

ANDHRA UNIVERSITY
M.SC. MICROBIOLOGY- SEMESTER SYSTEM
(EFFECTIVE FROM THE ACADEMIC YEAR 2020 - 2021)

SCHEME OF INSTRUCTION AND EXAMINATION

Paper No.	Title of the Paper	Periods/Week	Duration of Exam (Hours)	Maximum Marks	Credits
I Semester					
MB 101	General Microbiology	4	3	100	4
MB 102	Virology	4	3	100	4
MB 103	Bio-molecules	4	3	100	4
MB 104	Analytical Techniques	4	3	100	4
Practical					
MBP 105	Microbiological methods & Virology	12	6	100	4
MBP 106	Analytical Techniques	12	6	100	4
Total Marks and Credits for I Semester				600	24
II Semester					
MB 201	Microbial Physiology &	4	3	100	4
MB 202	Enzymology & Cell Biology	4	3	100	4
MB 203	Molecular & Microbial	4	3	100	4
MB 204	Immunology	4	3	100	4
Practical					
MBP 205	Enzymology & Immunology	12	6	100	4
MBP 206	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
MB 302	Medical Microbiology	4	3	100	4
MB 303	Bio-statistics & Bio-informatics	4	3	100	4
MB 304	Molecular Biotechnology	4	3	100	4
Practical					
MBP 305	Molecular Biology & Molecular	12	6	100	4
MBP 306	Medical Microbiology & Bio-informatics.	12	6	100	4
MB 307	MOOCs course I			100	4
MB308	Intellectual Property Rights			50	2
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 & Agriculture	4	3	100	4
MB 404	Pharmaceutical Microbiology	4	3	100	4
Practical					
MBP 405	Industrial Microbiology & Environmental	12	6	100	4
MBP 406	Food, Agriculture & Pharmaceutical	12	6	100	4
MB407	MOOCs course II			100	4
MB408	Value Added Course			50	2
Total Marks and Credits for IV				700	28
Project Work/Dissertation				100	4
Grand Total Marks and Credits for 4				2700	108

- Out of 100 Theory and 100 Practical Marks for each paper, 20 marks for internal assessment and 80 marks for semester-end examinations.
- Out of 80 Marks of each practical examination, 15 marks should be allotted for viva-voce and 10 marks for Record.
- Choice based credit system – for the students of other Departments.

Course Outcomes

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

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

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

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

CO5: The Master's degree in Microbiology will address the increasing need for skilled scientific

manpower with an understanding of global research applications in the field of basic and applied Microbiology

Course Specific outcomes

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

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

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

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

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

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

I SEMESTER
MB 101: GENERAL MICROBIOLOGY

UNIT – I:

History, discovery, evolution, development and Recent trends in Microbiology. Contributions of Van Leeuwenhock, Joseph Lister, Pasteur, Koch, Jenner, Winogradsky and Beijerinck. Nobel laureates in Microbiology. . Numerical taxonomy, Genetic and molecular classification systems; Concepts, nomenclature and taxonomic ranks. Phylogenetic trees. Identification, characterization and classification of microorganisms- Principles of bacterial taxonomy and classification: - Bergey's manual and its importance, concept of kingdom - Haeckel's three kingdom concept-Whittaker's five kingdom concept-three domain concept of Carl Woese.

Unit-II

General properties of bacterial groups. Major characteristics used in Taxonomy-morphological, nutritional(cultural), chemical, biochemical, physiological, metabolic, ecological, immunological, pathogenic properties.

Distinguishing characteristics between prokaryotic and eukaryotic cells. Structure and function of cell wall of bacteria, cell membranes, flagella, pili, capsule, gas vesicles, carboxysomes, Mesosomes, Nucleoid, 70S Ribosomes , magnetosomes and phycobolisolomes. Reproduction in bacteria and spore formation.

Morphology, Ultra structure and chemical composition of bacteria, Actinomycetes, Spirochetes, Rickettsiae, Mycoplasma, Chlamydiae – TRIC agents and LGV, Cyanobacteria, Archaeobacteria

UNIT- III:

Methods of Sterilization: Physical methods – Dry heat, moist heat, radiation methods, filtration methods, Chemical methods and their application.

Microscopic identification, characteristics, staining methods – simple staining, differential staining, structural staining and special staining methods.

Microbiological media-Natural and synthetic; autotrophic, heterotrophic and phototropic and prototrophic media: basal, defined, complex, enrichment, selective, differential, maintenance and transport media.

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 –IV

Microbial cultures: Concept of pure culture, Methods of pure culture isolation, Enrichment culturing techniques, single cell isolation, and pure culture development. 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, CO₂ liberated O₂ consumed, extra cellular enzymes), dry weight, turbidity. Cultivation of aerobes and anaerobes.

UNIT- V

Eukaryotic microorganisms: General characteristics, reproduction and economic importance of fungi. Classification, structure, composition, reproduction and other characteristics of fungal divisions-Zygomycota, Ascomycota, Basidiomycota, Deuteromycota.

General characteristics, thallus organization, reproduction and economic importance of algal divisions. Distribution of algae. Classification of algae by Fritsch.

Characteristics of Various protozoa-Morphology, nutritional requirements, reproduction, Life cycle and Pathology of *Entamoeba histolytica*, *Plasmodium*, Free Living Pathogenic Amoeba *Nagalaria* & *Acanthamoeba*.

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, Paperback, 1152 pages**
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 Grawhills.
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.Taloro and A.Taloro**, Foundations in Microbiology, Wm.C.Brown Publications, 2nd edition.
19. **D.E. Alcamo, Jones and Bartiett, Boston**, Fundamentals of Microbiology.
20. **J.G.Black**, Microbiology – Principles & Applications, John Wiley & Sons, New york.
21. **G.J.Tortora, B.R.Funke and C.L. Case**, Microbiology Addison Wesley Longman Inc., 7th edition Pub. Daryl Fox
22. **M.A. Sleigh**, The Biology of the Protozoa, American Elsevier, Newyork.

MB 102: VIROLOGY

UNIT-I:

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

UNIT-II:

Nomenclature and ICTV classification, Major characteristics of different virus families/genera/groups-Poxviridae, Hepadnaviridae, Adenoviridae, Herpesviridae, Ortho and Paramyxoviridae, Retroviridae, Reoviridae, Parvoviridae, Rhabdoviridae, Picornaviridae. Algal, Fungal and Bacterial viruses- Phycodnaviridae, Cyanophages, Partitiviridae and Totiviridae. Subviral agents-sat viruses, Sat nucleic acids, Viroids, Prions

Unit-III

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, fecal, oral, respiratory, seed and pollen. Horizontal (Indirect) transmission- aerosols, fomites, water, food, graft, dodder. Vector-arthropod, non-arthropods, virus and vector relationship. Multiple host infections – viral zoonosis.

Unit -V

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

REFERENCE BOOKS FOR MB 102:

1. **John B Carter.**2013 Virology: Principles and Applications Reviews , 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. **Wagner and Hewlett**, 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,
14. **M.V.Nayudu**, 2006, Plant viruses. Prentice Hall Publication.

MB 103: BIOMOLECULES

UNIT – I:

Major Biomolecules: Carbohydrates – Classification, chemistry, properties, and function– mono, di, oligo and polysaccharides. Biological role of homo and heteropolysaccharides, Lectins, Conjugated polysaccharides– glycoproteins, mureins and lipopolysaccharides.

UNIT-II:

Lipids – classification, chemistry, properties and function – free fatty acids, triglycerides, phospholipids, glycolipids & waxes. Conjugated lipids – lipoproteins. Major steroids of biological importance – prostaglandins. Chemistry and properties of sterols and steroids, 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, function and their properties. Structural polymorphism of DNA, RNA. 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.

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, 4th edithion , 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

UNIT – I:

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

UNIT – II:

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

Unit-III

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

UNIT – IV:

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

UNIT-V:

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

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: MICROBIOLOGICAL METHODS & VIROLOGY

1. Isolation methods – Enrichment culturing, Pour plate, Spread plate, Streak plate and Dilution methods.
2. Staining methods – Gram's stain, Capsule staining, Cell wall staining. Indian Ink Method or Hiss's method. Demonstration of granules in bacterial cells – Albert's method, Neisser's method. Acid-fast staining by Ziehl-Neelsen's method. Flagella and spore stain, Negative stain.
3. Calibration of Microscope, Measurement of size of spores and cells
4. Detection of motility by hanging drop method
5. Selective and indicator media – Crystal violet blood agar, Potassium tellurite blood agar, Neomycin blood agar, Salt nutrient agar, Mannitol salt agar, Phenolphthalein phosphate nutrient agar and Esculin bile medium.
6. Enumeration of bacteria – Quantitative estimation of microorganisms – total and viable counts.
7. Growth curves, Bacterial growth measurement, viable count by spread plate method. Measurement by dry weight and turbidometric methods
8. Culturing of anaerobic microorganisms-Pyrogallol tube method, anaerobic jar, thioglycollate media.
9. Metabolic (Biochemical) tests – Catalase and Oxidase tests. Indole reaction. Methyl red and Voges-Proskauer reactions, citrate utilization, starch and gelatin hydrolysis; H₂S production.
10. Isolation & Identification of known & unknown bacteria.
11. Isolation of phage from soil/sewage. Cultivation and preservation of phages, Quantitation of phages by plaque assay.
12. Growth phases of phage and burst size
13. Cultivation of animal viruses by different routes in embryonated chicken/duck eggs Yolksac, Allantoic and Chorioallantoic membrane (CAM) routes.
14. Animal cell culture-Sheep kidney cell culture, chicken embryo fibroblast cell culture
15. Mechanical inoculation of plant viruses – Tobacco mosaic virus or cucumber mosaic virus and graft transmission of plant viruses.
16. Isolation and culturing of fungi (yeasts and molds) and algae.
17. Observation of specimen and permanent slides.
 - Fungi: *Aspergillus niger*
 - Yeast: *Saccharomyces cerevisiae*
 - Helminth: *Taenia solium*, *Enterobius vermicularis*
 -

- Protozoa: *Plasmodium falciparum*, *Giardia lamblia*

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.Gunashakaran**, 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

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 NH₂ 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

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.

MB 201: MICROBIAL PHYSIOLOGY & METABOLISM

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.

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, anaplerotic reactions, synthesis of peptidoglycans and glycoproteins. Nitrate and sulphate respiration.

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 glycerols, 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) with emphasis on the role of monooxygenase and dioxygenase pathways. Secondary metabolism - Utilization of secondary metabolites for production of vitamins, toxins (aflatoxin and corynebacterial), hormones (GA), and antibiotics (penicillin and streptomycin).

MB 202: CELL BIOLOGY & ENZYMOLOGY

UNIT-I:

Differences between prokaryotic and eukaryotic cells.

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 receptors, GPCR and nuclear receptors. Ras pathway, MAP kinase pathway. Second messenger system: Cyclic nucleotides - cAMP, cGMP, Calcium, nitric oxide, IP₃ and DAG. Mechanism of signal transduction- G-protein signalling. Vascular trafficking- Clathrin coated vesicles, COP-I and COP-II coated vesicles

UNIT-IV:

Outlines of enzyme classification, nomenclature, assay of enzymes and kinetics of enzyme catalyzed reactions – Michaelis – Menton equation, determination of K_m, V_{max} and k_{cat} values.

Enzyme inhibitors, competitive, uncompetitive and noncompetitive 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.

MB 204: IMMUNOLOGY

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, opsonins. 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.

