

St. Joseph's College (Autonomous) Bangalore
Department of Microbiology
Syllabus for B.Sc. Microbiology: Choice Based Credit System (CBCS)

Theory (2016-2019)

Semester I

Paper I - **MB 116:-** Basic Microbiology and Microbiological techniques

Semester II

Paper II - **MB 216:-**Biophysics, Biochemistry and Microbial diversity

Semester III

Paper III - **MB 316:-**Microbial physiology, growth and control of microorganisms

Semester IV

Paper IV-A **MB 416A:-** Microbial genetics and Molecular biology

Paper IV-B **MBOE 416B:-** Microbial diseases – Causes, Prevention and Cure

Semester V

Paper V – **MB 5116:-** Immunology and Medical Microbiology

Paper VI - **MB 5216:-** Agricultural and Environmental Microbiology

Semester VI

Paper VII - **MB 6116:-** Food and Fermentation Technology

Paper VIII- **MB 6216:-** Microbial technology

KEY WORDS: OE – Open Elective

St. Joseph's College (Autonomous) Bangalore
Department of Microbiology
Syllabus for B.Sc. Microbiology

Practicals (2016-2019)

Semester I

Practical paper I - **MB 1P₁** – Basic Microbiology and Microbiological techniques

Semester II

Practical Paper II - **MB 2P₁**:- Biophysics, Biochemistry and Microbial diversity

Semester III

Practical Paper III - **MB 3P₁**:- Microbial physiology, Growth and Control of
Microorganisms

Semester IV

Practical Paper IV - **MB 4P₁**:- Microbial genetics and Molecular biology

Semester V

Practical Paper V - **MB 5P₁**:- Immunology and Medical Microbiology

Practical Paper VI - **MB5 P₂**:- Agricultural and Environmental Microbiology

Semester VI

Practical Paper VII - **MB 6P₁**:- Food and Fermentation Technology

Practical Paper VIII - **MB 6P₂**:- Microbial technology

DEPARTMENT OF MICROBIOLOGY (UG) (2016-2019)					
<u>Semester 1</u>	Code Number	Title	Number of teaching hrs /week	Number of credits	Max marks for SE and duration of examination
Theory	MB-116	Basic Microbiology & Microbiological techniques	04	04	70-3Hrs
Practical	MB-1P ₁	Basic Microbiology & Microbiological techniques	03	01	35-3Hrs
Total Number of credits:				05	
<u>Semester 2</u>	Code Number	Title	Number of teaching hrs /week	Number of credits	Max marks for SE and duration of examination
Theory	MB-216	Biophysics, Biochemistry and Microbial diversity	04	04	70-3Hrs
Practical	MB-2P ₁	Biophysics, Biochemistry and Microbial diversity	03	01	35-3Hrs
Total Number of credits:				05	
<u>Semester 3</u>	Code Number	Title	Number of teaching hrs /week	Number of credits	Max marks for SE and duration of examination
Theory	MB-316	Microbial physiology, growth and control of microorganisms	04	04	70-3Hrs
Practical	MB-3P ₁	Microbial physiology, growth and control of microorganisms	03	01	35-3Hrs
Total Number of credits:				05	
<u>Semester 4</u>	Code Number	Title	Number of teaching hrs /week	Number of credits	Max marks for SE and duration of examination
Theory	MB-416A	Microbial Genetics, Molecular Biology	02	02	35-1 ^{1/2} Hrs
	MBOE-416B	Microbial diseases – Causes, Prevention and Cure	02	02	35-1 ^{1/2} Hrs
Practical	MB-4P ₁	Microbial Genetics, Molecular Biology	03	01	35-3Hrs
Total Number of credits:				05	

OE: OPEN ELECTIVE

<u>Semester 5</u>	Code Number	Title	Number of teaching hrs /week	Number of credits	Max marks for SE and duration of examination
Theory	MB-5116	Immunology and Medical Microbiology	03	03	70-3Hrs
Practical	MB-5P ₁	Immunology and Medical Microbiology	03	01	35-3Hrs
Theory	MB-5216	Agricultural and Environmental Microbiology	03	03	70-3Hrs
Practical	MB-5P ₂	Agricultural and Environmental Microbiology	03	01	35-3Hrs
Total Number of credits:				08	
<u>Semester 6</u>	Code Number	Title	Number of teaching hrs /week	Number of credits	Max marks for SE and duration of examination
Theory	MB-6116	Food and Fermentation Technology	03	03	70-3Hrs
Practical	MB-6P ₁	Food and Fermentation Technology	03	01	35-3Hrs
Theory	MB-6216	Microbial technology	03	03	70-3Hrs
Practical	MB-6P ₂	Microbial technology	03	01	35-3Hrs
Total Number of credits:				08	

St. Joseph's College (Autonomous), Bangalore.

**Department Of Microbiology
Syllabus for B Sc. Microbiology**

Semester – I

MB 116 – Basic Microbiology and Microbiological Techniques

No. of lecture hours: 60

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

1

b. Contribution of Scientists to the field of Microbiology:

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

4

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

Bacteria with unusual properties:

Mycoplasma

Rickettsias

Actinomycetes

Spirochaetes

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 and function)

Structure and function of cell wall, cell membrane, flagella, cell organelles (Nuclear, EPR, Golgi apparatus, ribosome).

Overview of yeast cell (ultra structure and functions)

Reproduction in fungi: asexual and sexual

6

e. Virology

Structure, Reproduction, Cultivation and Significance of Viruses:

Bacterial- lytic, lysogeny, lamda and T4, Plant- TMV, Animal- HIV.

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

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

10

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 (Tyndallization, Pasteurization)

Moist heat under pressure (Autoclave)

Dry heat (incineration, hot air over)

Filtration (Porcelain filter, diatomaceous earth filter, seitz filter, sintered glass filter, membrane filter, air filters, HEPA filter)

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

iii) Chemicals (alcohols, formaldehyde, phenol hypochloride, halogens and heavy metals):

Characteristics of an ideal antimicrobial chemical agent

Evaluation of antimicrobial chemical agents- Tube dilution and agar plate techniques,

6

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; Sinauer Assocites;.
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. Rajeshwara reddy; General Microbiology.

Practical I

MB 1P₁ – 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

MB 216– Biophysics, Biochemistry and Microbial diversity

No. of lecture hours : 60

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 Radioactivity
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

REFERENCES:

1. Michael M Cox, David L Nelson; Lehninger, Principles of Biochemistry; 5th 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.

Practical II

MB2P₁ – 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

MB 316 – Microbial physiology, growth and control of microorganisms

No. of lecture hours: 60

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. 3
- 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. 10
 - (ii) Anabolism:
 - Gluconeogenesis
 - Photosynthesis (Cyclic and non cyclic); CO₂ fixation (C₃ and C₄)
 - Biosynthesis of Peptidoglycan. 8
- c. Lipid metabolism:
 - (i) Catabolism:
 - Oxidation of saturate fatty acids – β oxidation pathway
 - (ii) Anabolism:

- Biosynthesis of straight chain even carbon saturated fatty acid (palmitic acid) 4
- d. Amino acid metabolism:
- (i) Catabolism:
 - Overview of catabolism of amino group.
 - Nitrogen excretion and urea cycle.
- (ii) Anabolism:
 - Overview of aminoacid biosynthesis. 4

UNIT - III

Antibiotics and other chemotherapeutic agents:

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

REFERENCES:

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

Practical – III

MB3P₁: Microbial Physiology, Growth and Control of microorganisms (11 sessions 3hr/week)

1. Nutritional requirement – Growth on various carbon and nitrogen sources.
2. Bacterial growth curve (Spectrophotometric method) and generation time.
3. Estimating microbial population
 - Bacterial growth- SPC
 - Fungal growth- linear growth of fungi
4. Counting of yeast cells by using a haemocytometer
5. Use of Micrometer and calibration, measurement of yeasts/ fungal spores
6. Biochemical tests used for the identification of bacteria, IMViC, fermentation of carbohydrates (any three), starch hydrolysis, Gelatin fermentation, catalase and oxidase test.
7. Evaluation of anti microbial antibiotic sensitivity tests (paper disc plate method)

Semester – IV

MB 416A – Microbial Genetics and Molecular Biology

No. of lecture hours: 30

UNIT – I

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|--|---|
| 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

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|--|---|
| 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

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|---|---|
| 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 |

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, 2nd edition, Narosa Publishing House, New Delhi.
4. David L. Nelson, Michael M. Cox; Lehninger Principles of Biochemistry, 5th 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, 5th edition., Pearson, Benjamin Cummings and CSHL press.
6. T. A Brown (2010), Gene Cloning and DNA analysis, 6th edition, Wiley and Blackwell publishers.

Practical - IV

MB 4P₁ – Microbial Genetics and Molecular Biology

(11 sessions 3hr/week)

1. Induction of mutations by physical and chemical mutagens.
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
MBOE 416B –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.

Dengue, HIV, Hepatitis, Tuberculosis, Typhoid, Candidiasis and Malaria **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); 8th Edition; Orient Longman publication, Hyderabad.
4. David Greenwood, Richard C.B. Slack and John. F. Peutherer; Medical Microbiology(2008), 7th Edition, Elsevier India Private Ltd., New Delhi.
5. Jawetz, Melnick and Adelbergs; Medical Microbiology (2010); 25th Edition; McGraw Hill Companies, USA.

Semester V-Paper V

MB 5116 – Immunology and Medical Microbiology

No. of lecture hours: 45

UNIT-I

Immunity: Definitions, types (natural, acquired, active and passive).	2
Mechanisms of innate immunity.	2
Antigens: Definition, types of antigens, factors influencing antigenicity.	2
Immunoglobulins: Definition, structure, types, properties and functions of immunoglobulins.	
Production of monoclonal antibodies and their applications.	5
Antigen and antibody reactions: General features of antigen and antibody reactions.	
Precipitation, agglutinations, complement fixation, ELISA, opsonization	6

UNIT-II

Cells and organs of the immune system: Structure and function.	4
Immune response: AMI and CMI	1
Complement system: Properties, components, pathways and functions.	1
Major histocompatibility complex (MHC): Structure and function.	1

UNIT-III

Hypersensitivity: Types (I, II, III, IV), mediators of hypersensitivity reactions, mechanism of mast cell degranulation and detection of Type I hypersensitivity.	2
Transplantation immunology: Types, graft acceptance, genetic basis of graft rejection.	
Mechanism and manifestations of graft rejection.	2
Vaccines: Definition, types and examples.	2

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
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UNIT-V

a. Normal human flora

b. Important groups of pathogenic microorganisms: (classification, culture and biochemical characters, antigenic structure, pathogenicity, pathogenesis, clinical and lab diagnosis, epidemiology, prophylaxis and chemotherapy)	1
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Bacterial

- a. Enterobacteriaceae (*Salmonella*)
- b. Gram +ve cocci (*Staphylococcus*, *Streptococcus*)
- 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

10

REFERENCES:

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

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 V-Paper VI
MB 5216 – Agricultural and Environmental Microbiology

No. of lecture hours : 45

UNIT-I

Agricultural Microbiology

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, and mosaic. Epidemiology of plant diseases.

General methods of plant diseases control

a) Eradication

b) Chemical control

c) Biological control **5**

UNIT-III

Preparation of Bioinoculants: **5**

Biochemistry of symbiotic and non symbiotic nitrogen fixation and phosphate

Solubilization

Production of Bioinoculants

Methods of application, Comparison with chemical fertilizers

Biopesticides: *B. thuringiensis*, NPV, CPV, GPV, *Beauverria bassiana* **3**

Anaerobic Digesters

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

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

UNIT-IV

Environmental Microbiology

Air Microbiology

Microflora of air, methods of air sampling, air pollution, biological indicators of pollution, air sanitation and air-borne infections **5**

UNIT-V

Water microbiology **8**

Bacteriology of potable and recreational water

Analysis of water - Physico-chemical and biological parameters, Indices of fecal pollution

Detection of bacterial pathogens

Waste water treatment methods - primary, secondary and tertiary treatments **2**

UNIT-VI

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

Bioremediation - Bioremediation and waste management. An emerging technology using microorganisms, need and scope of bioremediation.

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, 4th edition, Tata McGraw hill
8. Subbha Rao, M.S. 1995. Soil microorganisms and plant growth
9. Vijaya Ramesh, Environmental Microbiology.

PRACTICAL-VI

MB 5P₂- 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 VI- Paper VII
MB 6116 – Food and Fermentation Technology

No. of lecture hours : 45

UNIT – I

Dairy Microbiology

- a. Definition, composition and types of milk – skimmed, toned and whole **5**
- b. Microbiological analysis of milk
- Sources of microbial contamination of milk, microflora in raw milk.
- Dye reduction test – MBRT and Resazurin Test.
- Total bacterial count, Brucella ring test and test for mastitis
- c. Pasteurization of milk
- Methods of pasteurization – LHT, HTST, UHT.
- Tests for determination of efficiency of pasteurization
- d. Spoilage of milk
- Succession of microorganisms in milk
- Colour and flavor defects, Sweet curdling, Stormy fermentation, Ropiness, Biochemical fermentation.

UNIT – II

- Milk products: Long** term preservation of milk (preparation of milk powder, condensed, sweetened milk, sterilized [tetrapack] milk. **5**
- Butter – Types and production
- Cheese – Types and production (Cheddar and Cottage)
- Yoghurt – Types and production
- Other traditional fermented milk products – names and organisms associated (tabulation only)

UNIT – III

Food Microbiology

- Food preservation Principles of food preservation **4**
- Use of chemical preservatives, Canning, Freezing and Dehydration, Use of Radiations.
- HACCP, Food sanitation and control.

UNIT – IV

- Food spoilage:** Chemical and physical properties of food affecting microbial growth – pH, water

activity, redox potential, nutrients, antimicrobial compounds.	5
Sources of spoilage microorganisms and their role.	
Change in colour and flavor, degradation of carbohydrates, proteins and fats, change in organoleptic properties.	

UNIT – V

Microbial food infection and food poisoning	6
<i>a. Staphylococcus aureus</i>	
<i>b. Clostridium botulinum</i>	
<i>c. Bacillus cereus</i>	
<i>d. Clostridium perfringens</i>	
<i>e. Salmonella</i>	
Organisms causing food infection, their sources and prevention	
Mycotoxins – Aflatoxin B1, G1 – structure, detection, mode of action and detoxification.	

UNIT – VI

FERMENTATION TECHNOLOGY

History, scope and development of industrial microbiology; Isolation, screening and maintenance of industrially important microorganisms.	2
Strain improvement methods (Mutation, Recombination and r-DNA technology).	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 and inhibitors, buffering agents etc.	3
Sterilization of media and raw materials	1
Inoculum preparation – bacteria and fungi	1
Fermentor: Basic structure, construction and types (Stirred, airlift and fluidized)	2
Control of process parameters – temperature, pH, O-R potential, aeration, agitation, contamination.	2
Down-stream processing steps – Recovery of fermented broth	3
Quality control assurance	1

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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.
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.

PRACTICALS – VII

MB 6P₁ – 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 alcoholic beverages
9. Alcohol estimation (Alcoholometry)
10. Spotters - Study of fermentors, aflatoxin and food borne pathogens
11. Industrial visit

Semester VI- Paper VIII

MB 6216 – MICROBIAL TECHNOLOGY

No. of lecture hours : 45

UNIT – I

- 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, types, pBR322 and pUC18, Phage DNA-insertional and replacement vectors (Lambda), Cosmids-properties 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. 4
- d. Transformation of r-DNA into target host organisms: Calcium chloride mediated gene transfer, *Agrobacterium* mediated DNA transfer, Electroporation, Microinjection, Liposome fusion, Microparticle bombardment.
- e. Screening and selection of recombinant host cells: Insertional inactivation, *In situ* colony / DNA hybridization and Immunological techniques, Blotting techniques.
Construction of gene libraries: Genomic and cDNA libraries. 2
Polymerase chain reaction (PCR) and its applications. 2

UNIT – II

- a. Production of chemicals – Fermentative production of alcohol and alcoholic beverages (beer, wine), organic acids (citric acid), organic solvents (acetone/butanol), vitamins (B12), antibiotics (penicillin) and enzymes (amylase). 8
- b. Production of single cell proteins and oils (Spirulina) and their applications 2
- c. Production of recombinant therapeutics : vaccine (Hepatitis) and hormones (Insulin, Somatostatin) 3
- d. Recent trends in diagnostics: biosensors and biochips 2
- e. Gene therapy and types. Antisense gene therapy for treatment for cancer 2
- f. Development of transgenic plants (insecticidal and delayed fruit ripening) 2
- g. DNA fingerprinting in forensics 1
- h. Environment: GEMs in bioremediation. 1
- i. Intellectual Property Rights and Protection Acts 1

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1. A. H. Patel, Industrial Microbiology
2. Animal Cell Culture , M. Butler
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9. Peppler, 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.
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Practical – VIII

MB 6P₂ - 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. Preparation and estimation of SCP from *Spirulina*
6. Preparation and estimation of citric acid from *Aspergillus niger*
7. Wine production and organoleptic tests
8. Immobilization of yeast cells