Rights - Copyright & Patenting  | 1 |

**NOTE: 4 hours of self-study assigned from the above units.**

**REFERENCES:**

1. A. H. Patel, Industrial Microbiology
2. Animal Cell Culture , M. Butler
3. Casida, J.F. 1968. Industrial Microbiology, Wiley Eastern Ltd., New Delhi.
4. Chawla H S, Introduction to plant biotechnology, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
5. Cruger, W. and Crueger, A. 2000. Biotechnology: A Text Book of Industrial Microbiology, Second Edition, Panima Publishing Corporation, New Delhi.
6. Glick, B.K and J.J. Pasternak, 1994, Molecular Biotechnology Principles and Application of Recombinant DNA, ASM Press, Washington.
7. Gupta P K, 2006, Elements of biotechnology, Rastogi Publications, Meerut.
8. Kalyan Kumar De 2001, An Introduction to plant tissue culture, New central book agency, Calcutta.
9. Pepler, H.J. and Pearman, D. 1979. Microbial Technology, Vol. I. Academic Press, New York
10. Plant and Industrial Biotechnology, B.D. Singh
11. Sathyanarayana. U, 2009, Biotechnology, Books and allied (P) ltd, Kolkata.
12. Brown, T.A. 2000, Gene Cloning, fourth edition, Chapman and Hall Publication, USA.
13. Old R.W. and Primrose S.B., 1996, Principles of Gene Manipulations, Blackwell Science Publications, London.

# **BLUEPRINT**

Code number: **MB 6218**

Title of the paper: **Microbial Technology**

Total marks for which the questions are to be asked (including bonus questions)		Number of Hrs	Chapter number
	58	27	Unit I
	38	18	Unit II
<b>Total</b>	<b>96</b>	<b>45</b>	
<b>Maximum marks for the paper (Excluding bonus question)= 70</b>			

## Practical – VIII

### MB 6P<sub>2</sub> - Microbial technology

(11 sessions: 3hr/ week)

1. Isolation of plasmid DNA
2. Restriction digestion
3. DNA ligation
4. Demonstration of transformation and calculating transformation efficiency.
5. Retrieving DNA sequences of a particular gene from two species from data base (NCBI), BLAST based comparison and analysis, MSA and constructing phylogenetic tree using NJ method. (Tool: MEGA 7)
6. Preparation and estimation of citric acid from *Aspergillus niger*
7. Wine production and organoleptic tests
8. Immobilization of yeast cells