# Vidhyadeep University

# MSc Microbiology

# Sem-I

| Sl. No. | Components of Study | Course code | Title of the course | Credit hours/ week | No. of Credits | IA | SEEM | Total Marks |
|---|---|---|---|---|---|---|---|---|
| 1 | Core-Theory | MB-1001 | Microbiolobial Diversity | 6 | 04 | 20 | 80 | 100 |
| 2 | Core-Theory | MB-1002 | Microbial Physiology | 6 | 04 | 20 | 80 | 100 |
| 3 | Compulsory Foundation | MB-1003 | Advance Biochemistry | 6 | 04 | 20 | 80 | 100 |
| 4 | Elective Foundation | MB-1004 | Biophysics and Biostatistics | 6 | 04 | 20 | 80 | 100 |
| 5 | Practical-I | MB-1005 | Introductory Microbiology &Microbial Physiology | 6 | 04 | - | 100 | 100 |
| 6 | Practical-II | MB-1006 | Biochemistry & Biophysics andBiostatistics | 6 | 04 | - | 100 | 100 |
| Total | | | | 36 | 24 | 80 | 520 | 600 |
| 7 | Audit Course** (Self-Study) | | **Human and Professional Ethics - I** | 0 | - | 100 | - | - |

| Sl. No. | Components of Study | Course code | Title of the course | Credit hours/ week | No. of Credits | IA | SEEM | Total Marks |
|---|---|---|---|---|---|---|---|---|
| 1 | Core-Theory | MB-2001 | Molecular Biology | 6 | 04 | 20 | 80 | 100 |
| 2 | Core-Theory | MB-2002 | Recombinant DNA technology | 6 | 04 | 20 | 80 | 100 |
| 3 | Compulsory Foundation | MB-2003 | Immunology | 6 | 04 | 20 | 80 | 100 |
| 4 | Elective Foundation | MB-2004 | Medical Microbiology | 6 | 04 | 20 | 80 | 100 |
| 5 | Practical-I | MB-2005 | Molecular Biology and RecombinantDNA Technology | 6 | 04 | - | 100 | 100 |
| 6 | Practical-II | MB-2006 | Immunology and MedicalMicrobiology | 6 | 04 | - | 100 | 100 |
| Total | | | | 36 | 24 | 80 | 520 | 600 |
| 7 | Audit Course** (Self-Study) | | | 0 | - | 100 | - | - |

**MB 1001- INTRODUCTORY MICROBIOLOGY**

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|---|---|
| Course Code | MB-1001 |
| Course Title | INTRODUCTORY MICROBIOLOGY |
| Credit | 4 |
| Teaching perWeek | 6 |
| Minimum weeks perSemester | |
| EffectiveFrom | June-2023 |
| Purpose ofCourse | To exhibit ability to pursue careers in the industry, agriculture, and applied research where microbial systems are increasingly employed.<br>To address the increasing need for skilled scientific manpower, contributing to application, advancement and impartment of knowledge in interdisciplinary areas related to Microbiology and life sciences.<br>To exhibit excellent professional skills, communication skills and ethical attributes as an effective team member. in a competitive global environment.<br>To demonstrate right mixes of innovative ability, equipped with entrepreneurship abilities contributing to self and national development.<br>The graduates will be cognizant and responsive to the societal needs and will possess the initiative and critical acumen required to continuously improve their knowledge through life long learning. |
| Course Objective | To provide information on microscopy and staining materials that helps to observe microorganism.<br>To provide detailed knowledge on isolation, cultivation and enumeration of microorganisms.<br>To provide in depth knowledge about classification and taxonomy of microorganisms.<br>To provide information on prokaryotic and eukaryotic microorganisms. |
| Course Outcome | Be able to know the microbial structure, sterilization and disinfection techniques<br>Be able to know the maintainence and preservation of microbial culture.<br>Be able to know nomenclature, taxonomic trends and major characteristics used in taxonomy.<br>Be able to know the discovery, classification, structure and importance of prokaryotes, fungi, algae and protozoa |

| | **$PO_1$** Know ledge | **$PO_2$** Analysis | **$PO_3$** Design | **$PO_4$** Development | **$PO_5$** Modern Tools | **$PO_6$** Society | **$PO_7$** Environment | **$PO_8$** Ethics | **$PO_9$** Team work | **$PO_{10}$** Communication | **$PO_{11}$** Programme Management | **$PO_{12}$** Lifelong Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **$CO_1$** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | - | - | - | 1 | 1 |
| **$CO_2$** | 3 | 2 | 2 | 2 | 2 | 1 | 1 | - | - | - | 1 | 1 |
| **$CO_3$** | 3 | 2 | 1 | 2 | 3 | 2 | 2 | - | - | - | 1 | 1 |
| **$CO_4$** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | - | - | - | 1 | 1 |

**Course content**

| Unit No. | Content | Hours/Week |
|---|---|---|
| Unit-1 | **History and Scope of Microbiology**:- Discovery of microorganisms and development of microbiology - Contributions of pioneers- Prokaryotic and Eukaryotic microorganisms - Origin and evolution of microorganisms. Distinguishing of different microorganisms-Scope and relevance of Microbiology - Future of Microbiology<br>**Microbial Structure**: - Microscopy – principles and applications of light microscope-Bright field- Dark-field, Phase – contrast, Fluorescent, Scanning and Transmission electron microscopes, Confocal microscopy, Scanning tunneling microscope. Preparation of microbiological samples for microscopy-simple and differential staining, special and structural staining. Negative contrast staining for virus samples. Preparation of tissues for thin sectioning (fixation, dehydration, infiltration, embedding and sectioning).<br>**Physical and Chemical methods of sterilization and disinfection**:- Heat, radiation, pH, atmospheric pressure, filters, various chemical agents, safety precautions. The concept of containment facility. | |
| Unit-2 | **Microbiological media**:- Types of media-natural and synthetic; autotrophic, heterotrophic and prototrophic media; basal, defined, complex, enrichment, selective, differential, maintenance and transport media.<br>**Isolation, cultivation and enumeration of microorganisms**:- Isolation from different natural sources. Approaches for obtaining pure cultures. Cultivation of aerobes and anaerobes. Continuous, batch, synchronous broth and stock cultures. Enumeration / measurement of growth of microorganisms.<br>**Maintenance and preservation of microbial cultures**:- Repeated sub-culturing, sterile soil/sand preservation, glycerol-deep freezing, oil overlay, drying methods, freeze-drying. | |
| Unit-3 | **Microbial Taxonomy**:- Classification of microorganisms – introduction – Hackel's three kingdom concept – Whittaker's five kingdom concept – three domain concept of Carl Woese. Basis of microbial classification. Concepts, nomenclature and taxonomic ranks; major characteristics used in Taxonomy – morphological, physiological and metabolic, ecological, numerical taxonomy; genetic and molecular classification systems; the kingdoms of organisms and phylogenetic trees. Characteristics of prokaryotes and eukaryotic cells | |
| Unit-4 | **Prokaryotic microorganisms**:-Brief outlines on discovery, nature, origin, evolution, morphology and structure, composition, reproduction and other characteristics of Bacteria (Eubacteria) Spirochetes, Rickettsias, Chlamydias, Pseudomonads, Acetic acid bacteria, Mycloplasmas, Cyanobacteria, Archaebacteria, Actinomycetes (Actinobacteria).<br>**Eukaryotic microorganisms**:<br>**Fungi:-** Classification, structure, composition, reproduction and other characteristics of fungal divisions – Zygomycota, Ascomycota, Basidiomycota and Deuteromycota and slime and water molds. General characteristics and importance of fungi – Saccharomyces, Candida, Pichia, Pencillium, Neurospora, Rhizopus, Aspergillus, Agaricus, Cryptococcus, Fusarium, Trichoderma, Claviceps.<br>**Algae**:- Classification, structure, reproduction and other characteristics of algal divisions. Characteristics of Chlorella, Senedesmus, Gelidiella and Gracellaria. Economic importance of algae, phytoplantanic microalgae.<br>**Protozoan parasites**:- Classification, morphology and structure,reproduction and other characteristics of pathogenic protozoa like Entamoeba, Plasmodium, Leishmania, Cryptosporidium, Trichomonas, Taxoplasma, Trypanosoma, Giardia. | |

## Reference Books:

| Title | Authors | Publishers |
|---|---|---|
| Brock Biology of Microorganisms | Madigan et al | Prentice-Hall International, Inc. 8th ed |
| Microbiology | Prescott et al | Wm. C. Brown Publ, 3rd ed |
| Principles of Microbiology | R.A. Atlas | Wm.C. Brown. Publ2nd ed |
| Foundations in Microbiology | K. Talaro and A. Talaro. | Wm. C. Brown Publ. 2nd ed |
| Microbiology | Pelczar et al | Tata McGram-Hill Publ. Company Ltd 5th ed |
| General Microbiology | S.B. Sullia, | Oxford and IBH Publishers. |
| General Microbiology | Stainer et al., | Macmillan Educational Ltd. |
| Instant Notes in Microbiology | J. Nicklin et al | Viva Books Pvt. Ltd. |
| Microorganisms, Biotechnology and Disease Students Book. | Pauline Lourie and Susanwells | Cambridge University Press. |
| Introductory Mycology | Alexopoulos et al | John Wiley and Sons. 4th ed |
| Introductory Psychology | H.D. Kumar | East West Press. 2nd ed |

# MB 1002- MICROBIAL PHYSIOLOGY

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|---|---|
| Course Code | MB-1002 |
| Course Title | MICROBIAL PHYSIOLOGY |
| Credit | 4 |
| Teaching per Week | 6 |
| Minimum weeks perSemester | |
| Effective From | June-2023 |
| Purpose ofCourse | To exhibit ability to pursue careers in the industry, agriculture, and applied research where microbial systems are increasingly employed.<br>To address the increasing need for skilled scientific manpower, contributing to application, advancement and impartment of knowledge in interdisciplinary areas related to Microbiology and life sciences.<br>To exhibit excellent professional skills, communication skills and ethical attributesas an effective team member. in a competitive global environment.<br>To demonstrate right mixes of innovative ability, equipped with entrepreneurship abilities contributing to self and national development.<br>The graduates will be cognizant and responsive to the societal needs and will possessthe initiative and critical acumen required to continuously improve their knowledge through life long learning. |
| Course Objective | To provide insights in to nutrition and microbial growth.<br>To know the concepts of bioenergetics, photosynthesis and carbon metabolisms.<br>To provide in depth information about aerobic and anaerobic respiration and lipidmetabolism.<br>To provide detailed information on protein, nucleic acids and secondary metabolisms |
| Course Outcome | Be able to know about the nutrition and microbial growth.<br>Be able to know about photosynthesis and carbon fixation.<br>Be able to know in depth details about aerobic and anaerobic respiration.<br>Be able to know in depth about various pathways in protein and nucleotide metabolisms. |

| | **$PO_1$** Know ledge | **$PO_2$** Analysis | **$PO_3$** Design | **$PO_4$** Development | **$PO_5$** Modern Tools | **$PO_6$** Society | **$PO_7$** Environment | **$PO_8$** Ethics | **$PO_9$** Team work | **$PO_{10}$** Communication | **$PO_{11}$** Programme Management | **$PO_{12}$** Lifelong Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **$CO_1$** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | - | - | - | 1 | 1 |
| **$CO_2$** | 3 | 2 | 2 | 1 | 2 | 1 | 1 | - | - | - | 1 | 1 |
| **$CO_3$** | 3 | 1 | 1 | 2 | 3 | 2 | 2 | - | - | - | 1 | 1 |
| **$CO_4$** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | - | - | - | 1 | 1 |

## Course Content

| Unit No | Content | Hours/ Week |
|---|---|---|
| Unit-1 | **Nutrition:** Elemental nutrient requirements of microbes; nutritional groups of bacteria; autotrophy- photoautotrophy and bacterial photosynthesis; chemoautotrophy and autotrophic metabolism;heterotrophy – photoheterotrophy and chemoheterotrophy, heterotrophic metabolism in bacteria; nutritional mutants and their use in metabolic studies.<br>**Uptake and Transport of nutrients in microbes –** Structural organization of plasma membrane in relation to transport, types and mechanisms of transport (passive, simple, facilitated, active, chemical modification) with reference to sugars, amino acids and ions; methods for studying of transport, coupling of transport of ions and metabolites to ATP/proton gradient.<br>**Microbial Growth:** building of macromolecules from elemental nutrients, supramolecules, cell components and cells; cell cycle in microbes and generation times; batch culture phases and importance of each phase, continuous cultures, synchronous culture, factors influencing the microbial growth.<br>**Nature and properties of spores –** Physiology and biochemistry of sporulation and germination of spores. | |
| Unit-2 | The concepts of microbial metabolism, primary and secondary metabolism and their significance.<br>**Bioenergetics:** Concepts of free energy and thermodynamic principles in biology, energytransformation, ATP cycle, standard free energy of hydrolysis of phosphate compounds, energytransducers, redox potentials, free energy changes in redox reactions.<br>**Photosynthesis:** Oxygenic and anoxygenic photosynthesis, photosynthetic pigments, basic photochemistry of PS I and PS II and photosynthetic electron transport; modes of $CO_2$ fixation, halobacterial photosynthesis, sulphur, nitrogen and iron assimilating bacteria. Chloroplast mediated electron transport; chemolithotrophic electron transport systems. Biolumenescence.<br>**Carbohydrate metabolism:** Pathways underlying the utilization of different sugars (EMP, ED, HMP and phosphoketolase) in microorganisms, gluconeogenesis; synthesis of peptidoglycans and glycoproteins. | |
| Unit-3 | **Aerobic respiration :** TCA cycle – intracellular location and reactions of the cycle, amphibolic nature of the cycle, energetics of the cycle; the glyoxalate cycle. Mechanisms of substrate-level phosphorylation; respiratory electron transport in mitochondria and bacteria along with its components (carriers); mechanism of oxidative phosphorylation, uncouplers, inhibitors<br>**Anaerobic respiration** : nature of fermentation, the relationship of oxygen to growth and fermentation, biochemical mechanisms of lactic acid, ethanol, butanol, citric acid and acetone fermentations, study of fermentations, relationships between fermentation and energy production; nitrate and sulphate respiration.<br>**Lipid metabolism:** Biosynthesis of triacyl glycerols, phospholipids and glycolipids; oxidation of saturated and unsaturated fatty acids; microbial metabolism of aromatic and aliphatic hydrocarbons | |

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| Unit-4 | **Protein metabolism:** Assimilation of inorganic nitrogen and sulphur, biochemistry of nitrogen fixation; hydrolysis of proteins-exo-and endo-proteinases, outlines of biosynthesis and catabolism of amino acids in microbes (deamination, decarboxylation and transamination reactions). Urea cycle.<br>**Nucleotide metabolism :** biosynthesis of bases, nucleosides and nucleotides including deoxyribonucleotides, regulation of nucleotide synthesis; break down of nucleic acids – exo-and endo-nucleases (RNases and DNases) and phosphodiesterases, salvage pathways; catabolism of purines and pyrimidines.<br>**Secondary metabolism:** Utilization of secondary metabolites for production of vitamins, toxins (aflotoxin and corynebacterial), hormones (GA), and antibiotics (penicillin and streptomycin).<br>**Microbial toxins and extra cellular enzymes:** Exo-and endotoxins: physiology of toxin production; mode of action of toxins and extra cellular enzymes and their importance in pathogen virulence and pathogenesis. | |

## References:


| Title | Authors | Publishers |
|---|---|---|
| Microbial Physiology and Metabolism | D.R. Caldwell | Wm.C. Brown Publ. |
| Microbial Physiology | A.G. Moat & J.W. Foster | Wiley-Liss |
| Principles of Biochemistry | Lehinger | W.H.Freeman |
| Foundations in Microbiology | K. Talaro & A. Talaro | Wm. C. Brown Publ |
| Microbiology | Prescott et al. | Wm. C. Brown Publ |
| Molecular Cell Biology | Lodish et al. | W. H. Freeman |
| General Microbiology | Stainer et al., | Macmillan Educational Ltd. |

# MB1003- ADVANCED BIOCHEMISTRY

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|---|---|
| Course Code | MB-1003 |
| Course Title | ADVANCED BIOCHEMISTRY |
| Credit | 4 |
| Teaching per Week | 6 |
| Minimum weeks perSemester | |
| Effective From | June-2023 |
| Purpose ofCourse | To exhibit ability to pursue careers in the industry, agriculture, and applied research where microbial systems are increasingly employed.<br>To address the increasing need for skilled scientific manpower, contributing to application, advancement and impartment of knowledge in interdisciplinary areas related to Microbiology and life sciences.<br>To exhibit excellent professional skills, communication skills and ethical attributesas an effective team member. in a competitive global environment.<br>To demonstrate right mixes of innovative ability, equipped with entrepreneurship abilities contributing to self and national development.<br>The graduates will be cognizant and responsive to the societal needs and will possessthe initiative and critical acumen required to continuously improve their knowledge through life long learning. |
| Course Objective | To provide basic concepts of chemistry in life.<br>To provide in depth information lipids and amino acids.<br>To provide in depth information on proteins and catalytic proteins.<br>To provide in depth information in nucleic acids, hormones and vitamins. |
| Course Outcome | Be able to identify and analyze carbohydrates and lipids.<br>Be familiar with behavior of amino acids and structure functional relationships ofproteins and their profiling.<br>Be able to know the separation methods such as centrifugation and Electrophoresis |

| | **$PO_1$** Know ledge | **$PO_2$** Analysis | **$PO_3$** Design | **$PO_4$** Development | **$PO_5$** Modern Tools | **$PO_6$** Society | **$PO_7$** Environment | **$PO_8$** Ethics | **$PO_9$** Team work | **$PO_{10}$** Communication | **$PO_{11}$** Programme Management | **$PO_{12}$** Lifelon g Learnin g |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **$CO_1$** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | - | - | - | 1 | 1 |
| **$CO_2$** | 3 | 2 | 1 | 2 | 2 | 2 | 1 | - | - | - | 1 | 1 |
| **$CO_3$** | 3 | 1 | 2 | 2 | 3 | 2 | 2 | - | - | - | 1 | 1 |
| **$CO_4$** | 3 | 2 | 2 | 2 | 2 | 2 | 1 | - | - | - | 1 | 1 |

## Course Content

| Unit No. | Content | Hours/week |
|---|---|---|
| Unit -1 | **Basic concepts of Chemistry of life :** The major elements of life and their primary characteristics; atomic bonds and molecules – bonding properties of carbon, covalent and non-covalent bonds,Vander waals forces; polarity, hydrophilic and hydrophobic interactions; asymmetry of carbon compounds and cis-trans isomerism; electron transfer and oxidation/reduction; functional groups of organic compounds; hydrogen ion concentration of biological systems; Brownsted – Lowry acids and bases; ionization and titration of acids; dissociable biological compounds and physiological buffer systems.<br>**Carbohydrates :** Classification of carbohydrates; outline structure and properties of important mono-, di-and oligosaccharides and their identification and analysis; structure, occurrence and biological importance of structural polysaccharides (cellulose, chitin, agar, alginic acids, pectins, proteoglycans, sialic acids, blood group polysaccharides, bacterial cell wall polysaccharides). | |
| Unit -2 | **Lipids:** Building blocks of lipids. Classification of lipids. Fatty acids-physico-chemical properties, separation, distribution in nature characterization and saponification and iodine number. Nomenclature, outline structures, properties and functions of glycerides, neutral lipids (waxes, fats, oils, phospholipids, sphingolipids and glycolipids. Steroids – plant sterol, ergosterol, stigmasterol, cholesterol. Lipoproteins-classification, composition and importance. Salient features of bacterial lipids.<br>**Amino acids:** Classification, structure, physico-chemical properties, acid-base behaviour of amino acids.<br>**Peptides :** Characteristics of peptide bond, peptides of non-protein origin, properties and functions of peptides, determination of amino acid composition and sequence in peptides, chemical synthesis of peptides, peptides profiling | |

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| Unit -3 | **Proteins:** Classification, properties and biological functions of proteins; structural organization of proteins – primary, secondary, tertiary and quaternary; Ramachandran's plot; proteins denaturationand renaturation (ribonuclease); structure-function relationships of certain proteins – myoglobin,hemoglobin, collagen; chaperones.<br>**Catalytic proteins(enzymes) :** Classification, nomenclature, composition and structure, enzymes as biocatalysts, outlines of purification and assay of enzymes, kinetics of enzyme catalyzed reactions, factors influencing enzyme catalyzed reactions, regulation of enzyme activity – activators and inhibitors and mechanism of action of enzymes (chymotrypsin). Regulatory enzymes – allosteric enzymes. Isoenzymes, conzymes, ribozymes, abzymes. | |
| Unit -4 | **Nucleic acids :** Types and their composition, structures of purines, pyrimidines, modified bases, nucleosides, nucleotides and polynucleotides; properties of bases and functions of nucleotides; types and structural polymorphism of DNA and RNA; denaturation and renaturation of nucleic acids, factors influencing hybridization, cot values.<br>**Hormones and Growth regulators:** Classification, outline structures and functions of major animal and plant hormones.<br>**Vitamins:** Discovery and outline chemistry of fat soluble (A,D,E and K)and water soluble (riboflavin, pantothenic acid, niacin, pyridoxine, biotin, cobalamine folic acids and ascorbic acid) vitamins and their role in body functions.<br>**Porphyrins and other pigments :** Classification, structures and biological functions of porphyrins, brief account of haemoglobin and chlorphylls, cytochromes, xanthophylls and carotenoids of microorganisms | |

## Reference:


| Title | Authors | Publishers |
|---|---|---|
| Principles of Biochemistry | Lehninger, | Nelson and Cox (Worth). 3rd edition, 2000 |
| Biochemistry | Stryer | W.H. Freeman, 5th edition |
| Microbial Physiology and Metabolism | D.R. Caldwell | Wm.C. Brown Publ |
| Microbial Physiology | A.G. Moat & J.W | Foster. Wiley-Liss |
| Foundations in Microbiology | K. Talaro & A. Talaro | Wm. C. Brown Publ |

# MB1004-BIOPHYSICS AND BIOSTATASTICS

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|---|---|
| Course Code | MB-1004 |
| Course Title | BIOPHYSICS AND BIOSTATASTICS |
| Credit | 4 |
| Teaching per Week | 6 |
| Minimum weeks perSemester | |
| Effective From | June-2023 |
| Purpose ofCourse | To exhibit ability to pursue careers in the industry, agriculture, and applied research where microbial systems are increasingly employed.<br>To address the increasing need for skilled scientific manpower, contributing to application, advancement and impartment of knowledge in interdisciplinary areas related to Microbiology and life sciences.<br>To exhibit excellent professional skills, communication skills and ethical attributesas an effective team member. in a competitive global environment.<br>To demonstrate right mixes of innovative ability, equipped with entrepreneurship abilities contributing to self and national development.<br>The graduates will be cognizant and responsive to the societal needs and will possessthe initiative and critical acumen required to continuously improve their knowledge through life long learning. |
| Course Objective | Gives in sights on electrochemical and spectroscopy concepts.<br>Provide in depth knowledge on separation techniques such as centrifugation,electrophoresis and chromatography.<br>Give detailed information on interval date, proportion data and count data.<br>Provide knowledge on statistical basis of biological assays and design of experiments. |
| Course Outcome | Be able to know the principal, instrumentationand applications of spectroscopy,amino acid, nucleotide sequencers.<br>Be able to know principle, methods and applications of separation techniques.<br>Be able to gain knowledge on basic concepts in statistics.<br>Be able to design the experimental and statistical basics of biological assays. |

| | **$PO_1$** Know ledge | **$PO_2$** Analysis | **$PO_3$** Design | **$PO_4$** Development | **$PO_5$** Modern Tools | **$PO_6$** Society | **$PO_7$** Environment | **$PO_8$** Ethics | **$PO_9$** Team work | **$PO_{10}$** Communication | **$PO_{11}$** Programme Management | **$PO_{12}$** Lifelon g Learnin g |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **$CO_1$** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | - | - | - | 1 | 1 |
| **$CO_2$** | 3 | 2 | 2 | 2 | 2 | 2 | 1 | - | - | - | 1 | 1 |
| **$CO_3$** | 3 | 2 | 2 | 2 | 3 | 2 | 2 | - | - | - | 1 | 1 |
| **$CO_4$** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | - | - | - | 1 | 1 |

## Course Content:

| Unit No | Content | Hours/ Week |
|---|---|---|
| Unit-1 | **Electrochemcial techniques** (Principles and applications): Redox reactions; pH and Clarke oxygen electrodes; biosensors.<br>**Cell sorting and Flow cytometry** (Principles and applications):<br>Radioisotope techniques - Nature and types of radioactivity, half-life of isotopes; detection and measurement of radioactivity-GM counter, liquid scintillation counter, gama-ray counter, Cerenkov counting and autoradiography; quenching and quench correction; laboratory safety measures in handling isotopes; biological uses of radioisotopes.<br>**Spectroscopy :** Electromagnetic spectrum of light; simple theory of light absorption by biomolecules; Beer's – Lambert law; transmittance; extinction co-efficient; light sources; monochromators; types of detectors; working principle and applications of visible, UV-visible, IR, Raman, ESR, mass, plasma emission, atomic absorption, and NMR spectrophotometry; fluorimetry and flame photometry; ORD and CD; X-ray diffraction and X-ray crystallography.<br>**Amino acid and nucleotide sequencers:** Basic principle, functioning and applications of amino acid and nucleotide sequencers | |
| Unit-2 | **Centrifugation:** Simple theory of preparative and analytical centrifuges and rotors; sedimentation analysis; differential, rate-zonal and equilibrium density gradient centrifugations. Applications – isolation of cells, subcellular organelles, viruses and macromolecules.<br>**Electrophoresis** (Principles and applications) : Types of electrophoresis – paper, gel (starch, acrylamide and agarose) disc, vertical, horizontal submarine, gradient, 2-dimentional, pulse-field and capillary; isoelectrofocussing; isolation and analysis of gel separated molecules – recovery of molecules from paper/gels; Southern, Northern and Western blottings.<br>**Chromatography:** Principle/simple theory and applications of partition, adsorption, ion-exchange, gel permeation and affinity chromatography based techniques – paper, thin-layer, column, GLC, HPLC, FPLC | |
| Unit-3 | **Introduction:** Definition of statistics: population and universe, the sample and population, statistical inference; parameter and statistics.<br>**Interval Data:** Mean, mode, median and standard deviation. Concept of probability – classical and frequency definitions; axiones of probability; addition and multiplication theorems (statements only); conditional probability-Baye's theorem (statement only); simple applications. Binomial, Poisson and Normal distributions (definitions and uses only).<br>**Uncertainties** in estimation of mean, comparison of means and variances – t, F, and Z tests. **Proportion data:** examples of proportion data; (MPN, sterility testing of medicines, animal toxicity,therapeutic trial of drugs and vaccines, animal toxicity, infection and immunization studies) statisticaltreatment to proportion data. Chi-square test, goodness of fit. | |

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| Unit-4 | **Analysis of variance:** Analysis of variance: Introduction, procedure and tests for one-way and two- way classified data. Multiple comparisons. Analysis of CRD, RBD and LSD. Factorial experiments- main effects and interaction in a $2^2$ design, Duncan's Multiple Range Test.<br>**Correlation and regression,** formulae and application. Fitting straight line through a series of points. Fitting of exponential curves. Standard curve and interpolation of unknown Y-values. Multiple linear regression, logistic regression.<br>**Statistical basis of biological assays:** Response-Dose metameter. Delusion Assays, Direct and indirect assays. Quantal Responses, Probit, logit, $LD_{50}$, $ED_{50}$, $PD_{50}$ – Standard line interpolation assay, parallel assay (4 point, 6 point assays), slope ratio assay.<br>**Design of Experiments** – Multiple comparison tests, Dunken's, Tukey's, Scheffic's, Dunnelt's etc.Probit Analysis ,Multiple Regression, Logistic regression Discriminate Analysis<br>Clinical trails – Phase I, Phase II etc,Clinical trails (meaning and importance only). | |

## Reference:


| Title | Authors | Publishers |
|---|---|---|
| Practical Biochemistry: Principles and Techniques | K. Wilson and J. Walker | Cambridge University Press |
| Modern Experimental Biochemistry | R.F. Boyer | The Benjam CummingsPubl. Company. |
| Physical Biochemistry: Applications to Biochemistry and Molecular Biology | David Freifelder | W.H. Freeman and company |
| Introduction to Practical Biochemistry | S.K. Sawhney and Randhir Singh (eds) | NarosaPubl. House. |
| Biochemical Methods for Agricultural Sciences | Sadasivam and A. Manikam | WileyEastern Ltd. |

# MB 1005- INTRODUCTORY MICROBIOLOGY & MICROBIAL PHYSIOLOGY:

| Practical No. | Practical Name | Hours/Week |
|---|---|---|
| 1 | Microbiological laboratory safety measures | |
| 2 | Sterilization methods - Wet method, Dry method, Filters. Evaluation of alcohol effectiveness,Phenol coefficient method | |
| 3 | Preparation of different media for cultivation of bacteria & fungi | |
| 4 | Plating techniques – streak plate, spread plate methods | |
| 5 | Enumeration of Bacteria by serial dilution, viable count | |
| 6 | Qualitative tests for identification of Carbohydrates, amino acids, nucleic acids | |
| 7 | Quantitative tests for Protein, glucose, glycine, bilirubin, cholesterol, Inorganic phosphorous | |
| 8 | Determination of activity of – Peroxidase and Polyphenol oxidase in plant tissues. | |
| 9 | Purification and study of Acid Phosphatase from potato tubers: Extraction of enzyme; effect of substrate concentration; enzyme concentration; temperature; pH on enzyme activity. | |
| 10 | Determination of Bacterial growth curve | |
| 11 | Determination of effect of temperature on bacterial growth | |
| 12 | Determination of effect of pH on bacterial growth | |
| 13 | Determination of effect of salt on bacterial growth | |
| 14 | Determination of growth of fungi | |
| 15 | Determination of concentration of cyanobacterial pigments | |
| 16 | Determination of concentration of oligodynamic action | |
| 17 | Determination of activity of microbial hydrolytic enzymes like amylases, lipases and Process. | |
| 18 | Demonstration of aerobic and anaerobic respiration in microbes. | |
| 19 | Demonstration of Microbial fermentation | |
| 20 | Demonstration of microbial toxins | |

# MB 1006- : BIOCHEMISTRY & BIOPHYSICS AND BIOSTATISTCS

| Practical No. | Practical Name | Hours/Week |
|---|---|---|
| 1 | Calculating Mean, Mode Median | |
| 2 | Problems related to T test & F test & Z test | |
| 3 | Problems related ANOVA | |
| 4 | Measurement of pH | |
| 5 | Micrometry for cell size determination | |
| 6 | Cell counting by Haemocytometer | |
| 7 | Beer's Law | |
| 8 | Determination of λ max for coloured solutions | |
| 9 | Determination of DNA & RNA by UV spectrophotometry | |
| 10 | Determination of nucleic acid Bases by UV spectrometry | |
| 11 | Paper chromatography for separation of amino acids / pigments | |
| 12 | TLC for separation of lipids / amino acids | |
| 13 | Dialysis | |
| 14 | Separation of proteins by SDS-PAGE | |
| 15 | Separation of DNA by Agarose gel electrophoresis | |
| 16 | Isolation of chloroplasts by sucrose density gradient centrifugation | |
| 17 | Determination of concentration of green/yellow pigments by spectrophotometry | |

# SEM-II

## MB 2001-MOLECULAR BIOLOGY

| | |
|---|---|
| Course Code | MB-2001 |
| Course Title | MOLECULAR BIOLOGY |
| Credit | 4 |
| Teaching per Week | 6 |
| Minimum weeks perSemester | |
| Effective From | June-2023 |
| Purpose ofCourse | To exhibit ability to pursue careers in the industry, agriculture, and applied research where microbial systems are increasingly employed.<br>To address the increasing need for skilled scientific manpower, contributing to application, advancement and impartment of knowledge in interdisciplinary areas related to Microbiology and life sciences.<br>To exhibit excellent professional skills, communication skills and ethical attributesas an effective team member. in a competitive global environment.<br>To demonstrate right mixes of innovative ability, equipped with entrepreneurship abilities contributing to self and national development.<br>The graduates will be cognizant and responsive to the societal needs and will possessthe initiative and critical acumen required to continuously improve their knowledge through life long learning. |
| Course Objective | Gives basic concepts in genetics of bacteria and fungi<br>Provides in depth knowledge on genetic recombination<br>Gives overall picture about DNA replication and transcription<br>Provides in depth information about RNA biosynthesis and gene regulation |
| Course Outcome | Be able to gain knowledge on genome diversity and gene transfer mechanisms<br>Be able to gain information on mutations and gene transfer mechanisms<br>Be able to gain in depth-knowledge on DNA and biosynthesis<br>Be able to understand about positive and negative gene regulation |

| | **$PO_1$** Know ledge | **$PO_2$** Analysis | **$PO_3$** Design | **$PO_4$** Development | **$PO_5$** Modern Tools | **$PO_6$** Society | **$PO_7$** Environment | **$PO_8$** Ethics | **$PO_9$** Team work | **$PO_{10}$** Communication | **$PO_{11}$** Programme Management | **$PO_{12}$** Lifelon g Learnin g |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **$CO_1$** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | - | - | - | 1 | 1 |
| **$CO_2$** | 3 | 2 | 2 | 2 | 2 | 2 | 1 | - | - | - | 1 | 1 |
| **$CO_3$** | 3 | 2 | 2 | 2 | 3 | 2 | 2 | - | - | - | 1 | 1 |
| **$CO_4$** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | - | - | - | 1 | 1 |

## Course Content

| Unit No. | Content | Hours/week |
|---|---|---|
| Unit -1 | Nucleic acids as genetic information carriers – experimental evidences.<br>**Modern concept of gene –** Gene structure, co-linearity and polypeptide, one gene – one enzyme, protein polypeptide or product concepts; types of genes.<br>**Genetics of Bacteria and Fungi:** *E. coli, Bacillus, Streptomyces, Sacchromyces,* Filamentous fungi *(Neurospora).*<br>**Gene transfer mechanisms in bacteria: T**ransformation, conjugation, sexduction and transduction (generalized, abortive, contrasduction, specialized,) and gene mapping. Role of Rec gene products.<br>**Genome diversity:** Viruses – linear, circular and dividend genomes of RNA and DNA viruses. Prokaryotes – nucleoid and chromosome organization, genome evolution in microbes, phylogenetic trees. Eukaryotes – chromosome organization / structure, histones, nucleosomes, genome complexity, chromosomal banding. Organelle genomes. Genetic mapping of genomes.<br>**Plasmids:** bacterial and yeast plasmids, purification, properties, detection, transfer, replication an curing,significance/importance.<br>**Transposal / mobile genetic elements:** Prokaryotes – (IS elements, composite and complex transposons), mechanisms of transposition and importance – Eukaryotes (Yeast, Drosophila andMaize) – retrotransposons, retroelements. Exploitation of transposable elements in genetics. | |
| Unit -2 | **Mutations:** Types, mutagens and molecular mechanisms of mutation, isolation and analysis of mutants, significance of mutants.<br>**Genetic recombination:** General of homologous recombination, site specific recombination, transposition; illegitimate recombination and artificial recombination.<br>**Genetics of viruses :** Prokaryotic virus (phages) – Benzer's studies on r-II region of T4 and complementation, recombination in bacteriophages (T2), uses of phages in microbial genetics, Eukaryotic viruses-recombination and reassortment, cross-and multiplicity reactivation, complementation, phenotypic mixing, ploidy, DI particles, transduction of genes by retroviruses, evolution of viruses (influenza, HIV, herpesviruses). | |

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|---|---|---|
| Unit -3 | **DNA replication :** general principles, various modes of replication. Continuous and discontinuous synthesis, relation between cell cycle and DNA synthesis, replication fork and enzymology of DNA replication in prokaryotes and eukaryotes, replication of ssDNA, retroviruses and their unique mode of DNA synthesis, inhibitors of DNA replication.<br>**DNA damage and repair :** types of DNA damage-deamination, oxidative damage, alkylation and pyrimidine dimers; repair pathways – mismatch, short patch repair, nucleotide/base, excition repair, recombination repair and SOS system.<br>**Transcription (RNA biosynthesis) :** Types of RNA and their role, organization of protein and RNA (rRNA, tRNA, 5 sRNA) encoding transcription units (promoters and regulatory elements) and their transcription in prokaryotes and eukaryotes, polycistronic and monocistronic mRNAs. Types of RNA polymerases. Promoters and other regulatory elements and transcription factors, events of transcription. Maturation and processing of different RNAs : methylation, processing of rRNA;capping, polyadenylation, splicing and editing of mRNA; processing and modification of tRNA. Catalytic RNAs (ribozymes). Inhibitors of transcription. *Invitro* transcription systems. | |
| Unit -4 | **Translation (Protein biosynthesis) :** Central dogma theory and flow of genetic information, genetic code and its elucidation, structure and composition of prokaryotic and eukaryotic ribosomes, structural features of rRNA, mRNA and tRNA in relation to function, steps of protein biosynthesis (activation of amino acids, initiation, elongation, termination) in prokaryotes and eukaryotes; post- translational modification of proteins and their sorting and targeting; regulation of translation; inhibitors of protein biosynthesis; invitro translation systems.<br>**Regulation of gene expression :** An overview on levels of regulation, terminology and operon concepts, enzyme induction and repression; positive and negative regulation in *E. coli*- lac and ara operons; regulation by attenuation – his and trp operons; antitermination – N protein and nut sites in Lambda phage. Organization and regulation of nif and nod gene expression in bacteria; gal operon inyeast. Global regulatory responses-heat shock response, stringent response and regulation by small molecules such as cAMP and PPGPP.<br>**DNA binding proteins:** Enhancer sequences and control of transcription. Identification of protein – binding sites on DNA, control of transcription by interaction between RNA polymerases and promoter region, use of alternate sigma factors, controlled termination attenuation and anti termination | |

## References:


| Title | Authors | Publishers |
|---|---|---|
| Microbial Genetics | S.R. Maloy et al | Narosa Publishing House |
| Molecular Genetics of Bacteria | J.W. Dale | Wiley Publ. |
| Bacterial and Bacteriophage Genetics | E.A. Birge | Springer. |
| Principles of Molecular Virology | A. Cann | Academic Press. |
| Modern Genetic Analysis | Griffith. | W.H.Freeman |
| Genetics | Gardner | John Wiley & Sons Pte |
| Molecular Cell Biology | Lodish et al | Scientific America W.H.Freeman |
| Molecular Biology | David Freifelder | Narosa Publ. House |
| Text Book of Molecular Biology | Sivarama Sastry et al | Macmillan India Ltd |
| Advanced Molecular Biology : A Concise Reference | R.M. Twyman | Viva Books Pvt.Ltd. |
| Instant notes in Molecular Biology | P.C. Turner et al | Viva Books Pvt. Ltd. |
| The Biochemistry of nucleic acids. | B. Lewin | Oxford University press |
| Biochemistry | L. Stryer. W.H. Freeman and Co.Biochemistry | G.L.Zubay. W.C.B. Publ. |
| Microbial Genetics | David Freifelder | Narosa Publ. House. |
| Biochemistry and Molecular Biology | W.H. Elliott & D.C. Elliott | Oxford University Press. |
| Molecular biology of the Gene | Watson et al | Addison Wesley Longman |
| Schaums Outlines – Molecular and Cell Biology | W.D. Stansfield et al | McGraw-HillPubl. |

# MB - 2002: RECOMBINANT DNA TECHNOLOGY

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|---|---|
| Course Code | MB-2002 |
| Course Title | RECOMNINANT DNA TECHNOLOGY |
| Credit | 4 |
| Teaching per Week | 6 |
| Minimum weeks perSemester | |
| Effective From | June-2023 |
| Purpose ofCourse | To exhibit ability to pursue careers in the industry, agriculture, and applied research where microbial systems are increasingly employed.<br>To address the increasing need for skilled scientific manpower, contributing to application, advancement and impartment of knowledge in interdisciplinary areas related to Microbiology and life sciences.<br>To exhibit excellent professional skills, communication skills and ethical attributesas an effective team member. in a competitive global environment.<br>To demonstrate right mixes of innovative ability, equipped with entrepreneurship abilities contributing to self and national development.<br>The graduates will be cognizant and responsive to the societal needs and will possessthe initiative and critical acumen required to continuously improve their knowledge through life long learning. |
| Course Objective | Gives basic concepts in genetic engineering tools<br>Provides in depth knowledge on molecular tools<br>Gives overall picture about transgnics<br>Provides in depth information about proteome and genomes microbiology |
| Course Outcome | Be able to gain knowledge on genetic engineering tools<br>Be able to gain details on molecular tools<br>Be able to gain in depth-knowledge on transgenic plants<br>Be able to understand about "omics". |

| | **$PO_1$** Knowledge | **$PO_2$** Analysis | **$PO_3$** Design | **$PO_4$** Development | **$PO_5$** Modern Tools | **$PO_6$** Society | **$PO_7$** Environment | **$PO_8$** Ethics | **$PO_9$** Team work | **$PO_{10}$** Communication | **$PO_{11}$** Programme Management | **$PO_{12}$** Lifelong Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **$CO_1$** | 3 | 2 | 2 | 2 | 2 | 1 | 2 | - | - | - | 1 | 1 |
| **$CO_2$** | 3 | 2 | 2 | 1 | 2 | 2 | 1 | - | - | - | 1 | 1 |
| **$CO_3$** | 3 | 1 | 2 | 2 | 3 | 2 | 2 | - | - | - | 1 | 1 |
| **$CO_4$** | 3 | 2 | 2 | 2 | 2 | 1 | 2 | - | - | - | 1 | 1 |

**Course Content**

| Unit No. | Content | Hours/week |
|---|---|---|
| Unit -1 | **Genetic Engineering tools : Vectors-** types, plasmids, transposons, bacterial and animal virus based vectors, bacterial and yeast artificial chromosomes; **enzymes-**restriction endonucleases, different DNA and RNA polymerases ligases, nucleases, kinases, nucleotidyl transferases, alkaline phosphatase; **oligonucleotides-** linkers, homopolymer tails, primers, promoters; **cloning and expression hosts –** *E.coli Bacillus, Agrobacterium,* yeast and plant and animal cell cultures.<br>**Cloning strategies:** Generation of DNA molecules, attachment to vectors, and delivery of recombinant molecules into host cells, screening and identification of positives clones – antibiotic, nucleic acid andprotein based approaches. Construction and screening of cDNA and genomic DNA libraries. | |
| Unit -2 | **DNA sequencing:** Chemical method of Maxum and Gilbert, Sanger's dideoxy chain termination and primer walking methods. Automated sequencing. Sequence assembly. Genome sequencing and physical mapping of genomes.<br>**Site-directed mutagenesis:** Different approaches and its potential in changing genes.<br>**Molecular diagnostics :** Preparation of DNA and RNA probes, nucleic acid hybridization, factors influencing hybridization and their applications; PCR-principles, factors affecting PCR, different types of PCR and their applications and limitations; profiling of nucleic acids by DNA fingerprinting, RFLP, RAPD and AFLP. | |
| Unit-3 | **Transgenic plants:** Construction of plant cell expression vector with desired genes, biological and physical approaches for delivering genes into plant tissues, identification and regeneration of transformed tissues to transgenics. Transgenic plants as bioreactors.<br>**Transgenic animals:** Construction of animal cell expression vectors and delivering of genes into cultured animal cells. Production and use of transgenic animals (mice, sheep/goat, cow). | |
| Unit-4 | **Microbial genomics and proteomics : DNA microarray –** printing of oligonucleotides and PCR products on glass slides. Whole genome analysis for global pattern of gene expression using fluorescent labeled cDNA or end labeled RNA. Analysis of single nucleotide polymorphisms using DNA chips. **Proteome analysis-**two-dimentional analysis of total cellular proteins, isolation and sequence analysis of individual protein spots by mass spectroscopy. Protein microarray, advantagesand disadvantages of DNA and protein microarray.<br>**Applications and implications** of genetic engineering in biology, agriculture, medicine and industry. | |

## References:

| Title | Authors | Publishers |
|---|---|---|
| Principles of Gene Manipulation : An introduction to genetic engineering | Old andPrimrose. | Blackwell Scientific Publ. |
| Molecular Biotechnology | Glick and Pasternak | Panima Publ. |
| Recombinant DNA | J.D. Watson et al | Freeman and Co. |
| Protein expression : A Practical Approach | S.J. Higgins and B.D. Hames (eds). | OxfordUniversity Press. |
| Functional Genomics : A Practical Approach | .P. Hunt and R. Liveey (eds.). | OxfordUniversity Press. |
| DNA Microarrays : A Practical Approach | M. Schena (ed.). | Oxford University Press |
| Molecular biology and Biotechnology | J.M. Walker and R. Rapley | Panima. |
| Manual of Industrial Microbiology and Biotechnology | Demain, A.L | ASM Press. |
| Recombinant DNA and Biotechnology : A guide for Teachers | H. Kreuzer and A. Massey. | ASM Press. |
| Recombinant DNA and Biotechnology : A guide to students | H. Kreuzer and A. Massey | ASM Press. |
| Basic Biotechnology | C. Ratledge & B. Kristiansen | Cambridge University Press. |
| Molecular Cloning | Sambrook and Russel | CSH Press |
| Current Protocols in Molecular Biology | Ausbel et al. | John willey & sons inc |
| Genome analysis | Bruce Bireen | CSH Press. |

# MB 2003- IMMUNOLOGY

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|---|---|
| Course Code | MB-2003 |
| Course Title | IMMUNOLOGY |
| Credit | 4 |
| Teaching per Week | 6 |
| Minimum weeks perSemester | |
| Effective From | June-2023 |
| Purpose ofCourse | To exhibit ability to pursue careers in the industry, agriculture, and applied research where microbial systems are increasingly employed.<br>To address the increasing need for skilled scientific manpower, contributing to application, advancement and impartment of knowledge in interdisciplinary areas related to Microbiology and life sciences.<br>To exhibit excellent professional skills, communication skills and ethical attributesas an effective team member. in a competitive global environment.<br>To demonstrate right mixes of innovative ability, equipped with entrepreneurship abilities contributing to self and national development.<br>The graduates will be cognizant and responsive to the societal needs and will possessthe initiative and critical acumen required to continuously improve their knowledge through life long learning. |
| Course Objective | Gives a detailed information on cells and organs of the immune system.<br>Gives in depth knowledge about Antigen-antibody interaction.<br>Provides the details on immuno pathology.<br>Gives central concepts in transplantation and transfusion immunology |
| Course Outcome | Be able to describe immunology basics.<br>Be able to understand the theoretical principles of *in vitro* selogical tests.<br>Be able to explain allergic reactions.<br>Be able to explain immunization procedure and immunization programmes. |

| | **$PO_1$** Know ledge | **$PO_2$** Analysis | **$PO_3$** Design | **$PO_4$** Development | **$PO_5$** Modern Tools | **$PO_6$** Society | **$PO_7$** Environment | **$PO_8$** Ethics | **$PO_9$** Team work | **$PO_{10}$** Communication | **$PO_{11}$** Programme Management | **$PO_{12}$** Lifelon g Learnin g |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **$CO_1$** | 3 | 2 | 2 | 2 | 2 | 1 | 2 | - | - | - | 1 | 1 |
| **$CO_2$** | 3 | 2 | 2 | 2 | 2 | 2 | 1 | - | - | - | 1 | 1 |
| **$CO_3$** | 3 | 2 | 1 | 2 | 3 | 2 | 2 | - | - | - | 1 | 1 |
| **$CO_4$** | 3 | 1 | 2 | 2 | 2 | 2 | 2 | - | - | - | 1 | 1 |

## Course Content

| Unit No. | Content | Hours/week |
|---|---|---|
| Unit -1 | **Cells and Organs of the Immune system:** Hematopoiesis, Lymphoid cells, stem cells, Mononuclear cells, Granulocytes, Mast cells, Dendritic cells. Lymphoid organs – Primary and Secondary lymphoid organs.<br>**Types of immunity:** Innate immunity and adaptive immunity, comparative immunity, Immune dysfunction and its consequences.<br>**Immune responses to infectious diseases:** Viral, bacterial, protozoan and other parasitic diseases. | |
| Unit -2 | **Antigens:** types, properties, study of antigenicity, immunogenicity versus antigenicity, factors influencing immunogenicity. Epitopes, haptens, mitogens, superantigens. Viral and bacterial antigens.<br>**Antibodies:** Basic and fine structure of Immunoglobulins, classes and biological activities of Immunoglobulins, Antigenic determinants – Iso, allo and idiotypes. Immunoglobulin super family, antibody diversity, organization and expression of immunoglobulin genes. Production of polyclonal antibodies-animals, additives, adjuvants, routes, dose, collection and preservation of antisera, purification of immunoglobulins, quantitative and qualitative analysis of immunoglobulins.<br>**Monoclonal antibodies:** Hybridoma technology – principle and production of monoclonal antibodies, advantages and disadvantages over polyclonal antibodies, application of monoclonal antibodies.<br>**Recombinant antibodies:** Production and their advantages over conventional antibodies.<br>**Antigen and Antibody interactions:** Affinity, Avidity, Cross reactivity.<br>***In vivo* serological reactions:** Phagocytosis, Opsonization, Neutralization, Protection tests.<br>***In vitro* serological tests :** Precipitation tests in liquid and semisolid media, single and double immuno diffusion tests. Immuno electrophoresis tests (Rocket, counter current). Agglutinations tests- HA and HI, latex agglutination. Complement fixation tests, Labeled antibody based tests – Enzyme linked immunosorbent assays (ELISA), Western blotting, Radio immuno assay (RIA), Immunoflurescent and Immuno specific electron microscopy. Infectivity neutralization test. The relative advantages and disadvantages and their applications in Microbiology | |

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| Unit-3 | **Humoral immune response:** Primary and secondary immune responses, induction, regulation of the immune effector response.<br>**Cell mediated immune response:** Induction and mechanism, antibody-dependent cell mediates cytotoxicity (ADCC).<br>**Immune effector mechanisms:** Cytokines, Lymphokines, Chemokines and their classification, properties and functions.<br>**Complement cascade system:** Complements nomenclature, classification, complement components, functions, activation, regulation, biological consequences, complement deficiencies.<br>**Hypersensitive and Allergic reactions:** Classification, types I, II, III and IV.<br>**Immunopathology:** Immunodefficiencies – Primary immunodeficiency (genetic) diseases due to B cell, T-cell and combined defects (Hypogamma globulinemia, SCID, ADA) phagocyute and complement defects. Autoimmune diseases – Autoimmunity, induction, mechaniss of tissue damage in autoimmunity. Autoimmune diseases – Organ specific (Autoimmune anemias, Autoimmune thyroid diseases, Diabetes mellitus, Multiple sclerosis), Systemic autoimmune diseases (Rheumatoid arthritis, Systemic lupus erythematousus) and their therapy. | |
| Unit-4 | **Major histocompatability complex (MHC) :** Organization and Inheritance of HMC, cellular distribution of HMC molecules, regulations of HMC expression, MHC-immune responsiveness, disease susceptibility, MHC restriction, HLA antigens-Class I, II, III and their functions, Murine antigens and its functions.<br>**Transfusion Immunology:** Blood cell components, blood group systems in human and in animals, Rh typing, transfusion reactions, diseases associated with blood transfusion – Hemolytic anemias, Erythroblastosis featalis.<br>**Transplantation Immunology:** Transplantation antigens, types of transplants, Graft versus host reactions – immunological basis of graft rejection mechanism, prevention of graft rejection, clinical manifestations of graft rejection, Immunosuppressive therapy of allograft response, clinical transplantation.<br>**Tumor immunology:** Cancer and the Immune system, tumor specific antigens, tumors of theimmune system, immune response to tumors, cancer immunotherapy.<br>**Vaccinology :** Type of immunization procedures, active and passive immunization, designing of vaccines, classical and novel/modern approaches for the production of vaccines, purified macromolecules as vaccines, Recombinant – vector vaccines, DNA vaccines, Synthetic peptide vaccines, Multivalent sub-unit vaccines, uses of vaccines, benefits of vaccination, mass immunization programmes. | |

## References:


| Title | Authors | Publishers |
|---|---|---|
| Immunology. 2000 | J. Kuby | W.H. Freeman and Company. |
| Immunology. 1996 | I. Roitt, J. Brostoff and David Male | Mosby publications |
| Fundamental Immunology | R.M. Coleman, M.F. Lombard and R.E. Sicard | Wm. C. Brown Publishers |
| Immunology. 1997 | R.M. Hyde | B.I. Waverly Pvt. Ltd |
| Immunology. 1995 | I.R. Tizard | Saunders College Publishing. |
| Immunology – The Science of self and non-self discrimination | Jon Klein. | John Wiley andSons. |
| Immunology – An illustrated outline | David Male | Churchill Living Stone |
| Viruses that affect immune system | H.Y. Fan, I.S.Y. chen, N. Rosenberg and W.sugden | .American Society for Microbiology. |
| Immunobiology : The immune system in health and disease | C.A. Janeway, Jr., P. Travers | Current biology Ltd |

# MB 2004- MEDICAL MICROBIOLOGY

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|---|---|
| Course Code | MB-2004 |
| Course Title | MEDICAL MICROBIOLOGY |
| Credit | 4 |
| Teaching perWeek | 6 |
| Minimum weeks perSemester | |
| EffectiveFrom | June-2023 |
| Purpose ofCourse | To exhibit ability to pursue careers in the industry, agriculture, and applied research where microbial systems are increasingly employed.<br>To address the increasing need for skilled scientific manpower, contributing to application, advancement and impartment of knowledge in interdisciplinary areas related to Microbiology and life sciences.<br>To exhibit excellent professional skills, communication skills and ethical attributes as an effective team member. in a competitive global environment.<br>To demonstrate right mixes of innovative ability, equipped with entrepreneurship abilities contributing to self and national development.<br>The graduates will be cognizant and responsive to the societal needs and will possess the initiative and critical acumen required to continuously improve their knowledge through life long learning. |
| Course Objective | Provides information on infections and pathogenesis.<br>Helps to learn chemotherapy principle.<br>Be able to explain the symptoms of bacterial infections.<br>Be able to explain the symptoms of viral, fungal and parasitic diseases. |
| Course Outcome | Be able to explain about various infections.<br>Be able to understand the diagnostic methods.<br>Be able to explain the symptoms of bacterial infections.<br>Be able to explain the symptoms of viral, fungal and parasitic diseases |

| | **$PO_1$** Know ledge | **$PO_2$** Analysis | **$PO_3$** Design | **$PO_4$** Development | **$PO_5$** Modern Tools | **$PO_6$** Society | **$PO_7$** Environment | **$PO_8$** Ethics | **$PO_9$** Team work | **$PO_{10}$** Communication | **$PO_{11}$** Programme Management | **$PO_{12}$** Lifelong Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **$CO_1$** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | - | - | - | 1 | 1 |
| **$CO_2$** | 3 | 1 | 2 | 2 | 1 | 2 | 1 | - | - | - | 1 | 1 |
| **$CO_3$** | 3 | 2 | 2 | 2 | 3 | 2 | 2 | - | - | - | 1 | 1 |
| **$CO_4$** | 3 | 2 | 2 | 2 | 2 | 2 | 1 | - | - | - | 1 | 1 |

## Course Content

| Unit No. | Content | Hours/week |
|---|---|---|
| Unit -1 | **Principles of Medical Microbiology:** Historical developments Classification of<br>**Infection:** Sources of infection for man; vehicles or reservoirs of infection. Exogenous infection: 1) Patients 2) carriers – (Healthy; convalescent; contact; paradoxical and chronic) 3) Infected animals (zoonosis) 4) Soil endogenous infection. Mode of spread of infection: 1) Respiratory 2) skin 3) Wound and burn infection 4) Venereal infections 5) Alimentary tract infection 6) Arthorpod-borne blood infections 7) Laboratory infections. Nosocomial infections: common types of hospital infections, their diagnosis and control.<br>**Pathogenesis:** Adhesion in various hosts, cell damage, release of pathogens, Transmissibility, infectivity and Virulence. Opportunistic pathogens and True pathogens. Toxigenicity: Invasiveness, other aggressins (Hyaluronidase), coagulase, fibrinolysins or kinase, depolymerizing enzymes, (mucinase, lipases, proteases, nucleases, collagenase, neuraminidase). Organotropism, variation and virulence. | |
| Unit -2 | **Microbial Toxins**: Types of microbial toxins, Endotoxins, Exotoxins, LC 50 of toxins, Effective dose of toxins, Assay of toxins, Mechanism of action of Diphtheria, Cholera, Staphylococcal toxin and<br>Clostridial neurotoxins. Virulence and virulence factors of microbial toxins. Signs and symptoms of microbial intoxication<br>**Diagnostic methods**: Collection, transport and preliminary processing of clinical samples. Clinical, microbiological, immunological and molecular diagnosis of microbial diseases.<br>**Principle of Chemotherapy**: Chemotherapeutic agents, Mechanism of action of antimicrobial agents, Synthetic compounds and antibiotics and their assay in body fluids, drug resistance, Mechanisms of drug resistance, MDR. Various methods of drug susceptibility testing. Brief account on available vaccines and schedules, passive prophylactic measures. | |
| Unit -3 | **Bacterial diseases:** Symptoms, diagnosis , treatment and prevention of the diseases caused by *Staphylococcus, Streptococcus, Pneumococcus, Neisseria, Corynebacterium, Bacillus, Clostridium, Actinomycete, Rickettsiae, Chlamydiae, Mycoplasma, Enterobacteriacea, Vibrios, Yersinia; Haemophilus; Bordetella, Brucella; Mycobacteria, Spirochetes; Salmonella* species. | |

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| Unit -4 | **Viral diseases:** Virus-host interactions at cellular and organism levels. Common diseases caused by Poxviruses; Herpes virus; Adeno viruses; Picorna viruses; Orthomyxo viruses; Paramyxo viruses; Arbo viruses, Rhabdo viruses, Hepatitis viruses; Oncogenic viruses; Human Immuno deficiency viruses (HIV/AIDS). Prion diseases – Kuru, CJD disease and GSS syndrome.<br>**Fungal diseases:** Diseases caused by dermatophytes, dimorphic fungi and opportunistic fungal pathogens. Description and classification of pathogenic fungi and their laboratory diagnosis.<br>**Parasitic diseases:** Disease caused by parasites like *Entamoeba*, *Plasmodium*, *Trichomonas*, *Leishmania* and *Toxoplasma*, *Giardia*, *Wuchereria*, *Dracunculus.* | |

## Reference:


| Title | Authors | Publishers |
|---|---|---|
| Textbook of Microbiology. 2013 | Ananthanarayan R, Panikar CKJ | OrientLongman Ltd. |
| Review of Medical Microbiology and Immunology | Warren Levinson (2014) | Mc Graw Hilleducation |
| Diagnostic Microbiology (13th Edition) | Bailey & Scott's (2013) | Mosby |
| Color atlas and Text book of Diagnostic microbiology (6th Edition) | Eimer WKoneman | Lippinctt |
| Text Book of Medical Parasitology | Subash CP (2000) | All India Publishers & Distributors. 1st edition. |
| Text Book of Medical Parasitology (7th Edition) | Jayaran Paniker C.K | Jaypee Brothers. |
| Manual of Clinical Microbiology, 7th ed | E.H. Lennette et al Cruichshank *et al.,*(2012) | ASMPublications. |
| MedicalMicrobiology | Patrick R. Murray, Ken S. Rosenthal, Michael A. Pfaller | Elsevier saunders |
| Probiotics and Prebiotics: Current Research andFuture Trends | Koen Venema and Ana Paula do Carmo (2015) | Caister Academic Press |
| Antibiotics: Current Innovations and FutureTrends. | | Caister Academic Press |

# MB 2005- Molecular Biology and Recombinant DNA Technology

| Practical No. | Practical Name | Hours/Week |
|---|---|---|
| 1 | Isolation of Genomic DNA from microbes, plant/animal tissues | |
| 2 | Isolation of plasmids from Bacteria | |
| 3 | Curing of plasmids | |
| 4 | Competent cell preparation. | |
| 5 | Bacterial transformation. | |
| 6 | Bacterial transduction | |
| 7 | Bacterial Conjugation | |
| 8 | Mapping of bacterial genes by conjugation / transformation (problems) | |
| 9 | Side directed mutagenesis | |
| 10 | AMES test. | |
| 11 | Screening and isolation of streptomycin mutant resistant bacteria by gradient plate technique. | |
| 12 | Lethality curve construction | |
| 13 | Study of DNA methylation | |
| 14 | Study of DNA repair | |
| 15 | Invitro transcription assay | |
| 16 | Setting of Genetic Engineering laboratory | |
| 17 | Restriction enzyme analysis of plasmids | |
| 18 | Recovery of DNA from gels – Electroelution and extraction of DNA from low melting agarose gels. | |
| 19 | Southern blotting | |
| 20 | Western blotting for heterologous gene expression | |
| 21 | Polymerase chain reaction | |

## MB 2006- Molecular Biology and Recombinant DNA Technology

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|---|---|
| Course Code | **Practical Core 1: MBP-2006** |
| Course Title | Microbiology practical |
| Credit | |
| Teaching per Week | |
| Minimum weeksper Semester | |
| Effective From | June 2020 |
| Purpose of Course | To provide hand's on experience of using instruments in the laboratory for microbiologypurpose. |
| Course Objective | Gives hands on experience in Immuno precipitation test.<br>Provides hands on experience on various ELISA methods.<br>Will gain knowledge in immune globulins.<br>Gives hands on experience on blood related tests.<br>Given knowledge on virus cultivation<br>Provides hands on experience on various diagnostic tests. |
| Course Outcomes | Able performs various immune precipitations tests.<br>Be able to perform various types of ELISA methods.<br>Be able to gain practical knowledge about immunoglobulin's and their separation.<br>Be able to perform widal, VDRL and types.<br>Be able to perform various staining procedures.<br>Be able to identify blood cell types |
| Pre-requisite | Basic science |

| Practical No. | Practical Name | Hours/Week |
|---|---|---|
| 1 | Purification of immune globulins | |
| 2 | Electrophoretic separation of normal and immune serum | |
| 3 | Ouchterlony double Immuno diffusion | |
| 4 | Single radial Immuno diffusion | |
| 5 | Immuno precipitation test | |
| 6 | Rocket Immuno electrophoresis | |
| 7 | Counter current Immuno electrophoresis | |
| 8 | Isolation & Identification of Rosettee cells | |
| 9 | Dot ELISA | |
| 10 | Sandwich ELISA | |
| 11 | Antigen Capture ELISA | |
| 12 | Antibody Capture ELISA | |
| 13 | ASO titre. | |
| 14 | Complement fixation test | |

| | | |
|---|---|---|
| 15 | Widal Test | |
| 16 | VDRL Test | |
| 17 | Total counting of RBC & WBC | |
| 18 | Differential count of WBC | |
| 19 | Hemoglobin estimation | |
| 20 | Latex agglutination test | |
| 21 | Blood typing and Rh determination | |
| 22 | Identification of pathogenic organisms based on HIV& DOT-BLOT test | |