M.SC. MICROBIOLOGY
COLLEGE OF SCIENCE AND TECHNOLOGY
ANDHRA UNIVERSITY
VISAKHAPATNAM

(SYLLABUS EFFECTIVE FROM THE ACADEMIC YEAR 2020 - 2021)

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.

History of the Department

The Microbiology Department in Andhra University was started in 1999-2000 as a self-financing course by AUCST offering M. Sc and Ph. D programs. M.Sc. Microbiology follows Semester end examinations pattern as per UGC Model Curriculum.The faculty comprises a unique combination of basic researchers who are well-qualified and experienced with Doctorate degrees specialized in various arenas of applied Sciences. The Department of Microbiology has enjoyed sustained growth with an initial student intake of 24, that has gradually increased to 52 in the year 2019. The Department has 6 affiliated colleges in and around Visakhapatnam offering M.Sc. Microbiology with an average intake of 20-30 students in each college annually. International students from countries like Iran, Iraq, Ethiopia, UAE and Nepal are some of our alumni.

Mission

- The Department aims to develop competent and committed students with advanced level of communicative skills and attitude required to manageacademia-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 toenrol 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 multidisciplinaryresearch 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 6M.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, Pfizier, 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.

ANDHRA UNIVERSITY

M.SC. MICROBIOLOGY- SEMESTER SYSTEM (CBCS)

(**EFFECTIVEFROMTHEACADEMIC YEAR 2020 - 2021)**

SCHEMEOFINSTRUCTIONSANDEXAMINATION

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

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

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&MicrobialGenetics	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	MedicalMicrobiology	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	MedicalMicrobiology& 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 &AgricultureMicrobiology	20	80	32	4
MB404	PharmaceuticalMicrobiology	20	80	32	4
MBP405	Industrial Microbiology& Environmental Microbiology	20	80	40	4
MBP406	Food, Agriculture &PharmaceuticalMicrobiology	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 $^{1/2}$)	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 phototropic 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_2 liberated O_2 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 Phycobolisomes.Ultra structure, Morphology and Characterization of Archaebacteria, 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, Basidomycota, 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 andAcanthamoeba.*

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 (2nd 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 Eductional 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, 2nd edition.
19. D.E. Alcamo, Jones and Bartiett, Boston, Fundementals 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., 7th 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:Emphasizingbiological 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, Rhadboviridae, 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-arthopods, 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, Fundemental Virology, 4th edition, Lippiacott 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:Gainingconceptual 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 (Tm) 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, 4thedition, lSara Tenney pulishers
6. MARTIN, MAYER & RODWELL, Harper's Review of Biochemistry, Large medical publication
7. SMITH, HILL, LEHMAN, LEFKOWITZ, HANDLER & WHITE, Principles of Biochemistry: General aspects, 6th 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 workingsof 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 – contrastmicroscopy (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 andtransmission, 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, 5th 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 Methodor 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 redand Voges-Proskauer reactions, citrate utilization, starch and gelatin hydrolysis; H_2S 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 eggsYolksac, 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 falciparium, 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, 5th 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.Gunashekaran, 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_2 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 &VijayDeshpande – 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 Archaebacteria

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 Rhadboviridae 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, 4thedition, 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, 3rd edition, 1993, Pub. WM.C.Brown Publishers, Melbourne, Australia.
9. Biochemistry by Stryer.
10. Garrett and Grisham, 2005, Biochemistry, 3rd 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, 7th edition, 2008, Pub.Wm.C.Brown.

15. Lodish *et al.*, 1999, Molecular Cell Biology, 4th edition, WH.Greeman and company.
16. Stainer, 1958, General Microbiology, Macmillan educational Ltd., 5th 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, 4th 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, 27th edition, Pub. McGraw-Hill companies.
21. Cohn and Stumph, Principles of Biochemistry, 4th 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 thesignificance 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_3 and DAG. Mechanism of signal transduction-G protein signalling. Vascular trafficking- Clathrin coated vesicles, COP-I and COP-II coated vessicles

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 biochemicalaspects 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, 8th edition, Lippincott Williams & Wilkins.
2. Lodish & Baltimore, 2000, Molecular Cell Biology, 4th edition, Pub. W.H.Greeman and company.
3. Nicholas C. Price, Lewis Stevens, Fundamentals of Enzymology, 3rd edition, 2003, Pub. Oxford University Press.
4. Trevor Palmer, 2004, Enzymes, Biochemistry, Biotechnology, Clinical Chemistry, Pub. Harward Publishing Limited.

5. Lehninger, 2008, Biochemistry, 4th edition, Pub. W.H. Freeman and company.
6. Lehninger, Nelson and Cox, 2008, Principles of Biochemistry, 4th edition, Pub. W.H. Freeman and company.
7. Lubert Stryer, 2007, Biochemistry, 6th edition, Pub. W.H. Freeman and company.
8. Zubay, 1993, Biochemistry, 3rd edition, Pub. WM. C. Brown Co,,unition, Inc.
9. White Handler and Smith, 2004, Biochemistry, 6th edition, Pub. Tata McGraw-Hill Ltd.
10. Dixon and Webb, Enzymes, Acadamic 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 DNAPolymorphisms
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, intercalatingsubstances, mutator genes. Site directed mutagenesis, mutational hot spots, Reversion, secondsite 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 theSite 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. 4th 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,8th edition,.
4. Lodish & Baltimore, 2000, Molecular Cell Biology, 4th 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., 5th edition.
6. Stanley R. Maloy, John E Cronan Jr., 2001, Microbial Genetics, David Freifelder Jones and Bartleh Publishers Inc., 8th edition
7. Benjamin Lewin., Genes I– VII, 1st 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. 3rd edition, 2007.
10. Gardener, Genetics, 8th edition, Pub. John Wiley and sons, Inc, 1991.
11. Tamrin, 2002, Genetics, 7th edition, Pub. Tata McGraw-Hill Publishing company Ltd,.
12. Strickberger, Genetics, 3rd 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 immunologicaltechniques

RECOMMENDED BOOKS FOR MB 204:

1. Stewart, Immunology and Immunopathology, 8th edition, Churchill living stone.
2. Abul K. Abbas *et al.,* Cellular and Molecular Immunology, Elsvier publication.
3. Barret, 2005, Textbook of Immunology, 5th edition, Pub. Elsevier saunders Inc.
4. Roitt, Brostoff, Male, Essential Immunology, Harcourt Brace & Company (4th, 5th Edition), Mosby (6th Edition)
5. J.Kuby, Richard A. Goldsby, Thomas J. Kindt, Barbara A. Osborne, Immunology, 4th edition, Freeman & Company Mosby publishers. 2009.
6. Janeway and Travers, 1994, Immunobiology – The immune system in Health disease.
7. Tizard, 1995, Immunology – An introduction, 4th edition, Pub. Saunders college publishing.
8. Unani and Benacerraf, Text book of Imunology.
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: Developingtheoretical 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 andpectinase.
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 Km and *Vmax* 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:Developingdeep 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 Ciocalteau 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 ofbiosamples
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, 1st 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 thetetrad 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 compliment 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 andImmunosuppression

(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: Enumeratingthesteps 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, 3rd 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, 1st Edition WCB –Mc Graw Hill.
4. Lodith.H., Berk.A., Zipursky, S.I.Matsudira.P., Baltimore, D and Darnell. J, 2000, Molecular Cell Biology, 4th Edition, W.H. Truman & Co.
5. Lehinger: Principles of Biochemistry (2000) by Nelson D.L. and Cox, M.M., 3rd Edition, Worth Publishers.

6. Stryer, 2002, Biochemistry, 5th Edition, W.H. Freeman and Co.
7. Robert Weaver, 1999, Molecular Biology,1st 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, 2nd Edition, Narosa Publishing House.

MB 302: MEDICAL MICROBIOLOGY

Course Outcomes

CO1: Acquiring basic knowledge of host- microbe interactions
CO2: Understandingdiseases 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: Gaininginsights 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 treatmentof diseases caused by Bacteria; Air borne infections: *Streptococci,Pneumococcus, Corynebacterium diphtheria, M. tuberculosis Haemophilus influenzaeand N. meningitis*. Water borne infections: E. coli, *Salmonella, Shigella,Vibrio cholera*. Wound infections: Clostridium tetani, Staphylococci, *Proteus vulgarisPseudomonas.* Sexually transmitted diseases: *Treponema, Neisseriagonorrhea,*, Nosocomial Infections-*Klebsiella.,*

UNIT-III

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

UNIT-IV

Morphology, cultural characteristics, antigenic structure, pathogencity, clinical symptoms, laboratory diagnosis, prevention-control and treatment of diseases caused by Hemoflagellates; *Leishmania donavani*, *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 diagnosisof 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, 2nd edition.
2. Elmer R.Noble & Lea & Fibiger, Parasitology, Publishers, 5th edition.
3. D.O. White & F.J. Fenner, 1994, Medical Virology, Academic press, 4th Edition.
4. Melnick, Medical Microbiology.
5. Ananthanarayan, C.K.J.Panikar, Textbook of Microbiology, Oreint Longman Ltd., 2000, 6th Edition.
6. Mackie & Mc. Cauetrey: Practical Medical Microbiology (14th Edition), edited by J.G.Gollee, 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', 4th Edition.
9. Coloratlas, Textbook of Diagnostic Microbiology (5th Edition), edited by Eimer.W. Koneman, published by Lippinett.
10. Mosby, Diagnostic Microbiology by Bailey and Swotts, 10th Edition, published.
11. David Greenwood, Richard C.B.Slack, John.F.Peutherer, Medical Microbiology, 16th 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, 3rd Edition.
14. Jawetz, Melnick and Adelberg's, Medical Microbiology (2004) 23rd Edition, Mc Graw Hill.

15. W.B. Hugo& A.P. Russell, Pharmaceutical Microbiology edited, 7th edition, Black well 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 theability 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, HTPP. 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 Wisely 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.Baxevaris, 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, 2nd Edition by Mount CBS publishers

MB 304: MOLECULAR BIOTECHNOLOGY

Course Outcomes

CO1: Enumerating the versatile tools and techniques employed in r DNA technology

CO2: Familiarizing with the cloning strategiesand 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 acumens 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 therapyand 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, 3rd 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, Roya society of chemistry.
8. H. Krenzer, Recombinant DNA & Biotechnology.
9. M.Schena, DNA micro arrays.
10. David Freifelder, 2008, Molecular Biology, 2nd 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 trouble shooting 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 β-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 (Chemicalusing 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, 3rd 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: Impartingknowledge 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, Lowensten-Jension 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. Immunodiagnostics - 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, 4th Edition.
4. K.R.Aneja, Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom cultivation, 3rd Edition.
5. Alcamo, Laboratory Manual in Microbiology.
6. Bailey and Scott, Diagnostic Microbiology.
7. Cruckshanak 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, Virologoy.
11. Baxevanis, Bioinformatics-A Practical Guide to the Analysis of Genes and Proteins. 2nd Edition.
12. Higgis, Bioinformatics: Seqence, structure and Data Bank: A Practical Approach.
13. Misener, Bioformatics Methods and Protocols.
14. www.geneprot.com; www.hybrigenis.com; www.mdsprotemics.com; www.stromix.com; www.syrrx.com.

MODEL QUESTION PAPER
THIRD SEMESTER

SMB 301: **MOLECULAR BIOLOGY**

Time: Three Hours Maximum marks-80

(16X5=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 thediseases caused by *Shigella*and *Vibrio cholera*

OR

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

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

UNIT-III

5. (a)Write an essay on Dermatophytosis

(b) Explainthesuper infections caused by *Aspergillus*

OR

6. (a). Give an account on blastomycosis

(b). Write notes on Sub-cuteanous 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 Maximum marks-80

(16X5=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 ascloning vectors
(b) Discuss theligases 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) Explaintheyeast 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 microbesin 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 andbioleaching agents

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

Programme Specific Outcomes

PSO1: Understandingthe design of bioreactors and media formulations in fermentation technology
PSO2:Developing newStandard 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 archaebacteria 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_{12}. Production of antibiotics – Penicillin, Streptomycin, Erythromycin, bacitracin and tetracycline. Analytical Microbiology – Microbiological assays of Vitamins (Riboflavin, B_{12}), 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 kineticsin fermentation technology
LO3: Developing techniques of sterilization, isolation, preservation and improvement of industrially important micro-organisms
LO4: Perception ofmicroorganism'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, 2nd Edition.
7. Prescot & Dunn, 1982, Industrial Microbiology, 4th Edition., AVI publishing company
8. J.H. Peppler & 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.Perlman, 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 tropic levels. Energy transfer efficiencies between tropic 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 Verlog, New York.
2. D.Cdwd, 1999, Microbial Diversity, Academic press.
3. C.J. Hurst, Manual at Environmental Microbiology, 2nd 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, γ-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*, *BradyrhizobiumAzotobacter*, *Azospirillum*, Azolla; Anabaena Symbiosis, Blue green algae, Mycorrhiza, Biopesticides – toxins from *Bacillus thuringiensis, Psuedomonas syringae,* Use of Baculovirus, NPV virus, Protozoa &Fungi asbiological 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, 2nd 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: Acquiringbasic 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- β-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 andantimetabolites- 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, 6th Edition, Black well science.
2. Shanson D.C., Microbiology in clinical practice, 2nd 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, 2nd Edition.

6. Burns & Slater, Experimental Microbial Ecology.

7. Peppler, 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_{12}.
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, 2nd Edition.
4. Aneja, 2001, Experiments in Microbiology, Plant Pathology, Tissue Culture & Mushroom production Technology, 3rdEdition, New age international

MODEL QUESTION PAPER

FOURTH SEMESTER

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

Time: Three Hours Maximum marks-80
(16X5=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 ofStreptomycin
(b). Explain the Microbiological assays of Vitamin B_{12}.

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 Maximum marks-80 (16 X 5=80)

Answer one question from each Unit
All questions carry equal marks

UNIT-I

1) a) Explain the energy transfer efficiencies between the tropic 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 Maximum marks-80

(16X5=80)

Answer one question from each Unit
All questions carry equal marks

UNIT-I

1.(a) Discuss the classification of β-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 thealcohols 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 theTypes of microbial spoilage
(b) Explain thefactors affecting microbial spoilage

OR

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

(b) LAL test