

# Curriculum



**M.SC. MICROBIOLOGY**

**Netaji Subhas University**

**Jamshedpur, Jharkhand**

(SYLLABUS EFFECTIVE FROM THE ACADEMIC  
YEAR 2021 ONWORDS)

# DEPARTMENT OF MICROBIOLOGY

Microbiology is a broad discipline of Applied Sciences which deals with the world of microorganisms that are, too small to be seen with the naked eye. We are born into a world dominated by microorganisms, many of which carry out important functions essential for all the life on earth. As a consequence, we have countless intimate microbial associations; many enhance our lives, while others present us with potentially lethal challenges. The discipline of Microbiology overlaps with the other degree areas of biology like molecular biology, biotechnology, genetics, immunology and pathology. Further the scope of Microbiology is vast extending to various fields such as Pharma, Agriculture, Medicine, Food and dairy industry, Clinical research and Nanotechnology.

M.Sc. Microbiology

follows Semester end examinations pattern as per UGC Model Curriculum.

## **Mission**

- The Department aims to develop competent and committed students with advanced level of communicative skills and attitude required to manage academia-industry interface.
- The Department endeavours for continuous upgradation and dissemination of knowledge, creating and developing highly adaptable skills for suitable employment.
- The Department inspires uncompromising commitments to teaching and to develop practical oriented facilities.

## **Programme Structure**

- The M.Sc. Microbiology programme is a two-year course divided into four-semesters.
- Each semester includes four theory papers and two practical papers
- A Project work as summer dissertation is required to be completed in the fourth semester.

## **PROGRAM OUTCOMES**

PO1: To train the students in basic and advanced areas of Microbiology, focusing on the recent trends of the discipline with Particular emphasis on the practical aspects.

PO2: To stimulate scholarly progression and intellectual development of the programme grooming the students on par with excellence.

PO3: To promote talent and personality development boosting self-confidence and self-reliance in the student to achieve their goals

PO4: To infuse the latest advances in Microbiology by organizing Conferences, Symposia, Workshops and Webinars.

PO5: To instil moral values of professional ethics in students guiding them to be responsible individuals for a better society.

## **PROGRAM SPECIFIC OUTCOMES**

On completion of program students will be specifically able to

PSO1: Prepare and view specimens for examination using light microscopy

PSO2: Use pure culture and selective techniques to isolate microorganisms. Identify microorganisms (media-based, molecular and serological).

PSO3. Estimate the number of microorganisms in a sample by suitable enumeration technique

PSO4: Use appropriate microbiological and molecular lab equipment and methods.

PSO5: Practice safe microbiology, using appropriate protective, biosafety and emergency procedures.

PSO6: Document and report on experimental protocols, results and conclusions.

## **Course Outcomes**

CO1: Students gain familiarity in various microbiological methods and analytical techniques enabling them to pursue higher education.

CO2: Students' laboratory training will empower them to enrol in research institutions and pharmaceutical industries as career.

CO3: Students cultivate knowledge of the leading edge in a chosen specialized area of Microbiology, based on research experience from a master's project and international literature.

CO4: Students acquire deep insights of a repertoire of microorganisms, their metabolism and industrial applications.

CO5: The Master's degree in Microbiology will address the increasing need for skilled scientific manpower with an understanding of global research applications in the field of basic and applied Microbiology

## **Course Specific outcomes**

CSO1: Students develop the ability to independently carry out multidisciplinary research and communicate to a reputed scientific journal for publication.

CSO2: Students acknowledge health, safety and environmental (HSE) issues in handling and understanding the hazardous chemicals and biological materials.

CSO3: Students can compete in National level competitive exams such as UGC-CSIR NET-JRF or GATE or APSET.

CSO4: Students establish collaboration with various food and pharma industries enhancing student job opportunities

CSO5: Students relieved from the campus are renowned for their abled theoretical and technical skills

CSO6: Student from the campus emerge with positive attitude to face the challenges in the society

## **Programme Eligibility**

Students are eligible for admission into M.Sc. through Andhra Pradesh PG Common Entrance Test (APPGCET).

## **Achievements of the Department**

Microbiology has generated loads of opportunities for the past few years leading to a rush in the number of students who are looking to pursue this field as a career. Microbiologists work in Hospitals, clinical laboratories, food, water and dairy facilities (Food safety Officers) as well as in pharmaceutical industries as quality control and quality assurance technologists.

The Microbiology Dept. in AU has made significant contributions in terms of academic standards as evidenced by placement of students which is always 85-90%, remaining 10-15% enrolled for higher education. So far 19 batches of students have successfully completed the M.Sc. course and nearly 12 research scholars were awarded Ph.Ds and 6 M.Phils. from the Department. The alumni of this Department are tending higher positions in national and international research institutes and Pharma companies such as Indian Immunologicals, Reddys Labs, Divies, Aurobindo, Pfizer, Laurus, Lupin, Hetaro, Mylan, Santha Biotech, etc.

## **Future Plans**

- To develop the state- of- art laboratories training students to excel in latest Scientific technologies
- To incubate a full-fledged computer lab with biostatistics and bioinformatics software
- To provide student accessibility to online journals
- To modernize the curriculum that suits the needs of industry and competitive examinations
- To deliver skilled manpower suitable for different government and non-governmental organisations
- The core mission of the Department is to excel in research with the ultimate goals of improving human health and training the next generation of biomedical research scientists.

NETAJI SUBHAS UNIVERSITY  
M.SC. MICROBIOLOGY- SEMESTER SYSTEM (CBCS)  
(EFFECTIVE FROM THE ACADEMIC YEAR 2021-2022)

**SCHEME OF INSTRUCTIONS AND EXAMINATION**

Paper No.	Title of the Paper	Periods/ Week	Duration of Exam (Hours)	Maximum Marks	Credits
<b>I Semester</b>					
MB 101	General Microbiology	4	3	100	4
MB102	Virology	4	3	100	4
MB 103	Bio-molecules	4	3	100	4
MB104	Analytical Techniques	4	3	100	4
<b>Practical</b>					
MBP 105	Microbiological methods & Virology	12	6	100	4
MBP106	Analytical Techniques	12	6	100	4
<b>Total Marks and Credits for I Semester</b>				<b>600</b>	<b>24</b>
<b>II Semester</b>					
MB201	Microbial Physiology	4	3	100	4
MB 202	Enzymology & Cell Biology	4	3	100	4
MB203	Molecular & Microbial Genetics	4	3	100	4
MB 204	Immunology	4	3	100	4
<b>Practical</b>					
MBP 205	Enzymology & Immunology	12	6	100	4
MBP206	Microbial Physiology & Genetics	12	6	100	4
				100	4
<b>Total Marks and Credits for II Semester</b>				<b>600</b>	<b>24</b>
<b>III Semester</b>					
MB 301	Molecular Biology	4	3	100	4
MB302	Medical Microbiology	4	3	100	4
MB 303	Bio-statistics & Bio-informatics	4	3	100	4
MB 304	Molecular Biotechnology	4	3	100	4
<b>Practical</b>					
MBP305	Molecular Biology & Molecular Biotechnology.	12	6	100	4
MBP306	Medical Microbiology & Bio-informatics.	12	6	100	4
MB 307	MOOCs course I			50	2
MB308	Intellectual Property Rights			--	--
<b>Total Marks and Credits for III Semester</b>				<b>700</b>	<b>28</b>

<b>IV Semester</b>					
MB 401	Fermentation Technology & Industrial	4	3	100	4
MB 402	Environmental Microbiology	4	3	100	4
MB 403	Food Microbiology & Agriculture Microbiology	4	3	100	4
MB 404	Pharmaceutical Microbiology	4	3	100	4
<b>Practical</b>					
MBP 405	Industrial Microbiology & Environmental	12	6	100	4
MBP 406	Food, Agriculture & Pharmaceutical Microbiology	12	6	100	4
MB407	MOOCs course II			50	2
MB408	Value Added Course			50	2
<b>Total Marks and Credits for IV</b>				<b>700</b>	<b>28</b>
<b>MB409</b>	<b>Project Work/Dissertation and Credits</b>			<b>100</b>	<b>4</b>
<b>Grand Total Marks and Credits for 4</b>				<b>2700</b>	<b>108</b>

## **Course Structure and Examination -Choice based credit system**

The syllabus is divided into four semesters and all the semesters include four theory papers and two practical papers each with a project dissertation to be submitted in the fourth semester. Each theory paper is divided into five units and all the units carry equal weightage. All theory and practical papers are compulsory. Each theory and practical papers carry 100 marks. 100 marks allotted to the project work to be presented at the end of the fourth semester.

- **Number of theory and practical periods:** The syllabus is based on 18 (16 theory + 2 seminar hours) and 24 (2X12 each) practical hours per week. Candidates are required to pass separately in theory and practical examinations.
- **Seminar:** Every student has to give at least one seminar and submit a written summary of the same to the Department library
- **Project work (MBP:409):** The student will undergo training in the research institutes, Hospital facilities and pharma industries, at the end of II semester as a summer Dissertation. The reports of project work will have be submitted at the end of the IV semester. The project work (Dissertation work) will be evaluated by the

External and Internal examiner at the end of fourth semester. 100 marks are allotted to the Project work which is compulsory.

**Distribution of Theory/Practical/Seminar/Project (Dissertation) marks:**

**M.Sc. Microbiology**

**I Semester**

Paper Code Examination	Paper Title	Internal Marks	Maximum Marks	Pass Marks	CREDITS
MB101	General Microbiology	20	80	32	4
MB102	Virology	20	80	32	4
MB103	Bio-molecules	20	80	32	4
MB104	Analytical Techniques	20	80	32	4
MBP105	Microbiological methods & Virology	20	80	40	4
MBP106	Analytical Techniques	20	80	40	4

**II Semester**

Paper Code Examination	Paper Title	Internal Marks	Maximum Marks	Pass Marks	CREDITS
MB201	Microbial Physiology & Metabolism	20	80	32	4
MB202	Enzymology & Cell Biology	20	80	32	4
MB203	Molecular & Microbial Genetics	20	80	32	4
MB204	Immunology	20	80	32	4
MBP205	Enzymology & Immunology	20	80	40	4
MBP206	Microbial Physiology & Genetics	20	80	40	4



### III Semester

Paper Code Examination	Paper Title	Internal Marks	Maximum Marks	Pass Marks	CREDITS
MB301	Molecular Biology	20	80	32	4
MB302	Medical Microbiology	20	80	32	4
MB303	Bio-statistics & Bio-informatics	20	80	32	4
MB304	Molecular Biotechnology	20	80	32	4
MBP305	Molecular Biology & Molecular Biotechnology.	20	80	40	4
MBP306	Medical Microbiology & Bio-informatics.	20	80	40	4
MBP307	MOOCs course I	-	100	40	4

### IV Semester

Paper Code Examination	Paper Title	Internal Marks	Maximum Marks	Pass Marks	CREDITS
MB401	Fermentation Technology & Industrial Microbiology	20	80	32	4
MB402	Environmental Microbiology	20	80	32	4
MB403	Food Microbiology & Agriculture Microbiology	20	80	32	4
MB404	Pharmaceutical Microbiology	20	80	32	4
MBP405	Industrial Microbiology & Environmental Microbiology	20	80	40	4
MBP406	Food, Agriculture & Pharmaceutical Microbiology	20	80	40	4
MB407	MOOCs course II	-	100	40	4
MB409	Project Dissertation	-	100	40	4

**Practical Examination Marks distribution for 80 marks**

MBP-105/106/205/206/305/306/405/406	Marks
Major Experiment	20
Minor Experiment	15
Principle & Procedure (2X 5)	10
Spotters (4X2 <sup>1/2</sup> )	10
Record	10
Viva -Voce	15

Theory Papers - ----- 16 (16x4) =64 Credits

Credits Practical Papers - -----08 (08x4) =32 Credits

CBCS Papers MOOC's I &I----04 (4X2) =08 Credits

Project Dissertation-----01 (01x4) = 04 credits

Total Credits -----108

## **I SEMESTER**

### **MB 101: GENERAL MICROBIOLOGY**

#### **Course Outcomes**

CO1: Acquiring Knowledge on Landmark discoveries and contributions in Microbiology

CO2: Developing insights into the microbial techniques of sterilization and preservation

CO3: Familiarising with general characters of prokaryotic and Eukaryotic cellular organization

CO4: Understanding growth media characteristics and measurement methods

CO5: Enlisting the economically important microorganisms

#### **Programme Specific Outcomes**

PSO1: Understanding the classification of living organisms

PSO2: Able to understand the Preservation and Maintenance of Microbial cultures

PSO3: Perception of theoretical knowledge on bacterial growth measurements

PSO4: Distinguishing the Ultra structure and characterization of bacterial groups

PSO5: Comprehending the life cycle of prokaryotic (Eubacteria, Archaea, Cyanobacteria) and microscopic Eukaryotic organisms (Algae, Fungi and protozoans).

#### **Course Structure**

##### **UNIT – I:**

History, discovery, evolution, development and recent trends in Microbiology. Contributions of Van Leeuwenhoek, Joseph Lister, Pasteur, Koch, Jenner, Winogradsky and Beijerinck. Nobel laureates in Microbiology. Identification, characterization and classification of microorganisms- Principles of bacterial taxonomy and classification: Concepts, nomenclature and taxonomic ranks. Major characteristics used in Taxonomy-morphological, nutritional (cultural), chemical, biochemical, physiological, metabolic, ecological, immunological, pathogenic properties. Numerical taxonomy, genetic and molecular classification systems; phylogenetic trees. concept of kingdom - Haeckel's three kingdom concept-Whittaker's five kingdom concept-three domain concept of Carl Woese.

##### **UNIT- II:**

Methods of sterilization: Physical methods – Dry heat, moist heat, radiation methods, filtration methods, Chemical methods and their application. Preservation and Maintenance of Microbial cultures: Repeated sub culturing, preservation at low temperature, sterile soil preservation, mineral oil preservation, deep freezing and liquid nitrogen (cryo) preservation, drying, glycerol cultures, freeze-drying (lyophilization). Advantages and disadvantages of each method

##### **UNIT-III**

Microbiological media-Natural and synthetic; autotrophic, heterotrophic and phototrophic and prototrophic media: basal, defined, complex, enrichment, selective, differential, maintenance and transport media. Types of cultures- stock, batch, continuous and synchronous cultures. Growth measurement methods –Direct methods: viable plate counts, membrane filtration, microscopic counts, electronic counters, most probable number; Indirect methods: metabolic activity (measurements of NAD, ATP, DNA, and Protein, CO<sub>2</sub> liberated O<sub>2</sub> consumed), dry weight, turbidity.

#### **UNIT –IV**

Distinguishing characteristics between prokaryotic and eukaryotic cells. Morphology, Ultra structure and chemical composition of bacteria: Structure and function of cell wall of bacteria, cell membrane, Protoplasts, Spheroplasts, 70 S Ribosomes, Nuclear material/nucleoid. flagella, pili, capsule, gas vesicles, carboxysomes, magnetosomes and Phycobolosomes. Ultra structure, Morphology and Characterization of Archaeobacteria, Cyanobacteria, Actinomycetes, Spirochetes, Rickettsiae, Mycoplasma, Chlamydiae – TRIC agents and LGV, Cultivation of aerobes and anaerobes.

#### **UNIT- V**

Eukaryotic microorganisms: General characteristics, reproduction and economic importance of fungi. Classification, structure, composition, reproduction and other characteristics of fungal divisions-Zygomycota, Ascomycota, Basidiomycota, Deuteromycota and slime & water moulds. Structure, reproduction and other characteristics of algal divisions, Distribution of algae. Classification of algae by Fritsch. Products of algae and their economic importance. Characteristics of Various Protozoa-Morphology, reproduction. Life cycle and Pathology of *Entamoeba histolytica*, *Plasmodium*, Free Living Pathogenic Amoeba - *Naegleria* and *Acanthamoeba*.

#### **Learning Outcomes**

LO1: Deep insights into the various trends of basic and applied Microbiology

LO2: Emphasizing the discoveries and contributions in the field of Microbiology

LO3: Understanding of basic cellular organisation, morphology, Classification, Pathogenesis and economic importance of various groups of microorganisms

LO4: Comprehending the various methods for identification. isolation, sterilization and cultivation of microorganisms.

LO5: Acquaintance on study of microbial diversity using systematic approaches

#### **RECOMMENDED BOOKS FOR MB 101:**

1. Microbiology, 8th Edition International Student Version Jacquelyn G. Black (Marymount University) April 2012, ©2011, Wiley publication.
2. Understanding Microbes: An Introduction to a Small World. Jeremy W. Dale December 2012, Wiley-Blackwell
3. Brock Biology of Microorganisms :Global Edition, 13th Edition, Michael Madigan, John Martinko, David Stahl, David Clark Apr 2011,
4. William Barry Whitman, 2004, Bergey's Manual of Systematic Bacteriology (2<sup>nd</sup> edition) volumes I to VI, American Society of Microbiology. George M. Garrity, Julia A Bell, Timothy G. Lilburn.
5. GERHARDT, Methods for General and Molecular Bacteriology (2nd edition).
6. PELCZAR, CHAN & KRIEG, Microbiology (5th edition) M.C. Graw Hills.
7. MADIGAN, MARTINKO & PARKER, Brock Biology of Microorganism (9th edition) by Introduction to Microbiology by ROSS, Wasley Educational publisher, 1986
8. VOLK & WHEELER, Basic Microbiology, Edition 3, Publisher Lippincott
9. SALLE, Fundamental Principles of Bacteriology, Mc Graw hills.
10. Stainier, Deudroff and Adelberg, General Microbiology

11. Fritsch, F.E, Structure and Reproduction of Algae, Vol. I & II, Cambridge University Press.
12. Morris, I, Hutchon, Introduction to Algae, Pub 1967.
13. Zizac, Products and Properties of Algae.
14. Smith, GM., Fresh water algae of the United States.
15. Alexopolus, C.J, Introductory Mycology, Wiley scientific.
16. Ingold, CT, Dispersal in Fungi, Oxford university press
17. R.M. Atlas, Principles of Microbiology, Wm.C Brown Publications.
18. K.Talaro and A.Talaro, Foundations in Microbiology, Wm.C.Brown Publications, 2<sup>nd</sup> edition.
19. D.E. Alcamo, Jones and Bartiett, Boston, Fundamentals of Microbiology.
20. J.G.Black, Microbiology – Principles & Applications, John Wiley & Sons, New york.
21. G.J.Tortora, B.R.Funke and C.L. Case, Microbiology Addison Wesley Longman Inc., 7<sup>th</sup> edition Pub. Daryl Fox
22. M.A. Sleigh, The Biology of the Protozoa, American Elsevier, Newyork.

## **MB 102: VIROLOGY**

### **Course Outcomes**

- CO1: Gaining Knowledge on history, general characters of viruses and their evolution
- CO2: Characterizing different families of viruses with suitable type study
- CO3: Differentiating the plant and animal viruses and their cultivation methods
- CO4: Perceiving the virus-vector relationships
- CO5: Developing insights into sanitation, vector control and immunization control

### **Programme Specific Outcomes**

- PSO1: Understanding the classification of viruses
- PSO2: Emphasizing biological and biochemical properties of viruses
- PSO3: Comprehending the bacteriophages and other Phages and their replication strategies
- PSO4: Gaining insights into the structure and complexity of viral genomes
- PSO5: Able to gain knowledge on techniques employed for detection of viruses

## **Course Structure**

### **UNIT-I**

History and Discovery of Viruses, Nature, origin and evolution of viruses, New emerging and re-emerging viruses (Rota Virus, Zika Virus, Swine Flu, SARS, MERS and Covid-19), viruses in human welfare. Properties of Viruses- Biological properties of viruses – host range, transmission-vector, non-vector; Physical properties of viruses – morphology, structure, sedimentation, electrophoretic mobility, buoyant density; Biochemical characteristics – chemical composition of viruses, proteins, nucleic acids, envelope, enzymes, lipids, carbohydrates, polyamines, cations, Antigenic nature of viruses.

### **UNIT-II**

Nomenclature and ICTV classification, Major characteristics of different virus families/genera/groups-Poxviridae, Hepadnaviridae, Adenoviridae, Herpesviridae, Ortho and Paramyxoviridae, Retroviridae, Reoviridae, Parvoviridae, Rhabdoviridae, Picornaviridae.

Algal, Fungal and Bacterial viruses- Phycodnaviridae, Cyanophages, Partitiviridae and Totiviridae. Subviral agents-sat viruses, Sat nucleic acids, Viroids, Prions. Isolation, assay and maintenances of viruses – Animal, Plant and Bacterial Viruses: General methods of cultivation of viruses-in embryonated eggs, experimental animals, cell cultures (primary and secondary cell cultures, suspension and monolayer cell cultures) and cell strains, cell lines.

### **UNIT – III**

Structure and complexity of viral genomes, diversity among viral genomes – DNA and RNA genomes- linear, circular, double and single stranded; positive and negative sense of RNA genomes, mono, bi, tri and multipartite of genomes. Replication of viruses –lytic cycle, lysogenic cycle. Replication strategies of DNA, RNA viruses, Regulation of viral genome expression. Virus – host interactions – cytopathic effects of viral infections, inclusion bodies.

### **UNIT – IV**

Transmission of viruses – Vertical (Direct) transmission – contact, mechanical,transplacental, transovarial, sexual, faecal, oral, respiratory, seed and pollen. Horizontal (Indirect) transmission- aerosols, fomites, water, food, graft, dodder. Vector-arthropod, non-arthropods, virus and vector relationship. Multiple host infections – viral zoonosis.

### **Unit -V**

Diagnosis of viral diseases – clinical symptoms, immuno diagnosis, molecular methods used in viral diagnosis, prevention and control of viral diseases, sanitation, vector control, vaccines and immunization control – chemoprophylaxis, chemotherapy – anti viral drugs, Interferon -Nomenclature, types, Induction of interferons, Interferon therapy, efficacy of infection control.

### **Learning Outcomes**

- LO1: Developing insights on some plant and animal diseases caused by different viruses
- LO2: Understanding the modes of viral transmission.
- LO3: Characterising different types of viruses and their prevention and control methods
- LO4: Grasping the importance of Interferons, their induction and therapeutic applications
- LO5: Comprehending the complex interaction between viruses and host cells

### **RECOMMENDED BOOKS FOR MB 102:**

1. John B Carter.2013 Virology: Principles and ApplicationsReviews , John Wiley & Sons, Limited, 2013 - 400 page
2. Nicholas H. Acheson, 2011. Fundamentals of Molecular Virology, 2nd Edition, McGill Univ., Canada.
3. John Carter, Venetia A. Saunders, 2007, Virology: Principles and Applications..., John Wiley and Sons.
4. Frankel-Conrat, 1994, Virology: 3rd Edition. Prentice-Hall
5. Principles of Virology: 2004 Second Edition, ASM press
6. S.J.Flint et al., 2001, Introduction to Modern Virology:.5th edition. Dimmock et al., Blackwell Sci.Publ.
7. A.Cann, 2001, Principles of Molecular Virology, 3rd edition Academic Press
8. Waginer and Hewelett, 2004, Basic Virology, Black Well Science Publ
9. D.O.White and F.J.Fenner, 1994, Medical Virology, 4th edition. Academic Press.

10. R.Hull, 2001, Plant Virology, 4th edition by Academic Pres.
11. D.M.Knipe and P.M.Howley, 2001, Fundamental Virology, 4th edition, Lippincott Williams and Wilkins.
12. Murphy et al., 1999, Veterinary Virology. 3rd edition, Academic press.
13. R.G.Webster and Allan Granoff, 1994, Encyclopedia of Virology. Vol I, II, III,

### **MB 103: BIOMOLECULES**

#### **Course Outcomes**

- CO1:Overviewing the classification of major biomolecules- carbohydrates, lipids, proteins etc
- CO2:Developing insights into classification, chemical properties and functions of lipids
- CO3:Gaining conceptual knowledge of proteins and their structural classifications
- CO4:Perceiving the chemistry of sterols and steroids
- CO5:Understanding the structure, composition, types and functions of Nucleic acids

#### **Programme Specific Outcomes**

- PSO1: Comprehending the structure and classification of biomolecules
- PSO2:Providing the core and specialized knowledge of phospholipids, Glycoproteins, etc.
- PSO3:Understanding the methods for isolation, characterization and purification of proteins
- PSO4:Grasping the Physico-chemical properties and characterization of fats and oils
- PSO5: Emphasizing mineral metabolism in detail

### **Course Structure**

#### **UNIT – I**

Major Biomolecules: Carbohydrates - Classification, chemistry, properties and functions of monosaccharides, disaccharides, oligosaccharides and polysaccharides. Structure and biological role of homopolysaccharides - fructans, cellulose, dextran, inulin, chitins, xylans, arabinans, galactans. and heteropolysaccharides - bacterial cell wall polysaccharides, glycoaminoglycans, agar, alginic acid, pectin's. Lectins and their importance. Glycoproteins and their biological applications. Structure and functions of peptidoglycans and lipopolysaccharides.

#### **UNIT-II**

Lipids – classification, chemistry, chemical properties and functions of free fatty acids, triglycerides, phospholipids, glycolipids and waxes. Conjugated lipids-lipoproteins. Physico-chemical properties and characterization of fats and oil. Structure and properties of prostaglandins. Chemistry and properties of sterols and steroids. Biological importance of Bacterial and plant lipids.

#### **UNIT –III**

Amino acids and proteins – classification, structure and function. Essential amino acids & amphoteric nature of amino acids and reactions and functions of carboxyl and amino groups and side chains. Peptide structure. Ramachandran's plot. Methods for isolation and characterization of proteins. Structural levels of proteins – primary, secondary, tertiary and

quaternary, denaturation of proteins. Hydrolysis of proteins. Protein sequencing using various methods.

#### **UNIT – IV**

Nucleic acids – structure, composition, function and properties of DNA and RNA. Structural polymorphism of DNA. Circular DNA and supercoiling. Chargaff's rule. Denaturation and renaturation of DNA. Melting temperature ( $T_m$ ) of DNA. Hyperchromic effect. Structural characteristics of RNA. Sources, Chemistry and biochemical functions of fat and water-soluble vitamins. Chemistry of Porphyrins – Heme, Cytochromes

#### **UNIT-V**

Biological oxidation, Biological redox carriers, biological membranes, electron transport, oxidative phosphorylation and mechanism. Mineral metabolism – phosphorus, potassium, calcium and Trace elements –molybdenum, zinc, manganese, cobalt and copper. Influence of minerals on the production of toxins. Role of trace elements on microbial enzymes.

#### **Learning Outcomes**

- LO1: Able to gain theoretical knowledge on the characterisation of biomolecules
- LO2: Understanding the formation of peptide bond- concept of Ramachandran plot.
- LO3: Gaining knowledge on vitamins, their classification and biological significance
- LO4: Emphasizing the methods for isolation, characterization and sequencing of proteins
- LO5: In depth perception of mechanisms of biological oxidations and Mineral metabolisms

#### **RECOMMENDED BOOKS FOR MB 103:**

1. VOET & VOET, Biochemistry (2nd edition) John Wiley and sons.
2. CONN, STUMPF, BRUENING & DOI, Outlines of Biochemistry (5th edition) John Wiley and Sons.
3. STRYER, Biochemistry (3rd edition), Free man and company.
4. ZUBAY, Biochemistry, Brown Publishers
5. LEHNINGER, NELSON & COX, Principles of Biochemistry, 4<sup>th</sup>edition, ISara Tenney publishers
6. MARTIN, MAYER & RODWELL, Harper's Review of Biochemistry, Large medical publication
7. SMITH, HILL, LEHMAN, LEFKOWITZ, HANDLER & WHITE, Principles of Biochemistry: General aspects, 6<sup>th</sup> edition , Tata McGraw Hill Publishers.
8. Davidson, Biochemistry of Nucleic acids, Wiley scientific publishers
9. D.R.Caldwell, Microbial Physiology and Metabolism, Wm.C.Brown Publications.
10. P.L.P. Adams, J.T. Knowler and D.P. Leader, Biochemistry of Nucleic acids, Chapman&Hall, London.
11. E.S.West. W.R. Tood, H.S.Mason and J.T.V. Bruggen, Text Book of Biochemistry, Oxford & IBM Publishing Company Private Limited, New Delhi.



## **MB 104: ANALYTICAL TECHNIQUES**

### **Course Outcomes**

CO1: Introducing the basic concepts of qualitative and quantitative analysis of a given sample.

CO2: Deciphering the working of phase, fluorescent and electron microscopes

CO3: Studying various spectroscopic techniques and their applications

CO4: Perceiving the Laws of absorption and radiation

CO5: Comprehending the principle and workings of radio isotopic tracers

### **Programme Specific Outcomes**

PSO1: Understanding the various types and applications of microscopes

PSO2: Comprehending the principles of chromatography

PSO3: Studying the concept of separation science and its applications

PSO4: Developing theoretical knowledge on electrophoresis and centrifugation techniques

PSO5: Emphasizing the advantages and disadvantages of radioisotopes

### **Course Structure**

#### **UNIT – I**

Microscopy – Principles of light, phase, fluorescent & electron microscopes; Microtomy– sectioning. Microscopic techniques: Basic principles and applications of phase – contrast microscopy (phase annulus, phase plate, specimen preparations), fluorescent microscopy (filters, dark field condenser, complex optical system, sample preparations) and electron microscopy (Magnetic lenses, electron beams, condensers, types of electron microscopy – scanning and transmission, sample preparations - fixing of specimens, preparation of blocks, freeze-etch and freeze- fracture methods for EM, image processing methods in microscopy. microtomy and staining, negative staining techniques of biological samples),

#### **UNIT – II**

Principles of Centrifugation – Principles and applications of Centrifugation techniques-preparative and analytical methods, density gradient centrifugation. General principles and applications of chromatography – Paper, Column, Thin layer, Gas, Ion exchange, Affinity chromatography, HPLC, FPLC, GCMS and Gel filtration.

#### **UNIT-III**

Electrophoresis– Principles and applications of moving boundary, zone (Paper Gel) electrophoresis. Polyacrylamide, Pulse field, Immunoelectrophoresis. Immunoblotting. Isoelectric focusing, 2-D electrophoresis

#### **UNIT – IV**

Principles, Laws of absorption and radiation. Visible, ultraviolet, infrared and mass spectrophotometry. Absorption spectra, fluorescence flame photometry, cytometry and flow cytometry. NMR, ESR, Principles of colorimetry, Turbidometry, Viscometry. Determination of size, shape and molecular weight of macromolecules – osmotic pressure, flow birefringence, optical rotatory dispersion. Light scattering, diffusion, sedimentation and X-ray diffraction.

## **UNIT-V**

Radio isotopic tracers – methodology, problems of experimental design, radiometric analysis, stable and radioactive isotopes, preparation, labelling, detection and measurement of isotopes. RIA. Kinetics of radioactive disintegration. Manometric techniques. Molecular imaging of radioactive materials, safety guidelines.

### **Learning Outcomes**

LO1: Understanding the principle and applications of basic and advanced microscopy

LO2: Technical expertise of fixing of specimens and methods of sample preparations

LO3: Defining the fundamentals of spectroscopic analysis of biomolecules

LO4: Deep understanding of Principles, types and applications of Centrifugation

LO5: Emphasizing the concepts of radiochemical analysis and their applications

### **RECOMMENDED BOOKS FOR MB 104:**

1. CHATWAL & ANANAD, Instrumental Methods of Chemical Analysis, 5<sup>th</sup> edition revised Himalaya Publishers.
2. WILSON & WALKER, Practical Biochemistry: Principles and techniques, Academic publishers
3. David M Freifelder, Physical Biochemistry: Application to Biochemistry and Molecular biology (2nd edition) by. Publisher: W. H. Freeman; 2nd Revised edition (6 January 1983)
4. SADASIVAM & MANICKAM, Biochemical methods (2nd edition), New age inte.(p)Ltd.
5. UPADHYAY, UPADHYAY &NATH, Biophysical Chemistry: Principles and techniques, Himalaya Publishers
6. OSER, HAWK'S Physiological Chemistry, Mc Graw Hill Book company.
7. R.F.Boyer, Modern Experimental Biochemistry, Benjamin Cummings Publ. Company
8. Umbtict, Burris and Staffer, Manometric and Biochemical Techniques, Burgross.
9. B.D. Williams and K. Wilson, A Biologist's Guide to Principles and Techniques of Practical Biochemistry.

## **MBP 105: MICROBIOLIGAL METHODS & VIROLOGY**

### **Course Outcomes**

CO1: Providing technical expertise in handling and culturing microorganisms

CO2: Perceiving the microbial growth kinetics

CO3: Delivering hands-on experience on various Microscopic and Biochemical methods

CO4: Acquiring training on the general equipment's used in microbiology laboratory

CO5: Identifying and characterising the unknown microorganisms

### **Programme Specific Outcomes**

PSO1:Understanding the different morphological and biochemical characteristics of microbes

PSO2: Enlisting the various growth adjuvants and media compositions

PSO3:Enumerating the bacteria quantitatively through viable counts

PSO4: Developing the capability to handle microbial cultures under laboratory conditions

PSO5: Training in cultivation of viral, fungal and bacterial cultures under aseptic conditions

### Course Structure

1. Isolation methods – Enrichment culturing, Pour plate, Spread plate, Streak plate and Dilution methods.
2. Staining methods – Gram's stain, Capsule staining, Cell wall staining. Indian Ink Method or Hiss's method. Demonstration of granules in bacterial cells – Albert's method, Neisser's method. Acid-fast staining by Ziehl-Neelsen's method. Flagella and spore stain, Negative stain.
3. Calibration of Microscope, Measurement of size of spores and cells
4. Detection of motility by hanging drop method
5. Selective and indicator media – Crystal violet blood agar, Potassium tellurite blood agar, Neomycin blood agar, Salt nutrient agar, Mannitol salt agar, Phenolphthalein phosphate nutrient agar and Esculin bile medium.
6. Enumeration of bacteria – Quantitative estimation of microorganisms – total and viable counts.
7. Growth curves, Bacterial growth measurement, viable count by spread plate method. Measurement by dry weight and turbidometric methods
8. Culturing of anaerobic microorganisms-Pyrogallol tube method, anaerobic jar, thioglycollate media.
9. Metabolic (Biochemical) tests – Catalase and Oxidase tests. Indole reaction. Methyl red and Voges-Proskauer reactions, citrate utilization, starch and gelatin hydrolysis; H<sub>2</sub>S production.
10. Isolation & Identification of known & unknown bacteria.
11. Isolation of phage from soil/sewage. Cultivation and preservation of phages, Quantitation of phages by plaque assay.
12. Growth phases of phage and burst size
13. Cultivation of animal viruses by different routes in embryonated chicken/duck eggs Yolksac, Allantoic and Chorioallantoic membrane (CAM) routes.
14. Animal cell culture-Sheep kidney cell culture, chicken embryo fibroblast cell culture
15. Mechanical inoculation of plant viruses – Tobacco mosaic virus or cucumber mosaic virus and graft transmission of plant viruses.
16. Isolation and culturing of fungi (yeasts and molds) and algae.
17. Observation of specimen and permanent slides.
  - Fungi: *Aspergillus niger*
  - Yeast: *Saccharomyces cerevisiae*
  - Helminth: *Taenia solium*, *Enterobius vermicularis*
  - Protozoa: *Plasmodium falciparum*, *Giardia lamblia*

### Learning Outcomes

LO1: Hands on experience in basic techniques of Isolation, culturing, plating and sterilization.

LO2: Comprehend the major spectrophotometric and titrimetric approaches of biosamples

LO3: Basic understanding of cultivation of viruses and their growth characteristics

LO4: Maintenance and preservation of bacterial and fungal specimens under aseptic conditions

LO5: Understanding the working of different equipment's used in microbiological laboratories

## **RECOMMENDED BOOKS FOR MBP 105:**

1. CAPPUCCINO & SHERMAN, Microbiology: A laboratory manual, Benjamin Cummings Science publishing, 5<sup>th</sup> edition.
2. Gopal Reddy, M.N.Reddy, D.V.R. SaiGopal and K.V.Mallaiah, Laboratory Experiments in Microbiology, Himalaya Publishing House.
3. Reddy S.M. & Reddy S.R., Microbiology -Practical Manual, Books Selection Centre,Hyderabad.
4. S.K. Alexander,D.Strete and M.J. Mily, Laboratory Exercises in Organismal and Molecular Microbiology, Mc. Graw Hill, USA.
5. J.G. Cappunico and N.Sherman, Microbiology – A Laboratory Manual, 4th Edition,AddisonWelsley Longman Inc., England.
6. V.Kale and K.Bhusari, Practical Microbiology – Principles and Techniques, Himalaya Publishing House, New Delhi.
7. P.Gunashekarana, Laboratory Manual in Microbiology, New Age International PrivateLimited Publishers, New Delhi.
8. N. Kannan, Panima, Laboratory Manual in General Microbiology, Publishing Cooperation, New Delhi.
9. R.C. Dubey and D.K. Maheswari, Practical Microbiology, S.Chand & Company Limited, New Delhi.
10. J.G.Holt, N.R.Krieg, P.H.A. Sneath,J.T. Staley and S.T. Williams, Bergy's Manual of Determinative Bacteriology, Lippincott Williams & Wilkins, Philadelphia.
11. Barnett, Microbiology Laboratory Exercises, Mc. Graw Hill, U.S.A.
12. Benson, Microbiology applications: a Laboratory Manual in General Microbiology, Mc. Graw Hill, U.S.A.
13. Chan, Laboratory Exercises in Microbiology, Mc. Graw Hill, U.S.A.
14. F.G. Burleson, T.M Chambers, D.L. Wuiedbrauk, 1992, Virology: A Laboratory Manual.

## **MBP 106: ANALYTICAL TECHNIQUES**

### **Course Outcomes**

- CO1: Understanding the microbial growth kinetics and determination of kinetic parameters  
CO2: Making students well versed with analytical approaches to quantify major biomolecules  
CO3: Training the students in handling the instruments used in laboratory with relative ease  
CO4: Providing technical expertise on titrimetric and colorimetric approaches  
CO5: Preparing stock solutions with ease and precision

### **Programme Specific Outcomes**

- PSO1:Delivering the hands-on experience of various enzymatic assays  
PSO2:Developing insights into the different physiological phenomena of enzymes  
PSO3: Deep training in chromatographic techniques  
PSO4:Skilled training in sample preparation,spectroscopic and quantative analysis  
PSO5: Working on qualitative and quantative analysis of samples with relative ease

## **Course Structure**

1. Qualitative tests of carbohydrates, lipids, amino acids, proteins & nucleic acids.
2. Estimation of reducing sugar-Anthrone method
3. Estimation of sugar by titration method –Benedict’s method
4. Estimation of NH<sub>2</sub> group by Ninhydrin method, organic nitrogen in proteins/amino acids by Microkjeldhal method, Ultraviolet spectroscopy of proteins.
5. Determination of pKa and pI values of amino acids.
6. Quantitation of glycine by formol titration
7. Paper Chromatography of amino acids, sugars, and purine and pyrimidine bases.
8. Colorimetric determination of any one amino acid.
9. Separation of pigments by adsorption chromatography
10. Thin Layer chromatography separation – sugars & lipids
11. Molecular weight determination of enzymes / proteins by Gel filtration, SDS-PAGE.
12. Determination of saponification value of fats
13. Determination of iodine number of oils
14. Determination of acid value of fats
15. Demonstration of GM counter.
16. Determination of molar absorption coefficient of amino acid/protein and estimation of its concentration

### **Learning Outcome**

LO1: Understanding the basic principles of Microscopy and their applications

LO2: Comprehending the chromatographic techniques such as PC, TLC, etc.

LO3: Quantitative and qualitative estimations of proteins, sugars, lipids, fats, oils, etc.

LO4: Calculation of molarity, molality and normality in stock solution preparations

LO5: Determining the molecular weight of enzymes / proteins by electrophoretic methods

### **RECOMMENDED BOOKS FOR MBP 106:**

1. B. Shashidhara Rao & Vijay Deshpande – I.K, Experimental Biochemistry – A student comparison, International Private Limited, New Delhi.
2. K. Wilson and J. Walker, Practical Biochemistry - Principles and Techniques, Cambridge University Press.
3. D.T. Plummer, An Introduction to Practical Biochemistry, Tata Mc. Graw Hill Publishing Company Limited, New Delhi.
4. A. Rameshwar, Kalyani, Practical Biochemistry – A Basic Course, Publishers Ludhiana.
5. Jayaraman, Laboratory Manual in Biochemistry, Wiley Eastern Limited.
6. Oser, Hawk’s Physiological Chemistry, Mc. Graw Hill, U.S.A.

## **MODEL QUESTION PAPER**

### **FIRST SEMESTER**

SMB 101: GENERAL MICROBIOLOGY

Time: Three Hours

Maximum marks-80 (16X5=80)

**Answer one question from each Unit**  
**All questions carry equal marks**

#### UNIT-I

- 1.(a) Discuss the History and scope of Microbiology
- (b) Give an account on the contributions of Robert Koch and Joseph lister

OR

- 2 (a). Give an account on three kingdom and Five kingdom system of classification
- (b). Carl Woese Domain system

#### UNIT-II

3. (a) Give an account on physical methods of sterilization
- (b) Discuss the chemical methods of sterilization

OR

- 4.(a). Describe the methods of Preservation of microbial cultures
- (b) Write notes on the Maintenance of Microbial cultures

#### UNIT-III

5. (a)Write an essay on indirect methods of Growth Measurement
- (b) Explainthe methods direct Growth Measurement procedures

OR

6. (a). Give an account on types of Microbial cultures
- (b). Write notes on Enrichment media & Transport media

#### UNIT-IV

7. (a) Discuss the ultrastructure and function of a Bacterial cell wall
- (b) Explain reproduction and spore formation in Bacteria

OR

- 8.(a) Discuss the characteristics of Cyanobacteria and Spirochetes with suitable examples  
(b) Explain the Ultra structure, Morphology and Characterization of Archaeobacteria

UNIT-V

- 9(a). Discuss the general characteristics of Basidiomycota, and Deuteromycota  
(b) Explain the Morphology. Life cycle and Pathology of *Entamoeba histolytica*

OR

- 10.(a) Give an account on Classification of algae by Fritsch  
(b) Economic Importance of Algae

## **MODEL QUESTION PAPER**

### **FIRST SEMESTER**

SMB 102: VIROLOGY

Time: Three Hours

Maximum marks-80 (16X5=80)

**Answer one question from each Unit**  
**All questions carry equal marks**

UNIT-I

- 1.(a) Give an account on nature, origin and evolution of viruses  
(b) Give a note on new emerging and re-emerging viruses

OR

- 2 (a). Discuss the methods of transmission of viruses  
(b). Describe the biochemical characteristics of viruses

UNIT-II

3. (a) Discuss in detail the nomenclature and classification of viruses  
(b) Describe the characteristic features of Rhabdoviridae and Picornaviridae

OR

- 4.(a). Write an essay on isolation, cultivation and essay of animal viruses  
(b). Describe the features of subviral agents

UNIT-III

5. (a). Elaborate the structure and complexity of viral genomes  
(b) Explain the diversity among viral genomes

OR

6. (a). How do viruses regulate their gene expression?  
(b). Give an account of host virus interactions

UNIT-IV

7. (a) Describe the modes direct transmission of viruses  
(b) Discuss the methods direct transmission of viruses

OR

- 8.(a) Write briefly about Virus and vector relationship  
(b) How do viruses establish infection in multiple hosts

#### UNIT-V

- 9(a). Describe the methods of diagnosis of viral diseases  
(b).Discuss the measures of prevention and control of viral diseases

OR

- 10.(a).Describe the nomenclature and types of interferons  
(b).Explain the efficacy of interferons in infection control

## **MODEL QUESTION PAPER**

### **FIRST SEMESTER**

SMB 103: BIOMOLECULES

Time: Three Hours

Maximum marks-80 (16X5=80)

**Answer one question from each Unit**  
**All questions carry equal marks**

#### UNIT-I

- 1.a. What is Disaccharide? Explain with suitable examples  
b. Discuss about structure and function of peptidoglycans and LPS

OR

- 2.a. Write in detail about homopolysaccharides  
b. Describe the Lectins and Glycoproteins in detail

#### UNIT-II

- 3.a. Discuss in detail about Phospholipids  
b. Write about Physico-chemical properties of fats

OR

- 4.a. Describe the chemistry and properties of sterols and steroids  
b. Write about conjugated lipoproteins

#### UNIT-III

- 5.a. Explain about peptide structure and Ramachandran plot  
b. Discuss in detail about isolation and characterization of proteins

OR

- 6.a. Write about structural level organization of proteins  
b. Describe the amino and carboxyl group reactions of amino acids

#### UNIT-IV

- 7.a. Discuss in detail about structure, properties and polymorphism of DNA  
b. Explain in detail about fat soluble vitamin biochemical functions

OR



- 8.a. What is Porphyrin? Discuss chemistry of Heme  
b. Describe the biochemical functions water soluble vitamins

UNIT-V

- 9.a. Discuss in detail about biological redox carriers and biological membranes  
b. Write about role of trace elements on microbial enzymes

OR

- 10.a. Explain in detail about the major minerals  
b. Describe the electron transport chain mechanism in detail

**MODEL QUESTION PAPER**  
**FIRST SEMESTER**

SMB 104: ANALYTICAL TECHNIQUES

Time: Three Hours

Maximum marks-80 (16X5=80)

**Answer one question from each Unit**  
**All questions carry equal marks**

UNIT-I

- 1.a. What is the principles and applications of phase contrast microscopy?  
b. Write in detail about fluorescent microscopy

OR

- 2.a. Discuss principle and applications of SEM  
b. Describe the steps involved for sample preparation in electron microscopy

UNIT-II

- 3.a. Discuss in detail about density gradient centrifugation  
b. Give an account on Gel filtration chromatography

OR

- 4.a. Describe the ion exchange and affinity chromatography  
b. Write notes on HPLC

UNIT-III

- 5.a. Explain the principle and applications of PAGE  
b. Write notes on Immuno electrophoresis

OR

- 6.a. Discuss the principle and applications of 2-D electrophoresis  
b. Give an account on immunoblotting

UNIT-IV

- 7.a. Discuss the principles of colorimetry and turbidometry  
b. Explain the Laws of absorption and radiation

OR

- 8.a. Write notes on sedimentation and X-ray diffraction  
b. Describe the principle and applications of NMR

UNIT-V

- 9.a. Discuss in detail about labelling, and detection of radioisotopes  
b. Write about the Kinetics of radioactive disintegration

OR

- 10.a. Explain the molecular imaging of radioactive materials  
b. Discuss the safety guidelines while using radioactive elements

## **II SEMESTER**

### **MB 201: MICROBIAL PHYSIOLOGY & METABOLISM**

#### **Course Outcomes**

- CO1: Understanding the intricacies of microbial metabolism, growth and energy generation  
CO2: Acquainting with the pathways of catabolic and anabolic reactions  
CO3: Developing insights into amino acids metabolism  
CO4: Emphasizing various fermentation pathways, microbial communication and energetics  
CO5: Enumerating the utilization of secondary metabolites

#### **Programme Specific Outcomes**

- PSO1: Developing insights into microbial communities and their adaptations  
PSO2: Distinguishing microorganisms based on nutrition  
PSO3: Understanding fermentation, aerobic and anaerobic pathways for energy generation  
PSO4: Emphasizing on the catabolism of purine and pyrimidines  
PSO5: Developing insights into the microbial metabolism of hydrocarbons

#### **Course Structure**

##### **UNIT- I**

Microbial nutrition: Nutritional types –Autotrophy, heterotrophy and prototrophy. Autotrophic bacteria, chemosynthetic and photosynthetic microorganisms. Heterotrophic bacteria – saprophytes, parasites and mixotrophs. Bioluminescence in microorganisms. Physiology and biochemistry of sporulation and germination of spores. Anaerobic respiration – Fermentation, Biochemical mechanisms of lactic acid, ethanol, butanol and citric acid fermentations. Nitrate and sulphate respiration

##### **UNIT-II**

Carbohydrate metabolism in microbes- synthesis of carbohydrates in photosynthetic, chemosynthetic and heterotrophic microbes. Fermentation of carbohydrates by microorganisms –Embden-Meyerhof-Parnas (EMP) pathway, Entner-Doudoroff (ED) pathway, C2-C4 split pathway. Kreb's cycle, glyoxylate cycle, hexose monophosphate (HMP) shunt, gluconeogenesis, anapleurotic reactions, synthesis of peptidoglycans and glycoproteins.

### **UNIT-III**

Metabolism of amino acids –Biosynthesis of amino acids and their regulation with emphasis on tryptophan and histidine by microorganisms. Protein metabolism - Assimilation of inorganic nitrogen and sulphur, Biochemistry of nitrogen fixation. Urea cycle. Signal transduction with reference to nitrogen metabolism. Catabolism of amino acids, transamination, decarboxylation and oxidative deamination. Porphyrin biosynthesis and catabolism.

### **UNIT –IV**

Lipid metabolism - Biosynthesis of triacyl glycerol's, phospholipids and sphingolipids. Oxidation of saturated and unsaturated fatty acids. Nucleotide metabolism - Biosynthesis of purine and pyrimidine nucleotides. Structure and regulation of ribonucleotide reductase. Biosynthesis of ribonucleotides, deoxyribonucleotides and polynucleotides. Regulation of nucleotide synthesis. Catabolism of purine and pyrimidines. Inhibitors of nucleic acid biosynthesis

### **UNIT-V**

Microbial metabolism of aromatic and aliphatic hydrocarbons (camphor and 2,4-D) with emphasis on the role of monooxygenase and dioxygenase in the ring cleavage (ortho and metacleavage) and reductive catabolism. Secondary metabolism - Utilization of secondary metabolites for production of vitamins, toxins (aflatoxin and corynebacterial), hormones (GA), and antibiotics (penicillin and streptomycin).

### **Learning outcomes**

LO1 : Enlisting microbial communities based on their nutritional and energy requirements

LO2: Deep insights into the biology of nitrogen fixation

LO3: Acquainting with the concepts of microbial cross-talk.

LO4: Perception of biosynthesis of amino acids and their regulation

LO5: Understanding the utilization of secondary metabolites

### **RECOMMENDED BOOKS FOR MB 201:**

1. Moat and Foster, 2002, Microbial physiology, 4<sup>th</sup> edition, Pub. Wiley Liss and son's, Inc.
2. Price and Stevens, An introduction to bacterial physiology.
3. Oginsky and Umbreit, An introduction to bacterial physiology, Freeman & Company.
4. Gottschalk, Bacterial metabolism, University of Texas Medical branch at Galvaston
5. Ingraham, Lod and Neichardt, Growth of bacterial cell.
6. Dawes, Microbial energetic, Blakie & Sunlted Glasgow.
7. Lehninger, Nelson and Cox, Principles of Biochemistry.
8. Zubay, Biochemistry, 3<sup>rd</sup> edition, 1993, Pub. WM.C.Brown Publishers, Melbourne, Australia.
9. Biochemistry by Stryer.
10. Garrett and Grisham, 2005, Biochemistry, 3<sup>rd</sup> edition, Pub. Thomson Brook's and company.
11. M.Burrows, Textbook of Microbiology.
12. D.R.Caldwell, Microbial physiology and Metabolism, Wm.C.Brown Publ.
13. K.Talaro and A. Talaro, Foundations in Microbiology, Wm.C.Brown Publ.
14. Prescott *et al.* Microbiology, 7<sup>th</sup> edition, 2008, Pub.Wm.C.Brown.

15. Lodish *et al.*, 1999, Molecular Cell Biology, 4<sup>th</sup> edition, WH.Greeman and company.
16. Stainer, 1958, General Microbiology, Macmillan educational Ltd., 5<sup>th</sup> edition, Pub.
17. Madigan M.T., Martinko J.M., and Parker J., Prentice Brock Biology of microorganisms, -Hall, Perarson edition.
18. West E.S and Tood, 1974, Textbook of Biochemistry, 4<sup>th</sup> edition, Oxford and IBM Publishing Co.Pvt. Ltd.,New Delhi.
19. Donald Voet, Judith G.voet, Biochemistry, John Wiley & Sons, 1999, Pub. John Willeuy and son's, USA.
20. Harper, 2006, Biochemistry, Mc.Graw Hill, 27<sup>th</sup> edition, Pub. McGraw-Hill companies.
21. Cohn and Stumph, Principles of Biochemistry, 4<sup>th</sup> edition, 2008, W.H. Greeman and company.
22. Davidson, Biochemistry of Nucleic acids.
23. Mullar and Cords, Biological chemistry.
24. White Handler and Smith, Biochemistry, Mc Grahills.
25. Dwelley, Bacterial metabolism.

## **MB 202: CELL BIOLOGY & ENZYMOLOGY**

### **Course Outcomes**

- CO1:Specifying the significance of cellular organelles and their biogenesis.
- CO2: Perceiving the Physico-chemical properties of bacteria
- CO3: Signifying the cellular permeability and transport process
- CO4: Developing insights into the mechanism of signal transduction
- CO5: Understanding the laws of thermodynamics

### **Programme Specific Outcomes**

- PSO1: Gain knowledge on cellular organisation and transport mechanisms
- PSO2:Perceiving the concepts of entropy, enthalpy and free energy changes
- PSO3:Emphasizing oxidative phosphorylation and theories of ATP generation
- PSO4:Analysing the importance of mathematical and statistical methods required for the description, interpretation of enzymatic phenomena and processes
- PSO5:To integrate the practical aspects of enzymology with the kinetic theories providing a mechanistic overview of enzyme activity and regulation in cells

## **Course Structure**

### **UNIT-I**

Organellar Biology: Structure, function and biogenesis of chloroplast and mitochondria, mesosomes, lysosomes and cytoskeletal system. Photosynthesis in bacteria and plants: Organization, apparatus, electron donors and acceptors, energetics. Purple green photosynthetic bacteria. Physico-chemical properties of bacteria – intracellular osmotic pressure, permeability of the bacterial cell. Nutrient transport – simple diffusion, passive, facilitated diffusion and active transport. Transport of amino acids and inorganic ions in microorganisms.

### **UNIT-II**

Photosynthesis - Oxygenic and anoxygenic photosynthesis, structure of synthetic pigments, primary photochemistry of PS I and PS II, and photosynthetic electron transport, Carbon dioxide fixation, halo bacterial photosynthesis. Bacterial aerobic respiration- components of electron transport chain, free energy changes and electron transport, oxidative phosphorylation and theories of ATP formation, inhibition of electron transport chain. Bacterial anaerobic respiration: Introduction. Nitrate, carbonate and sulfate as electron acceptors. Electron transport chains in anaerobic bacteria.

### **UNIT-III**

Signal transduction in eukaryotes: Protein kinases, membrane receptors- Enzyme linked, GPCR and nuclear. Ras pathway, MAP kinase pathway. Second messenger system: Cyclic nucleotides - cAMP, cGMP, Calcium, nitric oxide, IP<sub>3</sub> and DAG. Mechanism of signal transduction-G protein signalling. Vascular trafficking- Clathrin coated vesicles, COP-I and COP-II coated vesicles

### **UNIT-IV**

Outlines of enzyme classification, nomenclature, assay of enzymes and kinetics of enzyme catalyzed reactions – Michaelis – Menton equation, determination of Km, Vmax and kcat values. Enzyme inhibitors, competitive, uncompetitive and non-competitive inhibition. Factors affecting enzyme reaction – pH, temperature, radiation, enzyme and substrate concentrations, activators, coenzymes and metalloenzymes. Ribozymes and Abzymes

### **UNIT-V**

Active site determination. Mechanism of action of ribonuclease, lysozyme and chymotrypsin. Isoenzymes, Regulatory enzymes – covalent modification, zymogen activation, Allosteric enzymes – ATCase, Glutamine synthetase. Hemoglobin and Myoglobin. Enzyme purification - Methods of isolation, purification. Recovery and yield of enzymes. Criteria for testing purity of enzyme preparations. Immobilized enzymes - Methods of Immobilization. Comparison of kinetics of immobilized and free enzymes. Application of Immobilized enzymes.

### **Learning Outcomes**

LO1: Understanding the biological and biochemical aspects of photosynthesis and respiration

LO2: Perception of basic knowledge of enzyme kinetics, the parameters of the enzymatic reaction and mechanisms of action of enzymes and inhibitors.

LO3: Developing insights into the knowledge on the structure of enzymes and their active sites

LO4: Emphasizing the basic concepts, terms and techniques used in enzymology

LO5: Deep learning of signal transduction and signalling pathways with receptor proteins

### **RECOMMENDED BOOKS FOR MB 202:**

1. E.B.P. De Robertis, 2001, Cell and Molecular Biology, 8<sup>th</sup> edition, Lippincott Williams & Wilkins.

2. Lodish & Baltimore, 2000, Molecular Cell Biology, 4<sup>th</sup> edition, Pub. W.H. Greener and company.

3. Nicholas C. Price, Lewis Stevens, Fundamentals of Enzymology, 3<sup>rd</sup> edition, 2003, Pub. Oxford University Press.

4. Trevor Palmer, 2004, Enzymes, Biochemistry, Biotechnology, Clinical Chemistry, Pub. Harward Publishing Limited.

5. Lehninger, 2008, Biochemistry, 4<sup>th</sup> edition, Pub. W.H. Freeman and company.
6. Lehninger, Nelson and Cox, 2008, Principles of Biochemistry, 4<sup>th</sup> edition, Pub. W.H. Freeman and company.
7. Lubert Stryer, 2007, Biochemistry, 6<sup>th</sup> edition, Pub. W.H. Freeman and company.
8. Zubay, 1993, Biochemistry, 3<sup>rd</sup> edition, Pub. W.M. C. Brown Co.,union, Inc.
9. White Handler and Smith, 2004, Biochemistry, 6<sup>th</sup> edition, Pub. Tata McGraw-Hill Ltd.
10. Dixon and Webb, Enzymes, Academic Press.
11. Ahern, Introduction to Experimental Cell Biology, Mc. Graw Hill, USA.
12. Metzler, The Chemical reactions of Living Cells, Vol 1 and 2.

## **MB 203: MOLECULAR & MICROBIAL GENETICS**

### **Course Outcomes**

CO1: Studying the genetic organization of prokaryotes and eukaryotes at a molecular level

CO2: Perceiving the fine structural analysis of Gene

CO3: Enumerating the biological significance of plasmids and their properties

CO4: Gaining insights into transposable elements in yeast and *Drosophila*

CO5: Developing insights into the mechanisms of mutations and their importance in evolution

### **Programme Specific Outcomes**

PSO1: Emphasizing the Prokaryotic and Eukaryotic genomes and their organisations

PSO2: Understanding the microbial inheritance and lateral gene transfer mechanisms

PSO3: Enumerating model organisms such as *E. coli*, *Yeast* and *Drosophila*

PSO4: Acquiring knowledge on molecular markers in DNA Polymorphisms

PSO5: Obtaining insights on mutations and various mutagens causing mutations

## **Course Structure**

### **UNIT-I**

Molecular organization of chromosomes in Prokaryotes and Eukaryotes. Centromeres and telomeres. Recombination at molecular level, heteroduplex analysis. Repeated sequences C value paradox, cot curves; Multigene Families-Pseudogenes, Overlapping genes, Split genes and Selfish genes. Molecular markers (RFLP and RAPD) Polymorphisms.

### **UNIT-II**

Fine Structure analysis of Gene. Benzer's studies on r-II locus of T4 bacteriophage, Complementation test and deletion mapping. *E. coli*, *Yeast* and *Drosophila* as model organisms. Hybridization in yeast, control of mating type loci in yeast. Tetrad analysis in eukaryotic microbes – Neurospora and yeast. Recombination in bacteriophages.

### **UNIT-III**

Bacterial genetics – Inheritance of characteristics and variability. Phenotypic changes due to environmental alterations. Genotypic changes. Bacterial recombination -Unidirectional Gene Transfer, U-tube Experiment. Bacterial transformation, Bacterial conjugation, Mapping of bacterial chromosome by interrupted mating. Transduction – Generalized and specialized transductions, Evolutionary significance of genetic exchange in Bacteria.

## UNIT-IV

Plasmids – types, properties and Replication. Sex plasmid F and its derivatives, drugresistance (R) plasmids, Col plasmids, Ti plasmid of *Agrobacterium* and other plasmids. Transposable elements – Mechanism of transposition. Types of bacterial transposons, duplication of target sequence at an insertion site. Deletion and inversion caused by transposons. Transposable elements in yeast and *Drosophila*. Retroposons.

## UNIT-V

Mutations – Terminology, types of mutations, Molecular basis of mutations, isolation and analysis of mutants- Fluctuation test, Replica plating and Ames test Antibiotic enrichment test, Chromogenic and substrate utilization methods. Mutagenesis – base analogue mutagens, chemical mutagens, intercalating substances, mutator genes. Site directed mutagenesis, mutational hot spots, Reversion, second site revertants, frame shift mutations, screening of mutants. UV damage of DNA and repair.

### Learning Outcomes

LO1: Developing insights into the fine structure of genes and multigene families

LO2: Perception of recombination mechanisms at molecular level

LO3: Deep understanding of the Site directed mutagenesis

LO4: Understanding the tetrad analysis and mapping of genes

LO5: Emphasizing the recombination in viruses and their exploitation as genetic tools

### RECOMMENDED BOOKS FOR MB 203:

1. J.D.Watson. 2004.Molecular Biology of the Gene. 4<sup>th</sup> Edition. 2004. Pearson Education.
2. Lodish. 2003. Molecular Cell Biology. Scientific american books, W.H. Freeman and Company.
3. E.B.P. De Robertis, 2001, Cell and Molecular Biology, Lippincott Williams & Wilkins, 8<sup>th</sup> edition,.
4. Lodish & Baltimore, 2000, Molecular Cell Biology, 4<sup>th</sup> edition, Pub Pub. W.H. Freeman and company.
5. Watson Roberts, Steitx Wainer, 2004, Molecular Biology of the Gene, The Benjamin/Cummings Publishing Company Inc., 5<sup>th</sup> edition.
6. Stanley R. Maloy, John E Cronan Jr., 2001, Microbial Genetics, David Freifelder Jones and Bartleh Publishers Inc., 8<sup>th</sup> edition
7. Benjamin Lewin., Genes I– VII, 1<sup>st</sup> edition, Pub. Oxpord University Press, New York.
8. Russell, Essentials of Genetics.
9. Larry Snyder and Wendy Champness, Molecular Genetics of Bacteria, A.S.M. Press. 3<sup>rd</sup> edition, 2007.
10. Gardener, Genetics, 8<sup>th</sup> edition, Pub. John Wiley and sons, Inc, 1991.
11. Tamrin, 2002, Genetics, 7<sup>th</sup> edition, Pub. Tata McGraw-Hill Publishing company Ltd.,
12. Strickberger, Genetics, 3<sup>rd</sup> edition, 1985, Pub. Asoke K. Ghosh, prentice Hall jof India Pvt. Ltd.
13. J.W. Dale, 1998, Molecular Genetics of Bacteria, 3rd Edition. , Wiley Publ.
14. Griffith, Modern Genetic Analysis.
- 15..E.A. Birge, Bacterial and Bacteriophage genetics, Springer.
16. W.Hays, Genetics of bacteria and their viruses.

## **MB 204: IMMUNOLOGY**

### **Course Outcomes**

CO1: Providing an overview of immune system, antigen- antibody structure and interactions.

CO2: Developing a better understanding of innate and adaptive immunity.

CO3 Theoretical knowledge on autoimmune disorders and hypersensitivity reaction

CO4:Emphasizing MHC and its role in immune response.

CO5: Enlisting the significance of vaccines in disease control and prevention

### **Programme Specific Outcomes**

PSO1:Integratingthe knowledge of immunology with health sciences

PSO2:Understanding the principle and applications of serological techniques

PSO3: Developing insights into Immune response to infectious diseases

PSO4:Comprehending the classification and properties of antigens and antibodies

PSO5:Emphasizing the applications of monoclonal antibodies in biomedical research

## **Course Structure**

### **UNIT-I**

History and scope of Immunology. Cells of the immune system: T lymphocytes, B lymphocytes - origin, activation, differentiation, characteristics and functions. Natural killer cells, Monocytes, Macrophages, APC, Neutrophils, Mast cells, Dendritic cells. Organs of the immune system: Lymphoid organs - thymus, bone marrow, spleen, lymph nodes, mucosa associated lymphoid tissue. Types of immunity - Adaptive and Innate immunity. Immunogenicity, Antigenicity, Nature and properties of antigens, Haptens, adjuvants, Epitopes.

### **UNIT-II**

Antibody structure, classification of antibodies, functions of IgG, IgA, IgM, IgD and IgE; Antigenic determinants on immunoglobulins - Isotypes, Allotypes, Idiotypes. Primary and secondary immune response. Antibody diversity, antigen receptors on B and T lymphocytes. Phagocytosis, Opsonization, opsonin's. The complement system – functions and components of complement, Complement activation – classical and alternative pathway. Complement receptors, biological consequences of complement activation. Major Histocompatibility Complex (MHC) - structure and functions of class I and class II MHC molecules. Human leucocyte antigen (HLA), MHC restriction and its role in immune response.

### **UNIT-III**

Antigen-Antibody interactions - Antibody affinity and avidity, Cross reactivity. Precipitation reactions – Radial Immunodiffusion, Double Immunodiffusion, Immunoelectrophoresis, Rocket electrophoresis. Agglutination reactions – Hemagglutination, Blood grouping, ELISA, ELISPOT, RIA, Immunoprecipitation, Immunofluorescence, Immunoblotting, Flow cytometry. Complement fixation test (CFT). Hybridoma technology: Polyclonal antibodies. Monoclonal antibodies – production and applications of monoclonal antibodies in biomedical research, clinical diagnosis and treatment. Abzymes.



## **UNIT-IV**

Humoral and cell-mediated immunity. Ontogeny of B and T lymphocytes, generation of memory B cells and affinity maturation. T and B cell interactions, super antigens. Cytokines, Interleukins, Interferons, lymphocyte mediated cytotoxicity (CTL). Antibody-dependent cell-mediated cytotoxicity. Reactions of immunity – antitoxins, neutralization of toxin with antitoxin. Immune response to infectious diseases: viral infections, bacterial infections and protozoan diseases. Hypersensitivity: Immediate (type I, type II, type III) and delayed (type IV) hypersensitivity reactions.

## **UNIT-V**

Auto immunity- organ specific (Hashimoto's thyroiditis) and systemic (Rheumatoid arthritis) diseases. Immunodeficiency diseases - Primary immunodeficiency (genetic) diseases due to B-cell and T-cell and combined defects (hypogammaglobulinemia, thymic aplasia, SCID). Secondary immunodeficiency (acquired). Transplantation immunology: Graft rejection - auto, allo, iso and xenograft. Tumor immunology, Immunological tolerance and Immunosuppression. Vaccines – Active and Passive immunization. Development and production of live attenuated and inactivated vaccines, sub unit vaccines, DNA vaccines, Recombinant vector vaccines. Immunotherapy of infectious diseases. Vaccinoprophylaxis, vaccinotherapy, serotherapy.

## **Learning Outcomes**

LO1: Understanding the Immunogenicity, adaptive and Innate immunity

LO2: Deep insights into antigenic-antibody interactions, Histocompatibility and autoimmunity

LO3: Perception of Hybridoma technology and its significance

LO4: Gain theoretical knowledge of Immunological tolerance and Immunosuppression.

LO5: Developing theoretical approach towards the immunological techniques

## **RECOMMENDED BOOKS FOR MB 204:**

1. Stewart, Immunology and Immunopathology, 8<sup>th</sup> edition, Churchill living stone.
2. Abul K. Abbas *et al.*, Cellular and Molecular Immunology, Elsevier publication.
3. Barret, 2005, Textbook of Immunology, 5<sup>th</sup> edition, Pub. Elsevier saunders Inc.
4. Roitt, Brostoff, Male, Essential Immunology, Harcourt Brace & Company (4<sup>th</sup>, 5<sup>th</sup> Edition), Mosby (6<sup>th</sup> Edition)
5. J.Kuby, Richard A. Goldsby, Thomas J. Kindt, Barbara A. Osborne, Immunology, 4<sup>th</sup> edition, Freeman & Company Mosby publishers. 2009.
6. Janeway and Travers, 1994, Immunobiology – The immune system in Health disease.
7. Tizard, 1995, Immunology – An introduction, 4<sup>th</sup> edition, Pub. Saunders college publishing.
8. Unani and Benacerraf, Text book of Immunology.
9. Paul, Fundamentals of Immunology, Lippincott Williams & willeins
10. Benjaini, Sunshine and Lesrowitz, Immunology – A short course.
11. Stites, Terr and Parslow, Basic and Clinical Immunology.
12. Herman N. Eosen, Immunology.
13. Constantin Bena, Molecular Basis of Immunology.
14. Jan Klein, Immunology – The science of self non-self-discrimination, John wiley & sons.

15. R.M.Coleman, M.F. Lombard and R.E. Sicard, Fundamental Immunology, Wm.C.Brown Publishers.

## **MBP 205: ENZYMOLOGY AND IMMUNOLOGY**

### **Course Outcomes**

CO1: Imparting knowledge on basic production, isolation and purification methods of enzymes

CO2: Developing theoretical understanding about enzyme kinetics

CO3: Hands on experience on serological techniques reflecting antigen-antibody interactions

CO4: Acquiring technical expertise in handling immunological kits

CO5: Perceiving practical insights into gel casting, serum preparations and blot techniques

### **Programme Specific Outcomes**

PSO1: Understanding the effects of substrate and enzyme concentration on enzyme activity

PSO2: Providing technical expertise to basic immunological techniques

PSO3: Training in handling DNA and Protein gel loading and band analysis

PSO4: Technical expertise in quantification and purification of enzymes from bio samples

PSO5: Performing blood grouping and determining Rh factor with precision

### **Course Structure**

- 1) Assay of microbial enzymes (any two) – Amylase, protease, catalase, urease and pectinase.
- 2) Production, isolation, purification and assay of any one of the above enzymes
- 3) Enzyme Kinetics: (any one of the above enzymes):
  - a) Effect of substrate and enzyme concentration on enzyme activity; Determination of  $K_m$  and  $V_{max}$  values.
  - b) Effect of pH, temperature and inhibitors on enzyme activity.
- 4) Enzyme and Whole cell immobilization.
- 5) Separation of Serum proteins- Immunoelectrophoresis.
- 6) Ouchterlony double diffusion.
- 7) Radial immunodiffusion.
- 8) Immunoprecipitation and precipitin curve.
- 9) ELISA.
- 10) Western blotting.
- 11) Agglutination inhibition test.
- 12) Blood grouping, Rh typing, VDRL, WIDAL
- 13) Raising antiserum.

### **Learning Outcomes**

LO1: Understanding the mode of action of enzymes and their kinetics

LO2: Acquainting with immunological approaches that encompass detection and understanding of antigen-antibody interactions

LO3: Technically trained to determine and quantify the presence/absence of antigens and antibodies in biological samples

LO4: Hands on experience on gel casting (SDS-PAGE) and electroblotting techniques

LO5: Well versed with calorimetric and spectroscopic analysis

### **RECOMMENDED BOOKS FOR MBP 205:**

1. Hudson and Hay, Practical Immunology.
2. Harlow and Lane, Antibodies: A Laboratory manual.
3. Rose and Friedman, Manual of Clinical Immunology.
4. Johnstone and Thrope, Immunochemistry in Practice.
5. Weir, Handbook of Experimental Immunology, Vol I and II.
6. Plummer, An Introduction to Practical Biochemistry, Tata McGraw-Hill publishers
7. Beedu Sashidhar Rao and Vijay Deshpande, I.K, Experimental Biochemistry, 2005 edition
8. Methods in enzymology series, Academic Press.

### **MBP 206: MICROBIAL PHYSIOLOGY AND GENETICS**

#### **Course Outcomes**

- CO1: Understanding the microbial growth kinetics  
CO2: Providing basic insights of microbial genetic manipulations  
CO3: Training the students in handling and manipulating the microbial samples  
CO4: Making students well versed with analytical approaches to quantify major biomolecules  
CO5: Acquiring technical expertise in handling microbial genetics kits

#### **Programme Specific Outcomes**

- PSO1: Developing deep insights into different physiological phenomenon's  
PSO2: Trained to handle microbial genetic modification strategies  
PSO3: Providing hands on experience in banding and karyotyping  
PSO4: Hands on experience in handling chemical mutagens  
PSO5: Overall practical understanding of DNA repair mechanisms

#### **Course Structure**

1. Estimation of proteins by Biuret method and Folin Ciocalteu method.
2. Estimation of DNA by Diphenyl amine method.
3. Estimation of RNA by Orcinol method
4. Estimation of Inorganic and organic phosphates by Fiske-SubbaRow method.
5. Estimation of Ammonical nitrogen and nitrates.
6. Strain improvement using chemical mutagens.
7. Isolation of mutants using EMS.
8. UV Survival curve of *E.coli*. or any other bacteria.
9. Study of the repair mechanism for the damage caused by UV radiation.
- 10 Find the effectiveness of disinfectants by Phenol coefficient test.
11. Demonstration of Ames test.
12. Protoplast preparation and regeneration.
13. Chromosome isolation, banding and karyotyping.
14. Bacterial conjugation

#### **Learning Outcome**

- LO1: Developing capability to quantify proteins and nucleic acids  
LO2: Perceiving insights to perform different gene transfer methods in microbes  
LO3: Handling of the general equipment's used in microbiology laboratory with ease  
LO4: Comprehending the major spectrophotometric approaches in quantification of biosamples  
LO5: Expertized in titrimetric and calorimetric analysis.

## **RECOMMENDED BOOKS FOR MBP 206:**

1. Jeffrey H Miller, A short course in bacterial genetics – A laboratory manual and Handbook for *Eschericia coli* and related Bacteria, Cold spring Harbor Laboratory press
2. S.K. Sawhney and Randhir Singh, 2001, Introductory practical Biochemistry, Pub. N.K. Mehra for Narasa publishing House.
- 3.K.R.Aneja, Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom Production Technology, New age international Publishers.
4. T.W. Zyskind and S.I. Bern stein, Recombinant DNA Laboratory Manual, Academic press.
5. Benson, H.J. WCB: Microbiological Applications (A Laboratory manual in General Microbiology) WM C. Brown Publishers.
6. Capuccino, J.G. and Sherman, N. Addison Wesley, 2004. Microbiology – A Laboratory Manual, Pub. Pearson Education Private Ltd.
7. N. Kannan, Laboratory Manual in General Microbiology, Panima Publishing Corporation.
8. R.C. Dubey and D.K. Maheswari, 2002, Practical Microbiology, S.Chand and Company Limited, 1<sup>st</sup> edition.
9. Beedu Sashidhar Rao and Vijay Deshpande, I.K, Experimental Biochemistry, International Pvt. Ltd.

## **MODEL QUESTION PAPER**

### **SECOND SEMESTER**

#### **SMB 201: MICROBIAL PHYSIOLOGY AND METABOLISM**

Time: Three Hours

Maximum marks-80 (16X5=80)

**Answer one question from each Unit  
All questions carry equal marks**

#### **UNIT-I**

- 1.a. What is Nutrition? Explain different types of microbial nutrition  
b. Describe the Nitrate and sulphate respiration in detail

**OR**

- 2.a. Write about anaerobic respiration in detail  
b. Discuss about biochemistry and germination of spores

#### **UNIT-II**

- 3.a. Discuss in detail about carbohydrate metabolism in photosynthetic bacteria  
b. Write about gluconeogenesis and its regulation

**OR**

- 4.a. Describe the biosynthesis of glycoproteins in detail  
b. Write about ED and anapleurotic reactions

UNIT-III

- 5.a. Explain about tryptophan biosynthesis and their regulation  
b. Discuss in detail about Porphyrin biosynthesis.

OR

- 6.a. Write about biochemistry of nitrogen fixation  
b. Describe the transamination, decarboxylation and oxidative deamination.

UNIT-IV

- 7.a. Discuss in detail about biosynthesis of phospholipids  
b. What are pyrimidines? Discuss about biosynthesis of pyrimidines

OR

- 8.a. Explain in detail about Oxidation of unsaturated fatty acids  
b. Describe the catabolism of purines

UNIT-V

- 9.a. Discuss in detail about camphor microbial metabolism  
b. Write about vitamin production in detail

OR

- 10.a. Explain in detail about 2,4-D and reductive catabolism  
b. Describe the antibiotic penicillin production in detail

**MODEL QUESTION PAPER**  
**SECOND SEMESTER**

SMB 202: CELL BIOLOGY AND ENZYMOLOGY

Time: Three Hours

Maximum marks-80 (16 X 5=80)

**Answer one question from each Unit**  
**All questions carry equal marks**

UNIT-I

- 1.a. Discuss the structure, function and biogenesis of chloroplast  
b. Explain Physico-chemical properties of bacteria
- OR
- 2.a. Write in detail about methods of nutrient transport  
b. Describe the transport of amino acids and inorganic ions in microorganisms.

UNIT-II

- 3.a. Discuss in detail about photochemistry of PS I and PS II  
b. Give an account on components of electron transport chain

OR

- 4.a. Explain oxidative phosphorylation  
b. Write notes on theories of ATP formation  
UNIT-III

- 5.a. Give an account on Protein kinases  
b. Describe the Ras pathway  
OR

- 6.a. Explain G protein signalling  
b. Write notes on Vascular trafficking  
UNIT-IV

- 7.a. Give a brief account on enzyme classification  
b. Explain Michaelis – Menton equation  
OR

- 8.a. Discuss Enzyme inhibitors and their types  
b. Write notes on Ribozymes and Abzymes  
UNIT-V

- 9.a. Discuss in detail about the mechanism of action of lysozyme  
b. Write notes on Haemoglobin and Myoglobin  
OR

- 10.a. Explain the methods of isolation and purification of enzymes  
b. Describe the applications of Immobilized enzymes

## **MODEL QUESTION PAPER SECOND SEMESTER**

**SMB 203: MOLECULAR & MICROBIAL GENETICS**

Time: Three Hours

Maximum marks-80 (16X5=80)

**Answer one question from each Unit  
All questions carry equal marks**

### **UNIT-I**

- 1.(a) Discuss the molecular organisation of chromosomes in prokaryotes  
(b) Give an account on the Holliday model of heteroduplex formation  
OR

- 2 (a). Write notes on pseudogenes; overlapping genes and split genes  
(b). RAPD and RFLP

### **UNIT-II**

3. (a) Give an account on Benzer's studies on r-II locus of T4 bacteriophage  
(b) Discuss the tetrad analysis in Neurospora  
OR

- 4.(a). Explain hybridization in yeast

(b) Write notes on the control of mating type loci in yeast

UNIT-III

5. (a) Write an essay on Inheritance of characteristics and variability in bacteria

(b) Describe U tube experiment demonstrating lateral gene transfer

OR

6. (a). Give an account on the mechanism of conjugation

(b). Write notes on mapping of bacterial chromosome by interrupted mating

UNIT-IV

7. (a) Discuss the types, properties and replication of plasmids

(b) Emphasize on R plasmids, col plasmids and Ti plasmid

OR

8.(a) Explain the classification of bacterial transposons

(b) Write notes on transposable elements in *Drosophila*

UNIT-V

9(a). Discuss the molecular basis of mutations

(b) Explain the methods of isolation and analysis of mutants

OR

10.(a) Give an account on Site directed mutagenesis

(b) Write notes on chemical mutagens and intercalating agents

**MODEL QUESTION PAPER**  
**FIRST SEMESTER**

SMB 204: IMMUNOLOGY

Time: Three Hours

Maximum marks-80 (16X5=80)

**Answer one question from each Unit**  
**All questions carry equal marks**

UNIT-I

1.(a) Give an account scope of Immunology

(b) Discuss the cells of the immune system

OR

2 (a). Describe the immunological process involved in Lymphoid organs

(b). Define the term immunity. Explain its types

UNIT-II

3. (a) Describe the structure and classification of antibodies

(b) Explain the mechanism of primary and secondary immune response

OR

4.(a). Elaborate the classical and alternative complement pathways and their biological significance

(b). Explain the structure and functions of Major Histocompatibility Complex

### UNIT-III

5. (a). Give an account on antigen antibody interactions

(b) Define precipitation reaction and describe its types

OR

6. (a). Discuss Complement fixation test and agglutination reactions

(b). Describe the procedure of monoclonal antibodies production and their applications

### UNIT-IV

7. (a) Give an account of B cell maturation, development and interactions

(b) Write the mechanism of lymphocyte mediated cytotoxicity

OR

8. (a) Explain mechanism of Immune response to infectious diseases

(b) Describe the types Hypersensitivity reactions

### UNIT-V

9. (a). Define auto immunity. Discuss various auto immune diseases

(b). What are Immunodeficiency diseases. Describe the types

OR

10. (a). Explain process of Immunological tolerance and Immunosuppression

(b). Give an account on Immunotherapy of infectious diseases

## III SEMESTER

### MB 301: MOLECULAR BIOLOGY

#### Course Outcomes

CO1: Understanding the organisation of genetic material and their hereditary patterns

CO2: Perceiving the concepts of central dogma and the deciphering of genetic code

CO3: Enumerating the steps involved in transcription and translational mechanisms

CO4: Gaining insights into catabolite repression mechanism

CO5: Distinguishing different modes of gene regulation and their expressions

#### Programme Specific Outcomes

PSO1: Emphasizing the mechanisms of replication, transcriptional and translational processes

PSO2: Understanding the biology of cancer and tumours

PSO3: Enumerating the various enzymes and their importance in replication

PSO4: Deep learning of gene regulation at the levels of transcription and translation

PSO5: Perceiving the importance of Regulatory genes, structural genes and repressors

### Course Structure

#### UNIT-I

Proof of DNA & RNA as genetic material; Transformation experiments, Blenders experiments, properties of genetic material. Modern concept of gene structure. Overlapping



genes, split genes, constitutive genes, jumping genes, Oncogenes. Types of tumors, physical, chemical and biological Carcinogens, chromosomal changes induced by Carcinogens. DNA damage and repair mechanisms.

#### **UNIT-II**

DNA replication – various modes of replication, Meselson-Stahl's studies on replication. Enzymes and Proteins involved in replication; Mechanism of replication – Initiation, polymerization and termination. Telomerase Replication. Topoisomerases, DNA ligases. Prokaryotic and Eukaryotic promoters. Mechanism of transcription and transcriptional activators. Posttranscriptional modifications.

#### **UNIT-III**

The genetic code: Deciphering the genetic code (Theoretical, Invitro and In vivo approach); theory of triplet code, elucidation of base composition of codons. Identification of stop and start codons, universality of the code, redundancy of the code, The decoding system.

#### **UNIT-IV**

Protein synthesis; Mechanism and role of various factors involved in Initiation, elongation and termination of Protein Synthesis, Inhibitors of protein synthesis. Mechanisms of protein translocation, Post translational processing of proteins, protein channelling. Role of RNA in protein synthesis.

#### **UNIT-V**

Regulation of gene expression at the levels of transcription and translation. Operon concept; Regulatory genes, structural genes and repressors. Negative and Positive regulation. Regulation of lac, ara and trp operons. Catabolite repression. Regulation of gene expression in lambda and nif operon. Regulation of gene expression in eukaryotes.

#### **Learning Outcomes**

- LO1: Understanding the importance of DNA and RNA that govern inheritance patterns
- LO2: Emphasizing the role of RNA in decoding and protein synthesis
- LO3: Insights into the mode of action of antibiotics on protein synthesis
- LO4: Perception of post transcriptional and post translational modifications
- LO5: Acquiring critical knowledge on telomerase replication, Intron splicing and protein channelling

#### **RECOMMENDED BOOKS FOR MB 301:**

1. B.alberts, D Bray, J.Lewis, M.Raff, K.Roberts and J.D. Watson, 1983, Molecular Biology of the Cell, Garland Publishing Inc., New York.
2. J.D. Watson, 1976, Molecular Biology of the Gene, 3<sup>rd</sup> Edition, W.A. Benjamin Inc., New York.
3. Hartwell, L., Hood, L., Goldberg, M.L., Reynolds, A.E., Silver, L.M. and Veres, R.C, 2000, Genetics: from genes to Genomes, 1<sup>st</sup> Edition WCB –Mc Graw Hill.
4. Lodith.H., Berk.A., Zipursky, S.I.Matsudira.P., Baltimore, D and Darnell. J, 2000, Molecular Cell Biology, 4<sup>th</sup> Edition, W.H. Truman & Co.
5. Lehinger: Principles of Biochemistry (2000) by Nelson D.L. and Cox, M.M., 3<sup>rd</sup> Edition, Worth Publishers.

6. Stryer, 2002, Biochemistry, 5<sup>th</sup> Edition, W.H. Freeman and Co.
7. Robert Weaver, 1999, Molecular Biology, 1<sup>st</sup> Edition. WCB –Mc Graw Hill.
8. Glick and Pasternak, 2001, Molecular Biotechnology Principles and Applications of Recombinant DNA, ASM Press.
9. Watson Gilman, Recombinant DNA, Scientific American Books.
10. James D Watson, A Passion for DNA Genes, Genomes and Society, CSHL Press.
11. Cooper, Cell and Molecular Biology, ASM Press.
12. David Freifelder, 2008, Molecular Biology, 2<sup>nd</sup> Edition, Narosa Publishing House.

## **MB 302: MEDICAL MICROBIOLOGY**

### **Course Outcomes**

- CO1: Acquiring basic knowledge of host- microbe interactions  
 CO2: Understanding diseases and their persistence in populations  
 CO3: Perceiving the biology of vectors and their role in disease transmission  
 CO4: Enlisting diseases of public significance, their prevention and control.  
 CO6: Gaining insights into Epidemiological studies, Herd immunity and Notifiable diseases

### **Programme Specific Outcomes**

- PSO1: Enumerating the diseases caused by Bacteria, Fungi, Protozoa, Helminths and Viruses  
 PSO2: Understanding the pathogenesis of medically significant diseases  
 PSO3: Emphasizing the importance of etiology of diseases  
 PSO4: Identifying the portals of entry and exit in disease transmission  
 PSO5: Developing insights into Sexually transmitted diseases

## **Course Structure**

### **UNIT-I**

Normal microbial flora of human body, host microbe interactions, Koch's Postulates. Infection and infection process- routes of transmission of microbes in the body. Reservoirs of Infection. Methods of transmission and role of vectors- biology of vectors. (1) House fly (2) Mosquitoes (3) sand fly. Epidemiological studies- Diseases in population, Portals of Entry and Exit, Herd Immunity, Control of Disease transmission . Notifiable diseases.

### **UNIT-II**

Morphology, cultural characteristics, antigenic structure, pathogenicity, clinical symptoms, laboratory diagnosis, prevention-control and treatment of diseases caused by Bacteria; Air borne infections: *Streptococci*, *Pneumococcus*, *Corynebacterium diphtheria*, *M. tuberculosis* *Haemophilus influenzae* and *N. meningitis*. Water borne infections: *E. coli*, *Salmonella*, *Shigella*, *Vibrio cholera*. Wound infections: *Clostridium tetani*, *Staphylococci*, *Proteus vulgaris* *Pseudomonas*. Sexually transmitted diseases: *Treponema*, *Neisseria gonorrhoea*, Nosocomial Infections- *Klebsiella*.

### **UNIT-III**

Morphology, cultural characteristics, antigenic structure, pathogenicity, clinical symptoms, laboratory diagnosis, prevention-control and treatment of diseases caused by Fungi- Opportunistic mycosis- *Aspergillus*, *Penicillium*, *Candida*, *Cryptococcus* Dermatophytosis- *Microsporum*, *Trichophyton* and *Epidermophyton*). Subcutaneous-, *Rhinosporidium*, Systemic Mycosis- Mucormycosis, Blastomycosis

#### **UNIT-IV**

Morphology, cultural characteristics, antigenic structure, pathogenicity, clinical symptoms, laboratory diagnosis, prevention-control and treatment of diseases caused by Hemoflagellates; *Leishmania donovani*, *L.tropica*, *Trypanosoma gambiense*. Intestinal flagellates; *Trichomonas*, *Giardia*, *Entamoeba histolytica*. Malarial parasites- *Plasmodium*, Helminthes; *Ascaris lumbricoides*, Hook worm, pinworm, Filarial parasites- *Wuchereria bancrofti*.

#### **UNIT-V**

Study of etiology, cultivation, antigenic structure, pathogenesis, laboratory diagnosis, prevention and treatment of a. Airborne infections: Influenza virus, Rhinovirus, Adenovirus, Mumps, Measles. Water borne, contact and sexually transmitted diseases: Poliovirus, HBV, HSV and HIV. Zoonotic viral infections: Rabies virus, Oncoviruses-HPV.

#### **Learning Outcomes**

LO1: Deep understanding of the microbial flora existing in humans

LO2: Gaining theoretical knowledge of most common medically significant organisms and the infections caused by them

LO3: Enumerating the methods and vehicles of disease transmission

LO4: Understanding the disease cycles and their out breaks

LO5: Systematic knowledge on the pathogenesis and laboratory diagnosis of diseases

LO6: Distinguishing nosocomial and zoonotic diseases with specific type studies

#### **RECOMMENDED BOOKS FOR MB 302:**

1. MIMS, Play Fair, Roitt & Mosby, Medical Microbiology, Publishers, 2<sup>nd</sup> edition.
2. Elmer R.Noble & Lea & Fibiger, Parasitology, Publishers, 5<sup>th</sup> edition.
3. D.O. White & F.J. Fenner, 1994, Medical Virology, Academic press, 4<sup>th</sup> Edition.
4. Melnick, Medical Microbiology.
5. Ananthanarayan, C.K.J.Panikar, Textbook of Microbiology, Oreint Longman Ltd., 2000, 6<sup>th</sup> Edition.
6. Mackie & Mc. Cautrey: Practical Medical Microbiology (14<sup>th</sup> Edition), edited by J.G.Gollée, Published by: Churchill Livingstone.
7. Subish.C.Panija, Textbook of Medical Parasitology, published by 'All India Publishers and distributors'.
8. C.K.Jaya Ram Paniker, Textbook of Medical Parasitology, Published by 'Jaypee Brothers', 4<sup>th</sup> Edition.
9. Coloratlas, Textbook of Diagnostic Microbiology (5<sup>th</sup> Edition), edited by Eimer.W. Koneman, published by Lippinett.
10. Mosby, Diagnostic Microbiology by Bailey and Swotts, 10<sup>th</sup> Edition, published.
11. David Greenwood, Richard C.B.Slack, John.F.Peutherer, Medical Microbiology, 16<sup>th</sup> Edition.
12. J.B.Sharma, Medical Microbiology – A Clinical perspective, paras publishing.
13. Patrick R.Murray, Ken.S.Rosenthal, George.S.Kobayashi, Michael A. Ptaller, Medical Microbiology, 3<sup>rd</sup> Edition.
14. Jawetz, Melnick and Adelberg's, Medical Microbiology (2004) 23<sup>rd</sup> Edition, Mc Graw Hill.

15. W.B. Hugo & A.P. Russell, Pharmaceutical Microbiology edited, 7<sup>th</sup> edition, Blackwell science.

## **MB 303: BIOSTATISTICS & BIOINFORMATICS**

### **Course Outcomes**

- CO1: Imparting basic knowledge of biostatistics and tools employed for quantitative analysis  
CO2: Gaining in depth knowledge on principles of Probability  
CO3: Understanding the concepts of genomics, proteomics and transcriptomics  
CO4: Developing modules predicting the protein secondary structure  
CO5: Emphasizing the ability to modify gene and protein structures in simulated systems

### **Programme Specific Outcomes**

- PSO1: Providing an overview of various bioinformatics tools, databases and sequence analysis  
PSO2: Gaining practice on statistical problems on mean, median, mode, standard deviation  
PSO3: Developing the concepts of World Wide Web and internet  
PSO4: Insights into peptide finger printing and fragment assembly  
PSO5: Understanding the molecular dynamics in protein structure prediction

## **Course Structure**

### **UNIT-I**

Biostatistics: Measures of Central tendency and distribution – mean, median, mode, range, standard deviation, variance. Basic principles of Probability theory, Bayes theorem, Normal distribution, Statistical inference – Types of errors and levels of significance. Comparison of variance (F-test), t-test for comparison of means, Chi square test. Analysis of variance (ANOVA) One way and two way. Correlation and Linear regression analysis.

### **UNIT-II**

Introduction to Bioinformatics and internet: Origin of Bioinformatics, Branches of Bioinformatics: Genomics, Proteomics, Transcriptomics. Scope of Bioinformatics. Introduction to Markov and hidden Markov models. Introduction to biological databases: NCBI, EMBL, EXPASY, PIR, Pfam. Concept of World Wide Web: HTML, HTTP. Similarity measures - Euclidean, Mahalanobis distance, Edit distance. Similarity matrices (PAM, BLOSUM)

### **UNIT-III**

Searching sequence databases using BLAST and FASTA. Pairwise sequence alignment using dynamic programming - global alignment by Needleman – Wunsch algorithms & local alignment by Smith – Waterman algorithms. Multiple sequence alignment – progressive alignment method and multidimensional dynamic programming.

### **UNIT-IV**

Molecular phylogenetics: Construction of Phylogenetic trees using maximum parsimony method and branch & bound method. Clustering methods – UPGMA, neighbor-joining and Maximum parsimony methods. Analysis of gene expression data by clustering (Agglomerative & Divisive). Gene prediction – Statistical based approaches and Similarity

based approaches, Genome annotation. Fragment Assembly, peptide sequencing using mass and spectroscopy data. Comparative genomics.

#### **UNIT-IV**

Modeling: Protein secondary structure prediction – Chou Fasman rules – neural networks – discriminant analysis. Prediction of transmembrane segments in membrane proteins. Protein 3D structure prediction – homology – threading – potential energy functions – energy minimization – molecular dynamics – simulated annealing.

#### **Learning Outcomes**

LO1: Insights into statistical approaches such as ANOVA, F-test, T-tests and Chi square tests.

LO2: Developing an overview on searching and alignment of biological databases

LO3: Understanding the genome annotation and algorithms of gene prediction

LO4: Construction of phylogenetic trees using clustering methods

LO5: Perception of 3D models of protein structure predictions

#### **RECOMMENDED BOOKS FOR MB 303:**

1. Daniel, 2006, Biostatistics, Eighth Edition. John Wiley and sons.
2. Durbin, Eddy, Krogh, Mathison, Biological sequence analysis.
3. T.A. Attwood and D.J. Parry – Smith, 2001, Introduction of Bioinformatics.
4. A.D. Baxevanis, 1998, Bioinformatics: A practical guide to the analysis of genes and proteins, (Edited) B.F. Publication.
5. David W, 2005, Bio-informatics ; sequence and Genome Analysis, 2<sup>nd</sup> Edition by Mount CBS publishers

#### **MB 304: MOLECULAR BIOTECHNOLOGY**

#### **Course Outcomes**

CO1: Enumerating the versatile tools and techniques employed in rDNA technology

CO2: Familiarizing with the cloning strategies and gene expression analysis

CO3: Enlisting the enzymes and their functions constituting genetic tool kit

CO4: Developing basic insights into nanotechnology, their synthesis and applications

CO5: Emphasizing on nucleic acid probe technology and their applications

#### **Programme Specific Outcomes**

PSO1: Gaining insights into the techniques of rDNA technology

PSO2: Perception of the expression of cloned genes in prokaryotic and eukaryotic host systems

PSO3: Understanding the screening of recombinants as well the expression of cloned genes

PSO4: Emphasizing the structural and functional analysis of recombinants

PSO5: Developing acumen into the synthesis of nanoparticles and therapeutic importance

### **Course Structure**

#### **UNIT-I**

r-DNA technology- Isolation of nucleic acids, DNA sequencing, Maxam-Gilbert and Di-deoxy methods, Pyrosequencing. Restriction endonucleases and other enzymes involved in rDNA technology. Southern, Northern blotting and western blotting, Dot Blotting. DNA finger printing, PCR- principle, types, application.

## **UNIT-II**

Cloning vectors- Plasmids, Cosmids and bacteriophages. Ligases- DNA ligases, ligation of fragments with cohesive ends & blunt ends; homopolymer tailing, Cloning strategies – shot gun experiments, gene libraries. Isolation of poly mRNA, synthesis of c-DNA, cloning of c-DNA in bacteria. Isolation of cloned genes, identification of recombinants-Insertion inactivation and Blue and white selection.

## **UNIT-III**

Gene transfer strategies: Transformation, microinjection, Ballistic Gun Method, Electroporation, Liposome mediated Gene Transfer. Gene expression- expression of cloned genes in bacteria, yeast, plant and animal cells. Application of recombinant DNA technology in Agriculture, Medicine and Industry. Gene therapy and genetic diseases- strategies for gene therapy- in vivo and ex vivo therapies. Gene delivery strategies: viral vectors and liposomes their advantages and disadvantages. Future prospects of gene therapy.

## **UNIT-IV**

Nanotechnology: Basic Principle and Applications: Synthesis of nanomaterials by physical and chemical methods, Synthesis of nanomaterials by biological methods using Bacteria, algae, and plant extracts. Biosensors. Nanomedicine and Cancer diagnostics and therapy, Nanotechnology in tissue engineering, Nano artificial cells, Nanotechnology in organ printing.

## **UNIT-V**

Nucleic acid probe technology, DNA micro array – printing of oligonucleotides and PCR products on glass slides, nitrocellulose paper. Whole genome analysis for global patterns of gene expression using fluorescent-labelled c-DNA or end labelled RNA probes. Analysis of single nucleotide polymorphisms using DNA chips. Protein micro array, advantages and disadvantages of DNA and protein micro arrays.

### **Learning Outcomes**

- LO1: Developing sound knowledge on procedural repertoire and strategies in gene cloning
- LO2: Enumerating the applications of genetic engineering in basic and applied biology
- LO3: Computing the applications of nanomedicine in cancer biology
- LO4: Understanding the genetically inherited disorders and gene therapy
- LO5: Acquiring deep insights into DNA and protein microarray techniques

### **RECOMMENDED BOOKS FOR MB 304:**

1. Glick & Palturah, 2003, Molecular Biotechnology, 3<sup>rd</sup> Edition.
2. Primrose, Modern Biotechnology, Black well scientific publication Oxford.
3. Lodish et al., Molecular Cell Biology, Mac Millan education.
4. R.Twyman, Advanced Molecular Biology: A concise reference, Springer.

5. Old & Primrose, Principles of Gene Manipulation: An introduction to genetic engineering.
6. J.D. Watson et al., Recombinant DNA, Wiley scientific
7. J.M. Walker, Molecular Biology & Biotechnology, Royal Society of Chemistry.
8. H. Krenzer, Recombinant DNA & Biotechnology.
9. M. Schena, DNA micro arrays.
10. David Freifelder, 2008, Molecular Biology, 2<sup>nd</sup> Edition, Narosa Publishing House.
11. Watson, Molecular Biology of Gene.
12. Tampion & Tampion, Immobilized cells: Principles and Applications.
13. David Goodsell, Nanobiotechnology, John Wiley
14. Nalwa HS, 2005, Handbook of Nanostructured biomaterials and their applications in nanobiotechnology, American scientific publishers
15. Niemeyer CM & Mirkin CA, 2005, Nanobiotechnology, Wiley Interscience.

## **MBP 305: MOLECULAR BIOLOGY & MOLECULAR BIOTECHNOLOGY**

### **Course Outcomes**

- CO1: Understanding the various techniques of recombinant DNA technology  
 CO2: Learning the isolation of genomic and plasmid DNA  
 CO3: Acquiring skilled expertise in handling molecular biology kits  
 CO4: Synthesizing silver nanoparticles and characterizing spectroscopically  
 CO5: Carrying out antimicrobial activity of green synthesized AgNPs

### **Programme Specific Outcomes**

- PSO1: Developing laboratory skilled knowledge in molecular biology experiments  
 PSO2: Trained hands-on experience in PCR and blotting techniques  
 PSO3: Understanding the practical difficulties in managing laboratory reagents  
 PSO4: Practical handling of PCR and its troubleshooting technical expertise  
 PSO5: Handling the instruments in the lab with ease

### **Course Structure**

1. Isolation of genomic DNA (from bacteria/fungi/plants)
2. Isolation of plasmid DNA.
3. Isolation of RNA.
4. Restriction Enzyme digestion – ligation of lambda DNA.
5. Transformation and Induction of  $\beta$ -galactosidase in *E. coli*
6. Bacteriophage titration – Plaque forming Units (PFU)
7. Polymerase Chain Reaction (PCR).
8. Recovery of DNA from gels – Electro elution and extraction of DNA from low melting gels.
9. Southern blotting.
10. Problems on DNA characteristics.
11. Preparation of Nanosilver by Wet reduction method (Chemical using Neem Extract (plants) & Bacteria (Microbiological))
12. Characterisation of Nanosilver by UV spectrometry and microscopic methods
13. Antimicrobial effect of Ionic silver and Nanosilver prepared by above methods.

### **Learning Outcomes**

- LO1: Developing practical experience in extraction of DNA/RNA  
 LO2: Hands on experience in restriction digestion, gel electrophoresis and gel elutions

- LO3: Gaining skilled knowledge in performing Transformation and bacteriophage titration  
 LO4: Synthesizing nanoparticles and executing their antimicrobial properties  
 LO5: Working on problems related to DNA/RNA and their characterization

### RECOMMENDED BOOKS FOR MBP 305:

1. Sambrook and Russell, Molecular Cloning – A Laboratory Manual, 3<sup>rd</sup> Edition, Volumes I to III, CSHL Press.
2. Ausbel et al., 2000, Current Protocols in molecular biology.
3. Genome analysis, 2000, 4 volumes, ESHL Press.
4. David Goodsell, Nanobiotechnology, John Wiley
5. Handbook of Nanostructured biomaterials and their applications in nanobiotechnology
6. Nalwa HS, 2005, American scientific publishers
7. Niemeyer CM & Mirkin CA, 2005 Nanobiotechnology, Wiley Interscience.

### MBP 306: MEDICAL MICROBIOLOGY, BIOSTATISTICS AND BIOINFORMATICS

#### Course Outcomes

- CO1: Demonstrating culture dependent studies of microbes and their disease manifestations  
 CO2: Acquiring technical expertise in handling diagnostic kits  
 CO3: Providing hands-on experience to basic serological techniques  
 CO4: Imparting knowledge in basic tools and algorithms used in bioinformatics  
 CO5: Understanding Protein data bases and genome sequence analysis

#### Programme Specific Outcomes

- PSO1: Performing microbial isolation and biochemical characterization of biological samples  
 PSO2: Distinguishing the microorganisms by biochemical and cultural characterization  
 PSO3: Learning methods for antimicrobial susceptibility testing  
 PSO4: Skilled training in gene clustering and protein modelling  
 PSO5: Developing in-silico practice in handling bioinformatics tools

#### Course Structure

1. Preparation of different media used in diagnostics Microbiology(culture media/observation): Blood Agar, Chocolate Agar, Mannitol salt agar, Blair Parker medium, MacConkey agar, Lowenstein-Jensen medium, Wilson Blair Bismuth sulphite medium, Biochemical media: TSI, Laboratory examination of sputum: collection of sputum. Microbiological examination of sputum for pus cells and predominant bacteria. Ziehl-Neelson staining to detect AFB culturing the specimen.
2. Collection of throat swabs – culturing the specimen. Laboratory examination of pus and skin specimens for *staphylococcus aureus*, *streptococcus pyogenes* and *Pseudomonas aeruginosa*.
3. Examination of urine for pathogenic microorganisms –collection of urine, microscopic examination of urine, comparison of normal specimen with urinary tract infection sample. The Enterobacteriaceae – *Escherichia coli*, *Klebsiella pneumonia* and *proteus mirabilis*. Urine cultures, single colonies, seeding in peptone water and Christensen's urea medium. Examination of blood agar, nutrient agar and Mac conkey plate cultures.
4. Mycology – Laboratory diagnosis of fungal diseases. Direct microscopy – cultures using Sabouraud's Dextrose agar medium – Fungi pathogenic for humans –



Filamentous fungi, yeasts, yeast like fungi and dimorphic fungi. *Aspergillus niger*, *Nocardia*, *Candida albicans*.

5. Medical Parasitology – *E. histolytica*, *G. lamblia*, *Trypanosomas*, *Leishmania* and *Plasmodium* (Permanent Slide Observation)
6. Laboratory diagnosis of common helminthes infections (permanent slide observations of helminthes)
7. Microscopic studies of viruses infected materials (demonstration)
8. Examination of blood smear by Leishman stain for Malarial parasites
9. Serological Tests: Haemoglobin estimation, RBC Count, WBC Count, Bleeding time, Clotting time, Erythrocyte Sedimentation Rate (ESR), Packed Cell Volume (PCV)
10. Immunodiagnosics - Tridot test for HIV, Hepatic test for HBV,
11. Use of Internet/software for sequence analysis of nucleotides and proteins: Studies of public domain databases for nucleic acid and protein sequences.
12. Determination of protein structure (PDB).
13. Genome sequence analysis
14. Problems related to measures of central tendency, dispersion, t-test and chi square test.

### Learning Outcomes

LO1: Technical expertise in isolation and identification of microbes from biological fluids

LO2: Hands on experience on serological diagnosis of HIV and Hepatitis

LO3: Practical knowledge on blood profiling protocols

LO4: Demonstrating the Insilco analysis for genome annotation and gene prediction

LO6: Working on problems related to measures of central tendency, t-test and chi square test

### RECOMMENDED BOOKS FOR MBP 306:

1. Mackie, Practical Medical Microbiology.
2. Cruichshank et al. Practical Medical Microbiology Vol-II.
3. J.G.Cappucinno and H.Sherman, Microbiology: A laboratory manual, 4<sup>th</sup> Edition.
4. K.R.Aneja, Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom cultivation, 3<sup>rd</sup> Edition.
5. Alcamo, Laboratory Manual in Microbiology.
6. Bailey and Scott, Diagnostic Microbiology.
7. Cruickshank et al., Medical Microbiology, Vol I & II
8. Monica Cheesbrough, Medical laboratory Manual for tropical countries Vol I & II.
9. Mitchal hasking , Virological Procedures.
10. Wilson and Topley, Virology.
11. Baxevanis, Bioinformatics-A Practical Guide to the Analysis of Genes and Proteins. 2<sup>nd</sup> Edition.
12. Higgs, Bioinformatics: Sequence, structure and Data Bank: A Practical Approach.
13. Misener, Bioformatics Methods and Protocols.
14. [www.geneprot.com](http://www.geneprot.com); [www.hybrigenis.com](http://www.hybrigenis.com); [www.mdsprotemics.com](http://www.mdsprotemics.com); [www.stromix.com](http://www.stromix.com); [www.syrx.com](http://www.syrx.com).

**MODEL QUESTION PAPER**  
**THIRD SEMESTER**

**SMB 301: MOLECULAR BIOLOGY**

**Time: Three Hours**

**(16X5=80)**

**Maximum marks-80**

**Answer one question from each Unit**  
**All questions carry equal marks**

**UNIT-I**

- 1.(a) Explain the experiments that proved DNA as the genetic material
- (b) Write notes on Overlapping genes and jumping genes

**OR**

- 2 (a). Describe the chromosomal changes induced by Carcinogens  
(b). Explain the Modern concept of gene structure

UNIT-II

3. (a) Explain the Mechanism of replication in prokaryotes  
(b) Write notes on Prokaryotic and Eukaryotic promoters  
OR

- 4.(a). Discuss about the Enzymes and Proteins involved in replication  
(b) Write notes on Posttranscriptional modifications

UNIT-III

5. (a) Explain the Deciphering of the genetic code  
(b) Write notes on stop and start codons

OR

6. (a). Explain the redundancy of the genetic code  
(b). Explain the decoding of genetic code

UNIT-IV

7. (a) Explain the mechanism of Protein synthesis  
(b) Describe the Post translational processing of proteins  
OR

- 8.(a) Explain the mechanism of protein translocation  
(b) Discuss the role of RNA in protein synthesis.

UNIT-V

- 9.(a). Describe the Regulation of lac operon  
(b) write notes on attenuation and lambda operon  
OR

- 10.(a) Describe the Regulation of tryptophan operon  
(b) Explain the Regulation of nif operon

**MODEL QUESTION PAPER**  
**THIRD SEMESTER**

SMB 302: MEDICAL MICROBIOLOGY

Time: Three Hours

Maximum marks-80 (16X5=80)

**Answer one question from each Unit**  
**All questions carry equal marks**

UNIT-I

- 1.(a) Discuss the Normal microbial flora of human body  
(b) Give an account on the host microbe interactions

OR

- 2 (a). Give an account on Diseases in population and notifiable diseases

(b). Write notes on Herd Immunity and Control of Disease transmission

#### UNIT-II

3. (a) Explain the pathogenesis of tuberculosis in detail

(b) Discuss the diseases caused by *Shigella* and *Vibrio cholera*

OR

4.(a). Describe the sexually transmitted diseases with suitable examples

(b) Write notes on the Nosocomial Infections with *Klebsiella* as type study

#### UNIT-III

5. (a) Write an essay on Dermatophytosis

(b) Explain the super infections caused by *Aspergillus*

OR

6. (a). Give an account on blastomycosis

(b). Write notes on Sub-cutaneous fungal infection

#### UNIT-IV

7. (a) Discuss the diseases caused by *Leishmania*

(b) Give an account on *Entamoeba histolytica*

OR

8.(a) Discuss the pathogenesis of malarial parasites

(b) Write notes on diseases caused by hook worm and pin worm

#### UNIT-V

9(a). Discuss the diseases caused by Influenza virus and Rhinovirus

(b) Explain the pathogenesis of HIV

OR

10.(a) Give an account on Zoonotic viral infections with Rabies virus as example

(b) Write notes on HPV

## MODEL QUESTION PAPER THIRD SEMESTER

SMB 303:BIOSTATISTICS & BIOINFORMATICS

Time: Three Hours

Maximum marks-80 (16 X

5=80)

**Answer one question from each Unit  
All questions carry equal marks**

#### UNIT-I

1) a) Discuss the mean, median and mode in measures of central tendency

b) Explain the correlation and linear regression

(Or)

2) a) Describe the steps involved in one-way ANOVA

b) Write an account of the basic principles of probability theory

#### UNIT-II

- 3) a) Describe the applications of NCBI and PIR  
b) Write the concept of HTTP and HTML file system

(Or)

- 4) a) Give an account of similarity measures  
b) Explain the scope of bioinformatics

#### UNIT-III

- 5) a) Describe the pairwise alignment by Needleman-Wunsch algorithm  
b) Write the types and applications of BLAST search

(Or)

- 6) a) Write the series of steps involved in the progressive alignment  
b) Discuss the utility of Smith- Waterman algorithm in local alignment

#### UNIT-IV

- 7) a) Describe the phylogenetic tree construction by UPGMA method

b) Write the analysis of gene expression by agglomerative clustering method

(Or)

- 8) a) Explain the similarity-based approaches for gene prediction  
b) Write short notes on fragment assembly

#### UNIT-V

- 9) a) Discuss the protein secondary structure prediction  
b) Give an account of molecular dynamics on proteins

(Or)

- 10) a) Describe the protein 3D structure prediction  
b) Explain briefly the membrane protein prediction methods

## **MODEL QUESTION PAPER**

### **THIRD SEMESTER**

SMB 304: MOLECULAR BIOTECHNOLOGY

Time: Three Hours

(16X5=80)

Maximum marks-80

**Answer one question from each Unit**  
**All questions carry equal marks**

#### UNIT-I

- 1.(a) Discuss the techniques involved in isolation of nucleic acids  
(b) Give an account on southern blotting and its applications

OR

- 2 (a). Give an account on types of PCR  
(b). Write notes on DNA Fingerprinting

#### UNIT-II

3. (a) Give an account plasmid as cloning vectors  
(b) Discuss the ligases and methods of ligation  
OR

- 4.(a). Describe the construction of cDNA library  
(b) Write notes on the blue-white screening method

#### UNIT-III

5. (a) Write an essay on methods of gene transfer  
(b) Explain the yeast expression system

OR

6. (a). Give an account on gene therapy  
(b). Write notes on applications of rDNA technology in agriculture

#### UNIT-IV

7. (a) Discuss the applications of nanotechnology  
(b) Explain the synthesis of nanomaterials by biological methods  
OR

- 8.(a) Discuss the exploitation of nanotechnology in tissue engineering,  
(b) Write notes on Nanotechnology in organ printing

#### UNIT-V

- 9(a). Discuss the principle of DNA microarray technique  
(b) Describe fluorescent-labelled c-DNA and end labelled RNA probes  
OR

- 10.(a) Give an account on the technique of Protein micro array  
(b) Discuss the advantages and disadvantages of protein micro arrays.

## IV SEMESTER

### MB 401: FERMENTATION TECHNOLOGY & INDUSTRIAL MICROBIOLOGY

#### Course Outcomes

CO1: Imparting knowledge on the exploitation of microbes in Fermentation technology

CO2: Emphasizing the steps involved in downstream processing

CO3: Enumerating the role of micro-organism in production of organic acids, alcohols, wine, vinegar, enzymes, vitamins, antibiotics, amino-acids and steroids.

CO4: Gaining deep insights into biofilms, biosurfactants, biofuels and bioleaching agents

CO5: Developing knowledge on the design of digesters and their applications

#### Programme Specific Outcomes

PSO1: Understanding the design of bioreactors and media formulations in fermentation technology

PSO2: Developing new Standard operating procedures for enhanced production and product recovery

PSO3: Perceiving the steps involved in the industrial production of antibiotics

PSO4: Insights into thermophilic and methanogenic archaeobacteria in oil fields instituting Petroleum Microbiology

PSO5: Enlisting the industrially important microbial products

## **Course Structure**

### **UNIT-I**

An introduction to fermentation processes – the range of fermentation processes. Microorganisms used in industrial microbiological processes – isolation, maintenance and strain improvement of industrially important microorganisms, screening methods, isolation of autotrophic mutants. Media and materials required for industrial microbiological processes, Antifoams and medium optimization.

### **UNIT-II**

Microbial growth kinetics, batch culture, continuous culture, fed batch culture and Dual or multiple fermentations. Inoculum development for large-scale processes. Design of fermentor: Construction and maintenance of aseptic conditions. Control of various parameters. Sterilization of media and Containment facility. Types of fermentors and fermentations. Computer application in fermentation technology. Recovery and purification of fermentation products (downstream process). Fermentation Economics.

### **Unit-III**

Industrial Production of Enzymes – amylases, Proteases, organic acids- lactic acid, citric acid, vinegar, amino acids – L-lysine, L-glutamic acid; Food supplements and hormones. Production of Vitamin B<sub>12</sub>. Production of antibiotics – Penicillin, Streptomycin, Erythromycin, bacitracin and tetracycline. Analytical Microbiology – Microbiological assays of Vitamins (Riboflavin, B<sub>12</sub>), amino acids (lysine, tryptophan). Assay of antibiotics – Penicillin, Streptomycin.

### **UNIT-IV**

Production of ethyl alcohol, beer & wine. Biofilms, biosurfactants, Biotransformation with reference to steroids and non-steroids, Petroleum Microbiology- sulphatereducing bacteria, Hyperthermophilic and methanogenic archaea in oil fields, fermentative, ironreducing and nitrate-reducing microorganisms. Microbial leaching- role of microorganisms in the recovery of minerals (uranium, copper) from ores.

### **UNIT-V**

Microbial products (antibiotics, and recombinant proteins) from genetically modified (cloned) organisms, Insulin Production. Biogas Production-Microbial groups involved in biogas production, design of digesters, Advantages and disadvantages. Biofuels: Hydrogen, Methane.

## **Learning Outcomes**

- LO1: Understanding the industrial production and purification of organic acids, alcohols, wine and vinegar
- LO2: Learning microbial growth and product formation kinetics in fermentation technology
- LO3: Developing techniques of sterilization, isolation, preservation and improvement of industrially important micro-organisms
- LO4: Perception of microorganism's role in biotransformation and leaching mechanisms
- LO5: Emphasizing the exploitation of microbes in biogas and biofuels production as small-scale industry

### **RECOMMENDED BOOKS FOR MB 401:**

1. Pandey, Solid State fermentation in Biotechnology.
2. Waiter, Industrial Microbiology.
3. Mansi, Fermentation Microbiology and Biotechnology.
4. Patel, 2008, Industrial Microbiology.
5. Greger, Biotechnology: A text book of Industrial Microbiology.
6. Whitaker. (Stanbury), 1997, Principles of Fermentation technology, 2<sup>nd</sup> Edition.
7. Prescott & Dunn, 1982, Industrial Microbiology, 4<sup>th</sup> Edition., AVI publishing company
8. J.H. Pepler & D. Perlman, Microbial Technology.
9. L.E.Casida., 2007, Industrial Microbiology, New age International
10. B.M. Miller & W.Litsky, Industrial Microbiology.
11. Rose, Economic Microbiology, Vol-I to V.
12. Ed.Permann, Advances in Applied Microbiology, Series of volumes.

## **MB 402: ENVIRONMENTAL MICROBIOLOGY**

### **Course Outcomes**

- CO1: Providing basic understanding of microbial diversity in the environment
- CO2: Developing insights into concept and components of ecosystem
- CO3: Perceiving microbial interactions with chemical pollutants in the environment
- CO4: Gaining deep insights into soil microbiology, aquatic and aero microbiology
- CO5: Enumerating the effects of chemical pollutants in the environment

### **Programme Specific Outcomes**

- PSO1: Understanding the intricacies of the ecosystem
- PSO2: Emphasizing the microbiology of Air and water
- PSO3: Acquiring familiarity on Environmental impact assessment studies
- PSO4: Gaining theoretical knowledge in microbial waste management and recycling
- PSO5: Developing cognizance in biomagnification, biofouling and Bioremediation processes.

### **Course Structure**

#### **UNIT-I**

Basic concepts of Ecology and Environment – Biological spectrum at levels of organization & realm of ecology. Ecosystem – Concept, components, food chains, food webs and trophic levels. Energy transfer efficiencies between trophic levels. Biological factors influencing the growth and survival of microorganisms- inter reactions of microbial population and community dynamics – Growth in closed environments and in open



environments. The kinetic properties of competition between microbial populations. Kinetic principles of Preypredator relationship.

## **UNIT-II**

Microbiology of Air: Air borne microbes and their reservoirs, Bioaerosols, Dispersal of airborne microorganisms. Air Sampling principles and techniques- Slit samples, cascade impactor, hirst trap, Anderson's air sampler, vertical cylinder trap, Burkard trap. Air spora: Concepts and components, indoor and outdoor air spora. Vertical profiles. Air sanitation- Control of air borne pathogens, irradiation, chemical disinfection, dust control.

## **Unit-III**

Microbiology of Water: Aquatic environment: Fresh water microorganisms, their zonation and characteristics. Salt water, oceans, estuaries, microorganism their zonation and characteristics. Faecal pollution of waters – water borne diseases, indicator organisms. IMVIC test, Determination of water potability by MPN and sanitary examination.

## **UNIT-IV**

Microorganisms and chemical pollutants: methyl mercury, trimethyl arsine, hydrogen sulphide, acid rain water, carbon monoxide, ammonia, nitrate, nitrogen oxides, nitrosamines, Eutrophication, algal toxins. Microorganisms and sewage treatment: COD, BOD & DO, trickling filters, activated sludge process, oxidation ponds; sludge treatment (anaerobic digestion).

## **UNIT-V**

Bio-magnification and Bioremediation Technology – Microbial degradation of oil spills, pesticides and detergents, Biofouling; Bioplastics PHB, PHA. Fate of genetically engineered microorganisms in the environment. Environmental impact assessment studies. Deterioration of materials – paper, textiles, painted surfaces, prevention of microbial deterioration.

## **Learning Outcomes**

LO1: Understanding biological spectrum at levels of organization & realm of ecology

LO2: Perception of Energy transfer efficiencies between tropic levels

LO3: Insights into kinetic principles of Prey predator relationship.

LO4: Theoretical knowledge on Air sampling and air sanitation

LO5: Enumerating the role of microbes in degradation of oil spills, pesticides and detergents.

## **RECOMMENDED BOOKS FOR MB 402:**

1. B.N.Johri, 2000, Extremophiles, Springer Verlag, New York.
2. D.Cdwd, 1999, Microbial Diversity, Academic press.
3. C.J. Hurst, Manual at Environmental Microbiology, 2<sup>nd</sup> edition, Editor in Chief, 2002, ASM Press.
4. Atlas, RM & Barta, R, 1998, Microbial Ecology: Fundamentals and Applications,
5. Tilak, 1997, Aerobiology,
6. Ralph Mitechell, Environmental Microbiology.
7. Eweis, Bioremediation principles.
8. Buruage, Techniques in Microbial Ecology.
9. W.P. Grant and P.E. Long, 1981, Environmental Microbiology.

## **MB 403: FOOD MICROBIOLOGY & AGRICULTURAL MICROBIOLOGY**

### **Course Outcomes**

CO1: Providing the basics to the general principles of food microbiology

CO2: Developing insights towards types of microbial spoilage of foods

CO3: Enumerating the microbes as Probiotics, Prebiotics and Synbiotics

CO4: Comprehending the role of Microorganisms in biogeochemical cycles.

CO5: Acquiring theoretical knowledge on the mode of action of biofertilizers and biopesticides

### **Programme Specific Outcomes**

PSO1: Understanding the epidemiology of food borne microorganisms of public health significance

PSO2: Analysing the significance of microbiological quality control programmes in food production

PSO3: Acquiring insights towards microbial composition and sampling techniques

PSO4: Emphasizing the importance of biofertilizers and biopesticides over chemical methods

PSO5: Enlisting the various microbial groups employed as biocontrol agents

## **Course Structure**

### **UNIT-I**

Microbiology of foods – Microbial flora of fresh foods, grains, fruits, vegetables, milk, meat, eggs and fish and their infestation by bacteria, fungi and viruses. Identification of specific groups – Bacteria, Viruses, Fungi and Protozoa. Microbial spoilage of milk, food, types of spoilage organisms, food poisoning, mycotoxins and bacterial toxins.

### **UNIT-II**

Fermented foods – Preparation of Yogurt, Streptococcus species, *Lactobacillus bulgaricus*; Manufacture of cheese; *Penicillium roqueforti*. Fermented soybean products. Microorganisms as food – single cell protein, yeast, algae and fungal biomass production. Probiotics, Prebiotics and Synbiotics.

### **UNIT-III**

Food processing- Thermal processing, Chemical processing (Sugar, Salt, Smoke, acid and chemicals). Food preservation: Methods of food preservation, Aseptic handling, pasteurization, of milk, refrigeration and freezing, dehydration, osmotic pressure, chemicals – organic acids, nitrates, nitrites and cresols; Radiation – UV light,  $\gamma$ -irradiation.

### **UNIT-IV**

Soil Environment- Microorganisms, soil structure, soil profile, Physico-chemical conditions, Microbial composition, sampling techniques, Role of Microorganisms in organic matter decomposition (cellulose, Hemicellulose, Lignin's). Bio-geo chemical cycles – Carbon cycle, Nitrogen cycle – Nitrogen fixation, nitrification, denitrification, sulphur, iron and

phosphorus cycles. Rhizosphere – Rhizosphere Microorganisms, Bio chelators (Siderophores).

#### **UNIT-V**

Biofertilizers – Introduction, biofertilizers using nitrogen fixing microbes – Phosphate solubilization- *Rhizobium*, *Bradyrhizobium*, *Azotobacter*, *Azospirillum*, *Azolla*; Anabaena Symbiosis, Blue green algae, Mycorrhiza, Biopesticides – toxins from *Bacillus thuringiensis*, *Pseudomonas syringae*, Use of Baculovirus, NPV virus, Protozoa & Fungi as biological control agents.

#### **Learning Outcomes**

LO1: Understanding food spoilage microorganisms; the microbiology of food preservation and food commodities; fermented and microbial foods

LO2: Developing principles and methods for the microbiological examination and preservation of foods

LO3: Emphasizing the role of microbes in maintaining soil profile and fertility

LO4: Insights into the role of microorganisms in decomposition of cellulose, hemicellulose and lignin's

LO5: Enumerating the various classes of microbes employed as biofertilizers and biocontrol agents

#### **RECOMMENDED BOOKS FOR MB 403:**

1. M.P. Dayle et al, 2001, Food Microbiology: Fundamentals & Frontiers, 2<sup>nd</sup> edition, ASM press.
2. Adams, M.R. and Moss M.O. 1995, Food Microbiology, Royal Society of Chemistry Publication, Cambridge.
3. Frazier W.C. and West haff D.C, 1988, Food Microbiology, Tata Mc.Graw Hill Publishing Company Limited, New Delhi.
4. Stantury, P.F., Whitekar, A. and Hall, S.J., 1995, Principles of Fermentation Technology.
5. Banwart, GJ, 1989, Basic Food Microbiology, CBS Publishers and Distributors, Delhi
6. Hobbs BC and Roberts.D, 1993, Food Poisoning and Food Hygiene, Edward Arnold (A division at Hodder and Strong hton) London.
7. G.Rangaswamy and Bagyaraj, Agricultural Microbiology, Prentice Hall India.
8. N.S. Subba Rao, 1995, Bio-fertilizers in Agriculture and Forestry.
9. N.S. Subba Rao, 1995, Soil Microbiology and Plant Growth.

#### **MB 404: PHARMACEUTICAL MICROBIOLOGY**

##### **Course Outcomes**

CO1: Understanding the classification and mode of action of antibiotics

CO2: Acquiring basic knowledge on the rules and regulations of GMP and GLP

CO3: Emphasizing the types of IPRs and their management

CO4: Gaining insights into microbial testing in pharma industry

CO5: Enumerating the role of microorganisms in the pharmaceutical industry

##### **Programme Specific Outcomes**

PSO1: Understanding the use and abuse of antibiotics and drug resistance

PSO2: Enlisting various chemical as possible antimicrobials  
PSO3: Enumerating the rules and regulations of WHO, ISO and US FDA  
PSO4: Emphasizing the hierarchical tiers of quality management in pharma industry  
PSO5: Perceiving the impact of Patenting biotechnological inventions and ELSI

## Course Structure

### UNIT-I

Antibiotics: General properties of antibiotics. Antibacterial-  $\beta$ -lactam antibiotics, Amino glycosidic antibiotics, Macrolides, Tetracyclines, Sulfonamides, Polypeptide and glycopeptide, Chloramphenicol. Antifungal- Nystatin, Griseofulvin, Amphotericin, Antiviral- Ribavirin, Acyclovir, Ganciclovir, AZT, Antiprotozoal and Anti helminthic agents. Mechanism of action of antibiotics – Bacterial cell wall, Cell membrane, Protein synthesis, Nucleic acid synthesis and antimetabolites- folate antagonism. Resistance- Mechanism of resistance against antibiotics.

### UNIT-II

Chemical Disinfectants, Antiseptics and Preservatives and their industrial significance. Factors affecting choice of antimicrobial agent. Phenols, Alcohols, Aldehydes, Halogens, Heavy metals, Quaternary Ammonium compounds, Sterilizing gases, Biguanides, Peroxide and Peroxygen compounds and other antimicrobials. Preservation of medicines using antimicrobial agents.

### UNIT-III

Good manufacturing and Good Laboratory practices, Regulatory aspects and Quality control, Quality assurance and Quality management in pharmaceuticals-ISO, WHO, US FDA, Documentation, Validation. Personal management, training, Personal Hygiene and Health.

### UNIT-IV

Intellectual Property Rights (IPR)- Types, Properties and Limitations (Trade Secret, Trade mark, Patents, Geographical indications, Designs, Copy Rights.). Management of IPRs, Advantages and Disadvantages. Patenting: Concept and its composition, Protection of right and their limitation, how to apply patents. Patenting biotechnology inventions and ELSI.

### UNIT-IV

Ecology of Microorganisms as it effects the pharmaceutical industry- Atmosphere, Water, Raw materials, Packaging, Buildings, Equipment's and others. Microbial Spoilage - Types and factors affecting spoilage. Control of microbial risk in medicines -Sterility tests, Microbial limit tests and endotoxin tests. Contamination of non-sterile pharmaceuticals in hospital & community environments.

### Learning Outcomes

LO1: Enlisting a wide range of chemicals employed as disinfectants, antiseptics and preservatives

LO2: Developing insights into the hierarchical systems of quality control, quality assurance and quality management tiers in pharma industry

LO3: Enumerating the various sterility tests practised in manufacture of sterile and non-sterile medicinal formulations

LO4: Perception of the properties and limitations of patents, trade secrets and copy rights

LO5: Emphasizing the types of microbial spoilage and their preventive measures

#### **RECOMMENDED BOOKS FOR MB 404:**

1. W.B. Hugo & A.D. Russell, Pharmaceutical Microbiology edited, 6<sup>th</sup> Edition, Black well science.
2. Shanson D.C., Microbiology in clinical practice, 2<sup>nd</sup> edition, London; Wright.
3. T Sammes Ellis Horwood, topics in Antibiotic chemistry Vol I to V.
4. Wulf Crueger, Biotechnology – A textbook of Industrial Microbiology, Panima publishers
5. A.H. Patel, 1984, Industrial Microbiology, Macmillan India Limited.
6. Coulson C.J., London; Taylor and Francis, Molecular mechanisms of drug action.
7. Denyes S.P. & Baird R.M. Chichester, Ellis Horwood, Guide to microbiological control in Pharmaceuticals.
8. Murray S. Cooper, Quality control in in the Pharmaceutical Industry- Edt., Vol- II, Academic press, New York.
9. Sydney H. Willin, Murray M. Tuckerman, William S. Hitchings IV, Good Manufacturing practices for pharmaceuticals, second Edt., Mercel Dekker NC Nework
10. Rajesh Bhatia, Rattan lal Ihhpunjani, Quality assurance in Microbiology, CBS Publisher & Distributors, New Delhi.

#### **MBP 405: INDUSTRIAL MICROBIOLOGY AND ENVIRONMENTAL MICROBIOLOGY**

##### **Course Outcomes**

- CO1: Providing exposure to design and run batch fermentation experiments  
CO2: Developing practical knowledge in production of acids and alcohols by fermentation  
CO3: Gaining skilled expertise in product recovery  
CO4: Estimating DO, COD and BOD of water samples  
CO5: Checking water potability with suitable procedures

##### **Programme Specific Outcomes**

- PSO1: Acquiring skilled training in the quantification of biological samples  
PSO2: Gaining expertise in handling fermenters with technical ease  
PSO3: Developing new approaches for production and recovery of fermented products  
PSO4: Understanding the adverse effects of pesticides on soil microbes  
PSO5: Estimating, characterizing and identification of air flora and soil flora

##### **Course Structure**

1. Production of citric acid by *A.niger*. Recovery & Fermentation.
2. Production of Ethanol by fermentation, recovery and estimation by dichromate method.
3. Preparation of Wine from grapes by fermentation.
4. Production of glutamic acid by fermentation.
5. Estimation of bacteria, actinomycetes and fungi in soil by dilution – Plating method.

6. Observation of air-borne microflora by petriplate exposure.
7. Effect of pesticides on soil microbes.
8. DO Estimation.
9. BOD Estimation.
10. COD Estimation
11. Determination of potability of drinking water by MPN & coliform test

### **Learning Outcomes**

- LO1: Hands on experience on preparation of wine by fermentation
- LO2: Practical insights on understanding the various parameters in downstream processing
- LO3: Developing skills towards advanced fermentation technology
- LO4: Technical expertise in air sanitation and environmental monitoring
- LO5: Performing qualitative analysis of water samples

### **RECOMMENDED BOOKS FOR MBP405:**

1. Srivastava, Handbook of milk Microbiology.
2. Demain, Manual of Industrial Microbiology and Biotechnology.
3. Aneja.,2001, Experiments in Microbiology, Plant Pathology, Tissue Culture & Mushroom production technology, 3rdEdition, New age international
4. Mc. Niel & L.H. Harvey, Fermentation: A practical Approach.
5. C.J. Hurst, Manual of Environmental Microbiology, 2<sup>nd</sup> Edition.
6. Burns & Slater, Experimental Microbial Ecology.
7. Pepler, Gerba & Brendecks, Environmental Microbiology: A Laboratory manual.

### **MBP 406: FOOD, AGRICULTURAL & PHARMACEUTICAL MICROBIOLOGY**

#### **Course Outcomes**

- CO1: Providing hands on experience on quality food testing
- CO2: Developing practical knowledge on microbiological quality testing
- CO3: Isolating and characterizing economically important microorganisms
- CO4: Acquiring skilled expertise in performing assays of antibiotics and vitamins
- CO5: Providing training in the preparation and evaluation of biofertilizers and biopesticides

#### **Programme Specific Outcomes**

- PSO1:Technical experience on isolation and characterization of microbes isolated from different food sources
- PSO2:Gainingproceduralacumens into antibiotic sensitivities towards test pathogens
- PSO3:Developing practical insights into microbiological assays
- PSO4:Designing experiments to produce biofertilizers and biopesticides with better efficiency
- PSO5: Extending outsourcing programmes on quality check analysis of food and water

### **Course Structure**

1. Microbiological examination of milk & milk products.
2. Determination of efficiency pasteurization by milk phosphatase test
2. Preparation of Yoghurt
3. Microbiological examination of fresh & canned foods.
4. Microbiological quality testing of milk by MBRT test and Resazurin test
5. Isolation of yeasts from grapes, observation of culture characteristics and morphology.
7. Isolation of *Rhizobium* from root nodules.
8. Isolation of *Azotobacter* from soil.
9. Microbiological Assay of antibiotics.
10. Microbiological Assay of Vitamin B<sub>12</sub>.
11. Preparation and observation/ evaluation of Bio-fertilizer
12. Preparation and observation/ evaluation of Biopesticide

### **Learning Outcomes**

- LO1: Developing skilled training in microbiological examination of fresh and canned foods  
LO2: Technical expertise in quality testing of milk and milk products  
LO3: Determining the microbial sensitivities of drugs on various test organisms  
LO4: Acquiring experience in isolation and culturing of *Rhizobium* and *Azotobacter*  
LO5: Gaining practical awareness in handling the equipment's in the laboratory.

### **RECOMMENDED BOOKS FOR MBP 406:**

1. Srivastava, Handbook of Milk Microbiology.
2. W.F. Harrigan, Laboratory methods in Food Microbiology.
3. C.J. Hurst, Manual of Environmental Microbiology, 2<sup>nd</sup> Edition.
4. Aneja, 2001, Experiments in Microbiology, Plant Pathology, Tissue Culture & Mushroom production Technology, 3<sup>rd</sup> Edition, New age international

## **MODEL QUESTION PAPER FOURTH SEMESTER**

**SMB 401: FERMENTATION TECHNOLOGY & INDUSTRIAL MICROBIOLOGY**

Time: Three Hours  
(16X5=80)

Maximum marks-80

**Answer one question from each Unit  
All questions carry equal marks**

**UNIT-I**

- 1.(a) Explain the range of fermentation processes  
(b) Explain the screening methods of industrially important microorganisms

OR

- 2 (a). Write about the strain improvement of industrially important microorganisms  
(b). Discuss the isolation of autotrophic mutants

**UNIT-II**

3. (a) Write about the types of fermentors  
(b) Describe Inoculum development for large-scale processes

OR

- 4.(a). Explain downstream processing  
(b) What is Fermentation Economics? Explain

**UNIT-III**

5. (a)Write about the Industrial Production of Enzymes – amylases, Proteases  
(b)Explain the Assay of antibiotic – Penicillin

OR

6. (a). Write the Industrial Production of Streptomycin  
(b). Explain the Microbiological assays of Vitamin B<sub>12</sub>.

**UNIT-IV**

7. (a) Explain the Production of ethyl alcohol  
(b)Write notes on Biosurfactants and Biotransformation

OR

- 8.(a) Explain the industrial Production of beer  
(b)Describe the Microbial leaching of uranium

**UNIT-V**

- 9(a). Explain the production of recombinant proteins from genetically modified organisms.  
(b) Write an essay on Biogas Production

OR

- 10.(a)Explain the production of biofuels  
(b)Write notes on Insulin production from genetically modified organisms

**MODEL QUESTION PAPER  
FOURTH SEMESTER**



SMB 402: ENVIRONMENTAL MICROBIOLOGY

Time: Three Hours  
5=80)

Maximum marks-80 (16 X

**Answer one question from each Unit**  
**All questions carry equal marks**

UNIT-I

- 1) a) Explain the energy transfer efficiencies between the trophic levels  
b) Discuss briefly the kinetics of prey-predator relationship  
(Or)
- 2) a) Write an account of microbial interactions  
b) Explain the various types of food chains

UNIT-II

- 3) a) Describe the Burkard trap and Anderson air sampling techniques  
b) Write the concept and components of air spora  
(Or)
- 4) a) Discuss the various methods to control the air borne pathogens  
b) Explain the dispersal of air borne microorganisms

UNIT-III

- 5) a) Give an account of fresh water microorganisms and their zonation patterns  
b) Describe the MPN method for the assessment of water quality  
(Or)
- 6) a) Write the zonation pattern of marine water  
b) Discuss the various water borne diseases

UNIT-IV

- 7) a) Explain the secondary sewage treatment process  
b) Discuss the eutrophication process  
(Or)
- 8) a) Describe the microbial production of methyl mercury and carbon monoxide  
b) Write short notes on algal toxins

UNIT-V

- 9) a) Explain the microbial degradation of oil spills and detergents  
b) Give an account of microbial deterioration of paper and textiles  
(Or)
- 10) a) Write about the environment impact and assessment studies  
b) Discuss briefly on PHA and PHB

**MODEL QUESTION PAPER**  
**FOURTH SEMESTER**

**SMB 403: FOOD AND AGRICULTURE MICROBIOLOGY**

Time: Three Hours

Maximum marks-80

(16X5=80)

**Answer one question from each Unit  
All questions carry equal marks**

**UNIT-I**

- 1.a. Write about microbial flora of different types of foods
- b. Describe the Bacterial toxins in detail

OR

- 2.a. Write about microbial spoilage of milk
- b. Discuss about identification of specific groups of bacteria on foods

**UNIT-II**

- 3.a. Discuss in detail about preparation of Yogurt
- b. Write about probiotics and synbiotics

OR

- 4.a. Describe the Fermented soybean products in detail
- b. Write about microorganisms used in SCP production

**UNIT-III**

- 5.a. Explain about Chemical food processing
- b. Write about chemical food preservation methods

OR

- 6.a. Discuss in detail about food preservation by physical methods
- b. Write a note pasteurization of milk

**UNIT-IV**

- 7.a. Discuss in detail about structure, profile and Physico-chemical conditions of soil
- b. Write a note on carbon cycle

OR

- 8.a. Explain in detail about organic matter decomposition
- b. Describe the Rhizospheric microorganisms, effects and importance

**UNIT-V**

- 9.a. Discuss in detail about mycorrhiza and its importance
- b. Write about Baculovirus and NPV virus

OR

- 10.a. Explain in detail biopesticides with suitable examples
- b. Describe the Fungi as biological control agents.

# MODEL QUESTION PAPER

## FOURTH SEMESTER

SMB 404: PHARMACEUTICAL MICROBIOLOGY

Time: Three Hours  
(16X5=80)

Maximum marks-80

**Answer one question from each Unit**  
**All questions carry equal marks**

### UNIT-I

- 1.(a) Discuss the classification of  $\beta$ -lactam antibiotics  
(b) Give an account on the mode of action of antibiotics

OR

- 2 (a). Give an account on antifungal and antiviral drugs  
(b). Write notes on tetracyclines and chloramphenicol

### UNIT-II

3. (a) Give an account on phenols and aldehydes as disinfectants  
(b) Discuss the alcohols as preservatives

OR

- 4.(a). Discuss the halogens and QACs as antimicrobials  
(b) Write notes on the preservation of medicines using antimicrobial agents.

### UNIT-III

5. (a) Write an essay on the regulatory aspects of Quality management in pharmaceuticals  
(b) Discuss GMP procedures in pharma industry

OR

6. (a). Give an account on Documentation and validation  
(b). Write notes on Personal Hygiene and Health

### UNIT-IV

7. (a) Discuss the types of IPRs  
(b) Explain the management and applications of IPRs

OR

- 8.(a) What are patents  
(b) Write notes on how to apply patents

### UNIT-V

- 9(a). Discuss the Types of microbial spoilage  
(b) Explain the factors affecting microbial spoilage

OR

- 10.(a) Give an account on Sterility tests and Microbial limit tests

(b) LAL test