Syllabus

M.Sc. Microbiology : 2022-23

Four Semester Course
(Choice Base Credit System)

School of Environmental Biology

Awadhesh Pratap Singh University Rewa M. P.

Master of Science (Microbiology) Program Outcomes (POs)

Program Outcome	Description
PO1	Foster learning through accumulation of knowledge in Science.
PO2	Identify complex problems in the society which can be addressed through science.
PO3	Formulate strategies and design experiments to address the societal problems using first principles of basic sciences and applied sciences.
PO4	Adopt appropriate scientific techniques and resources to solve societal issues with an understanding of the limitations.
PO5	Critically and analytically evaluate and interpret research based data to provide valid conclusions and solutions.
PO6	Demonstrate leadership qualities by working collaboratively in a team, to set goals, communicate scientific information to stakeholders, comprehend and write reports, develop documentation, make presentation and to give and receive clear instructions.
PO7	Apply ethical principles, commit to professional ethics and responsibilities and norms of the scientific practice

Program Specific Outcomes (PSOs)

Branch	PSO	Description
Microbiology	**PSO1**	Communicate and analyze the core concepts and theories in Microbiology and allied sciences (Microbial systematic, Immunology, Biochemistry, Medical Microbiology, Molecular Biology, Genetic Engineering, Biostatistics)
	PSO2	Apply basic concepts/ theories of Life Sciences for solving current scientific and social issues in key fields such as agriculture, food, environment, human health, transgenic animals, GMOs and plant disease management
	PSO3	Plan and design systematic research activities in the field of Microbiology and allied sciences including necessary skills for collecting, processing and interpreting data and drawing logical inferences
	PSO4	Engage in life-long learning in the broadest context of scientific advancement.

Course Outcomes (COs)

Semester	Course Code	Course Name	Course Outcomes (COs)
Ist Semester	**MB.101**	**Introduction to Microbiology and General Bacteriology**	**CO1 :** Describe the morphological features of Bacteria and their types, systematics for the classification of bacteria by latest approaches **CO2 :** State the principles of various sterilization techniques. skills involved in culture media preparation, pure culturing and staining techniques to identify and evaluate the bacteria **CO3:** illustrate the metagenomic approach for the identification of uncultivable forms of bacteria **CO4:** Explain the ultra structure of bacteria, virus, viriods and Prions **CO5:** Choose different techniques for the isolation of Aerobic and anaerobic microorganisms
	MB 102	**Virology and Mycology**	**CO1 :**Gain knowledge on genome and morphology of viruses and fungi . **CO2 :** Understand the methods of infection and exploitation of host cells by viruses and fungi for reproduction, their interaction with host organism physiology and immunity. **CO3:** Learn how disease viruses and fungi cause, the techniques to isolate and culture them, and their use in research and therapy. **CO4:** Analyse the ecology and classification of fungi and viruses.Evaluate the fields where fungi can be applied. **CO5:** Assemble the knowledge of fungal and phage genetics and the structure and function of YACs and YIPs with their applications in genetic engineering.
		Cell Biology and Biochemistry	**CO1 :** Distinguish molecular level detailed structure of cells and organelles present in cells. **CO2:** Illustrate the genome organization in prokaryotes and eukaryotes. **CO3 :**Interpret structure and concentration of carbohydrates, protiens and nucleic acids present in

			biological sample with the preparation of buffers with appropriate concentrations. **CO4:** Determine the saponification value and iodine number of Lipids and proteins. **CO5:** Assemble the concepts of various techniques for solving a research problem.
	MB 104	**Microbial Genetics and Molecular Biology**	**CO1 :** State the fundamentals of microbial genetics, processes behind mutations and other genetic changes. **CO2 :** Discuss the basic structure and function of gene in prokaryotes and bacteriophages. **CO3:** Illustrate the genome organization in prokaryotes and eukaryotes. **CO4:** Differentiate between the process of DNA replication in bacteria and viruses. **CO5:** Recommend the significance of gene transfer techniques in bacteria.
IInd Semester	**MB 201**	**Bioinstumentation**	**CO1 :** State the principles of various microbiological techniques. **CO2 :** Discuss the requirements and skills involved in purification of biomolecules. **CO3:** Demonstrate the steps involved in different techniques used to analyze biomolecules from different sources. **CO4:** Examine the quality/activity of purified biomolecules **CO5:** Assess the application of each technique.
	MB 202	**Immunology**	**CO1 :** Name the components of the immune system and their biological functions. **CO2 :** Discuss the concepts behind blood grouping and Rh incompatibilities. **CO3:** Demonstrate the technical know-how of diagnostic techniques in immunology. **CO4:** Distinguish the immunological disorders among human population. **CO5:** Recommend the medical applications of immunology in disease diagnosis and immunotherapy.
	MB 203	**Microbial Technology**	**CO1 :** List the isolation and screening of cultures for new microbial products; and features of inoculum development.

			CO2 : Discuss the strategies for various culture preservation techniques, microbial strain improvement methods and industrial media formulation. **CO3:** Illustrate the kinetics of microbial growth and features of different industrial bioreactors. Describe the fermentative production of alcohol and amylase/protease (SSF). **CO4 :** Discuss the citric acid and penicillin production by SmF andSSF and their respective bioassays. **CO5:** Compare the immobilization techniques and concepts pertaining to the downstream processing of microbial metabolites.
	MB 204	**Biostatistics,Computer Fundamentals and Bioinformatics.**	**CO1 :**Gain knowledge on statistical tests that can be conducted for the data **CO2 :** Employ statistical method for data collected **CO3:** Operate various softwares to examine the data collected **CO4:** Assess different biological databases, sequence alignment and phylogenetics **CO5:** Assemble the concepts of immunology in vaccine development.
IIIrd Semester	**MB 301**	**Medical Microbiology**	**CO1 :** State the significance of normal human flora, various host-pathogen interactions, and human microbiome project. **CO2 :** Discuss the pathogenicity, epidemiology, laboratory diagnosis, treatment, and prevention of important bacterial diseases. **CO3:** Illustrate the pathogenicity, epidemiology, laboratory diagnosis, treatment, and prevention of significant viral diseases. **CO4:** Compare the features of several human diseases caused by fungi. **CO5:** Assess the mode of action, target organisms, toxicity of antibiotics, antifungals and antiviral drugs.
	MB 302	**Recombinant DNA Technology**	**CO1 :** Explain difference between conventional cloning and modern cloning methods. **CO2 :** Interpret the technical know-how of versatile techniques in recombinant DNA technology. **CO3:** Examine the current applications of RDT in biotechnology and advances in the different areas like medical, microbial, environmental, bioremediation, agricultural, plant, animal, and forensic. **CO4:** Appraise the genetic engineering techniques

			and applications with their regulatory and ethical implications in basic and applied experimental biology. **CO5:**Assemble the knowledge of patent laws, their legal implications, handling and disposal of bio-hazardous materials, good laboratory and manufacturing practices.
	MB 303A	**Environmental Microbiology**	**CO1 :** Gain knowledge on the microorganisms present in the environment **CO2 :** Examine the types of microorganisms in the environment **CO3:** Prioritize the methods of making pollution free environment **CO4:** Formulate methods for exploiting microorganisms for human benefit . **CO5:** Recommend the current applications of microorganisms in biodegradation of environmental pollutants, in agriculture as biofertilizers and biopesticides, and in the development of alternate fuels.
	MB 303 B	**Microbial Diagnosis in health clinics**	**CO1 :** Understand the various types of diseases caused by pathoges and types of samples.Assemble the concept of collection, transport. **CO2 :**Learn processing of major clinical samples and immunomolecular diagnostic . **CO3 :** List out the routes of transmission of infections. **CO4 :** Explain the usage of disinfectants and sterilants **CO5:** Interpret the risks involved in a hospital environment and their management practices
	MB 304	**Microbial Physiology and Metabolism**	**CO1:**Determine the growth curve and generation time of bacteria as well as determine the concentration of phosphates. **CO2:** Outline the fundamentals of membrane transport and quorum sensing **CO3:**Explain the fundamentals of Carbohydrate metabolism and lipid metabolism and Mechanism of ATP synthesis. and bioleuminescence in bacteria. **CO4:** Differentiate the mechanism behind the oxygenic photosynthesis and anooxygenic photosynthesis **CO5:** Access the fundamentals of Amino acid metabolism and nucleic acid metabolism

IVth Semester	**MB 401**	**Agriculture Microbiology**	**CO1 :** Describe the types of biogeochemical cycles, physical and chemical characteristics of soil **CO2 :** Illustrate the different plant microbe interactions in rhizosphere, Phyllosphere and Spermosphere **CO3:** Illustrate the importance of Bacterial, fungal and Viral biological control agents **CO4:** Outlinethe different types of fungal, bacterial, viral, mycoplasma and viroid diseases caused in plants and control of these diseases **CO5:** Examine different types of post harvest diseases caused during the storage of food commodities
	MB 402A	**Food Microbiology**	**CO1:** Illustrate the production and spoilage of different fermented foods **CO2:** Distinguish the features of several food-borne infections and intoxications caused by microorganisms. **CO3 :** Name the processing methods used in food industry. **CO4 :** Describe the concepts behind microbial examination of food. **CO5:** Employ techniques to improve the shelf life of food products.
	MB 402B	**Enzyme Technology**	**CO1:**Examine the basic concepts of enzymology which includes the classification and mechanism of action . **CO2:**Demonstrate the steps involved in immobilization of whole cells and enzymes. **CO3:** Understand the production and commertial application of enzymes. **CO4:** Rate the quality of fermented food products **CO5:** Propose the role of regulatory agencies in food safety.

M. Sc. Microbiology (Choice Base Credit System)
A. P. S. University Rewa (M. P.)
Syllabus for Session 2021-22
The Scheme of Examination

M.Sc. Microbiology –I						
No. of papers.	**Name of papers**	**Course type**	**Theory**	**I. A.**	**Total**	**Total Credit.**
MB:101	Introduction to Microbiology and GeneralBacteriology	Core	60	40	100	4
MB:102	Virology and Mycology	Core	60	40	100	4
MB:103	Cell Biology and Biochemistry	Core	60	40	100	4
MB:104	*Microbial Genetics and Molecular Biology.	Generic elective	60	40	100	4
MB:105	practical		100		100	4
MB:106	Comprehensive viva voce		100		100	4
Total					**600**	**24**

M.Sc. Microbiology –II						
No. of papers.	**Name of papers**	**Coursetype**	**Theory**	**I. A.**	**Total**	**Total Credits**
MB:201	Bioinstrumentation	Core	60	40	100	4
MB:202	Immunology	Core	60	40	100	4
MB:203	Microbial Technology	Core	60	40	100	4
MB:204	*Biostatistics , Computer Fundamentals and Bioinformatics.	Generic elective	60	40	100	4
MB:205	practical		100		100	4
MB:206	Comprehensive viva voce		100		100	4
Total					**600**	**24**

M.Sc. Microbiology –III						
No.of papers.	**Name of papers**	**Coursetype**	**Theory.**	**I. A.**	**Total**	**Total Credits**
MB:301	Medical Microbiology	Core	60	40	100	4
MB:302	Recombinant DNA Technology	Core	60	40	100	4
MB:303	**(A) Environmental Microbiology **Or**	Discipline centric elective	60	40	100	4
	**(B)Microbial diagnosis in health clinics	Discipline centric elective				
MB:304	Microbial Physiology and Metabolism	Generic elective	60	40	100	4
MB:305	practical		100		100	4
MB:306	Comprehensive viva voce		100		100	4
Total					**600**	**24**

M.Sc. Microbiology –IV						
No.of papers	**Name of papers**	**Coursetype**	**Theory**	**I. A.**	**Total**	**Total Credit.**
MB:401	Agriculture microbiology	Core	60	40	100	4
MB:402	**(A) Food microbiology **Or**	Discipline centric Elective	60	40	100	4
	**(B) Enzyme technology	Discipline centric Elective				
MB:403	Project work of 3-4 months duration		100		100	4
MB:404	Comprehensive viva voce		100		100	4
			Total		400	16
	GRAND TOTAL				**2200**	**88**

M.Sc. Ist Semester

MB: 101- INTRODUCTIONS TO MICROBIOLOGY AND GENERAL BACTERIOLOGY

UNIT-I

1. Introduction and history of Microbiology and scope of Microbiology.
2. Microorganism: their general characteristics and composition of microbial world; Prokaryotes and Eukaryotes.
3. Classification of Microorganisms: Haekel's three kingdom concept, Whittaker's five kingdom concept, three domain concept of Carl Woese , classification and salient features of bacteria according to Berger's Manual of Determinative Bacteriology.
4. Nomenclature and modern method of Bacterial taxonomy.

UNIT-II

1. Morphology and ultra structure of bacteria : size, shape, and arrangement of bacteria, ultra structure of bacterial cell wall of eubacteria and archeobacteria , relation of Gram staining tobacterial cell wall. Protoplast and spheroplast formation and L-form.
2. Structure and function of flagella, fimbriae and pilli, capsule- type, composition and function , slimelayers, S-layers.
3. Cell membrane- structure and function of bacteria and archeobacteria , mesosomes , ribosomes, nucleoid ,cytoplasmic inclusion bodies- polyhydroxy butyrate, polyphosphate granules, oil droplets, cynophycin granules.
4. Endospore: structure, formation and germination of bacterial endospore . Chemotaxis and phototaxis.

UNIT-III

1. Bactrial nutrition: Basic nutritional requirements, growth factors, nutritional categories, physical requirements of bacterial growth.
2. Bacteriological media: types (complex, synthetic, differential and selective media) and their uses, culturecharacteristics of bacteria on different media.
3. Cultivation of bacteria: aerobic and anaerobic culture, shaker and still culture, maintenance and preservation of microbial culture.
4. Bacterial growth: growth kinetics, growth curve. Batch, continuous and synchronous culture. Measurement of growth and influence of environmental factors affecting growth.

UNIT-IV

1. General concept of rokaryotic and Eukaryotic genome. E.coli chromosome.
2. Genetic recombination and transformation.
3. Transduction : generalized and specialized transduction, phage conversion.
4. Plasmid: types and their significance. Conjugation and chromosomal mobilization. E.coli as a model prokaryotes.

UNIT-V

1. Control of microorganisms: Microbial death curve, concept of bioburden, thermal death time and decimalreduction time. Factors influencing the effectiveness of antimicrobial agents.
2. Control of microorganisms by physical agents: heat , filtration andradiation.
3. Chemical control of microorganisms : Halogens, phenol and other phenolic compounds, heavy metals,alcohols, ethylene oxide and aldehydes.
4. Antibiotics: properties and mode of action, drug resistance and its significance. Antimicrobial sensitivitytest.

M.Sc. Ist Semester

MB: 102 : VIROLOGY AND MYCOLOGY

UNIT-I

1. Brief outline on discovery and origin of viruses.
2. General properties of viruses, morphology and ultra structure of viruses, capsid and their arrangements, types of envelopes and their composition, measurement of viruses.
3. Viral genome; their types and structure, viral related agents-viroids and prions.
4. Classification and general properties of major families of viruses including detail account of their mode of replication.

UNIT-II

1. Cultivation of viruses- in embryonated eggs, experimental animals and cell lines; primary andsecondary cell lines, diploid cell culture.
2. Assay of viruses: physical and chemical methods (protein , nucleic acid, radioactivity tracers,electron microscopy, plaque method, pock counting and end point method.)
3. Serological methods: hemagglutination, hemagglutination inhibition, neutralization test, complement fixation, ELISA, RIA and immunoflourescence assay (IFA)
4. Purification of viruses: gradient centrifuge, electrophoresis, and chromatography.

UNIT-III

1. Plant viruses: recent advance in classification of plant viruses. Structure and pathgenicity of TMV.
2. Transmission of plant viruses with vector (insect, nematodes and fungi) and without vector (contact,seed and pollens). Biochemical changes induced by virus in plant cell.
3. Animal viruses: nomenclature and classification of animal viruses. Host responses to viral infection.
4. General idea about Cyanophage, Actinophage, and Mycophage.

UNIT-IV

1. Bacteriophage: classification, morphology and ultra structure.
2. One step growth curve (latent period, eclipse period, and burst of size.)
3. Life cycle : lytic and lysogenic life cycle of bacteriophages.
4. Brief account of M13, Mu, T3, T4, f x 174 and lamdaphage.

UNIT-V

1. Structure, reproduction and classification of fungi, general characteristics of Zygomycetes, Ascomycetes, Basidiomycetes, and Duteromycetes.
2. Cultivation of fungi, culture media for fungal growth, effects of environment on growth, isolation, identification and preservation of fungi.
3. Dimorphic fungi, yeast morphology, general characteristics and reproduction. Lichens, Micorrhiza, and Actinomycetes.
4. Ecology of fungi: concept of fungistatis, fungicidal, antagonism, symbiosis andSynergism.

M.Sc. Ist Semester

MB: 103- CELL BIOLOGY AND BIOCHEMISTRY

UNIT-I

1. Cell: size, shape, types & chemical composition of the cell.
2. Structural organization and function of intracellular organelles of eukaryotic cell: nucleus, mitochondria, golgi body, lysosomes, endoplasmic reticulum, peroxisomes, plastids, chloroplast, vacuole, cytoskeleton.
3. Membrane structure and function: molecular organization of cell membrane, membrane models, mechanisms of intracellular transport.
4. Cellular interaction: differentiation of cell membrane and intracellular communication and Gap junction.

UNIT-II

1. Cell differentiation: general characteristics of cell differentiation and cytoplasmic factors, differential gene action.
2. Cell signaling: cell surface receptors, G-protein, signal transductionpathways.
3. Cell cycle: mitosis and meiosis and their regulation. Programmed cell death andappoptosis.
4. Cancer biology: characteristics of cancer cell, types of cancer, oncogene andTumor markers.

UNIT-III

1. Carbohydrates: structure of sugars, classification, properties, chemical reactions, stereoisomerism and optical isomers of sugars.
2. Structure, properties and function of disaccharides, oligosaccharides, and polysaccharides, carbohydrate derivatives; peptidoglycan, glycoproteins,glycolipids.
3. Lipids : classification, structure, properties and functions of fatty acids, triacylglycerols, phospholipids, sterols and terpenes.
4. Lipids with specific biological functions, micelles and liposomes.

UNIT-IV

1. Amino acids: structure, classification, properties and functions.
2. Proteins : structural and functional proteins, synthesis of peptide bonds.Primary, secondary, tertiary and quaternary structure ofproteins.
3. Nucleic acids: structure and properties of purines and pyrimidine bases, nucleosides and nucleotides.
4. Basic structure and types of DNA and RNA.

UNIT-V

1. Enzymes: basic concept as a biocatalyst, specificity, active sites, activityunit and isoenzymes, enzyme classification.
2. Enzyme kinetics- Michaelis-Menton equation for simpleenzymes, determination of kinetic parameters.
3. Enzyme inhibition: competitive, noncompetitive and uncompetitive inhibition, allosteric enzymes.
4. Vitamins and cofactors: structure, distribution and biological properties.

M.Sc. Ist Semester

MB : 104 - MICROBIAL GENETICS AND MOLECULAR BIOLOGY (Generic Elective)

UNIT-I

1. Organization of genetic material in prokaryotes and eukaryotes.
2. Concept of gene, genome, genome size, C-value, and C-value paradox.
3. Nucleic acid as a genetic information carriers; experimental evidence. DNA denaturation and renaturation.
4. Gene is a unit of mutation and recombination; molecular basis of mutations, physical and chemical mutagens, spontaneous and induced mutation, selection of mutant.

UNIT-II

1. DNA damage and repair: types of DNA damage (deamination, oxidative damage, alkylation and pyrimidine diamers.), repair mechanism; mismatch repair, nucleotide excision repair, recombination repair, SOS repair.
2. Structure of DNA, super helicity of DNA, linking number, topological properties and role of topoisomerase.
3. DNA replication: general principle, various mode of replication, unwinding of DNA Helix, continuous and discontinuous synthesis of leading and lagging strands.
4. Enzymes of DNA replication in prokaryotes and eukaryotes; DNA polimerases, DNA ligase, primase.

UNIT-III

1. Structural features of RNA (rRNA, tRNA, mRNA) and polycistronic andmonocistronic RNA.
2. Transcription: general principle and processes of transcription; initiation, elongation and termination, types of RNA polymerases, inhibitors of RNA synthesis.
3. Control of Transcription by interaction between RNA polymerases and promoterregion, use of alternate sigma factors, controlled termination; attenuation and antitermination.
4. Post transcriptional modification, maturation and splicing of RNA transcripts, catalytic RNA.

UNIT-IV

1. Genetic code: nature of genetic code, codon, anticodon, wobble hypothesis.
2. Protein synthesis: steps, details of initiation, elongation and termination.
3. Inhibitors of protein synthesis: signal hypothesis.
4. Post translational modification: covalent modification, phosphorylation, glycosylation, methylation. Protein targeting.

UNIT-V

1. Regulation of gene expression: operon concept; regulatory and structural gene, operator, promoter,represser , induction and repression, positive and negative control.
2. Lac-operon, ara-BAD operon, trp operon, attenuation, mechanism of regulation of transcription.
3. Regulation of gene expression in eukaryotes: Britton and Davidson's model of regulation involveHCP and NHCP and hormones.
4. Transposable elements.

M.Sc.II^{Ind} Semester

MB : 201- BOINSTUMENTATION

UNIT-I

1. Microscopy: history and principles of microscopy, magnification power, Resolution limit, resolving power, numerical aperture.
2. Principles and application of light microscopy, properties of light, bright field,dark field, phase contrast and fluorescent microscopy. Determination of size ofmicroorganisms by micrometery.
3. Principles and application of electron microscopy- transmission and scanning electron microscopy.
4. Newer techniques in microscopy- confocal microscopy, scanning probe microscopy (scanning tunneling microscope and atomic force microscope).

UNIT-II

1. Concepts of acids and bases, pH, measurement of pH by uses of indicator andelectronic meter, buffersystem.
2. Chromatography: principles, types and applications of partition, adsorption, gelfiltration, paper and thin layer chromatography.
3. Affinity, ion exchange, and gas chromatography.
4. High performance liquid chromatography and FPLC.

UNIT-III

1. Electrophoresis: principle, types and applications, frontal and zonal electrophoresis, paper, starch gel, Polyacrylamide and agarose gel electrophoresis.
2. Isoelectric focussing and Isotachophoresis.
3. Two dimentional gel electrophoresis and pulse field gel electrophoresis.
4. Immunological techniques: immunoelectrophoresis , immunodiffusion, immuno fluoroscence.

UNIT-IV

1. Spectroscopy: basic principles, low of absorption and radiation, principles and application of visible,ultraviolet, infrared and mass spectroscopy.
2. Principles and application of NMR and ESR.
3. Principles and application of colorimetry, fluorscence flame photometry.
4. Fluorimetry , polarimetry and turbidometry.

UNIT-V

1. Centrifugation: basic principles of analytical and preparative centrifuge, differential and density gradient, zonal and isopycinic centrifuge. Sedimentation coefficient, factors affecting sedimentation coefficient and application.
2. Radioisotope techniques: half life, radioactive decay, radioactive assay methods based on ionization and excitation of gases.
3. Geiger Muller counter, liquid scintillation counter and gamma counter.
4. Quenching and use of radioisotopes in biological systems. Autoradiography- principles and applications.

M.Sc.II^{Ind} Semester

MB: 202- IMMUNOLOGY

UNIT-I

1. Infection: types of infection, sources of infection, reservoirs and vehicles of infection, predisposingfactors.
2. History of immunology, development of immunology as disciples.
3. Immune response: mechanism of innate and adaptive immune response.
4. Hematopoiesis: development of immune cells, regulation of hematopoiesis and stem cell technology.

UNIT-II

1. Structure, composition and types of cells involve in immune response: mononuclear cells, granulocytes,antigen presenting cells , lymphoid cells.
2. Anatomical organization of immune system: primary and secondary lymphoid organs: structureand function.
3. Antigens- structure and properties, factors affecting the immunogenicity , properties of B and T-cell epitopes, haptens, mitogens, superantigen.
4. Antibody : stucture, properties, types and function of antibodies, antigenic determinants on immunoglobulin; isotypes, allotypes, and idiotypes.

UNIT-III

1. Hybridoma technology and monoclonal antibody production and characterization.
2. Application of monoclonal antibodies in diagnosis, therapy and basis research, antibody engineering.
3. Antigen- antibody interaction : avidity and affinity measurements, detection of antigen-antibodyinteraction by precipitation, agglutination, RIA, ELISA, immunodiffusion.
4. Major histocompatibility complex: organization of MHC genes, types and function of MHCmolecules, MHC polymorphism, MHC related diseases.

UNIT-IV

1. Complement system: components, activation pathways, regulation of activation pathways, role ofcomplement system in immune response.
2. Cytokines: types, structure and functions, cytokines receptors, cytokine regulation of immunereceptors.
3. Immune response to infectious diseases: viral infection, bacterial infection, protozoan diseases,helminthes related diseases.
4. Vaccines: Active and passive immunization, whole organ vaccine, purified macromolecule as avaccine, DNA vaccine, recombinant vaccine.

UNIT-V

1. Hypersensitivity: type I, II, III and types IV hypersensitivity. Immunodeficiency diseases: primaryand secondary immunodeficiency.
2. Autoimmunity: organ specific autoimmune diseases, mechanism of autoimmune diseases and therapeutic approaches.
3. Transplantation immunology: immunologic basis of graft rejection, clinical manifestation of graftrejection and clinical transplantation.
4. Cancer immunology: tumor antigen, immune response to tumor, oncogene and induction, cancerimmunotherapy.

M.Sc.II^{Ind} Semester

MB: 203 -MICROBIAL TECHNOLGOY

UNIT-I

1. Industrial important strains of bacteria, fungi, and actinomycetes .Novel microbes for future industry.
2. Isolation and screening of the industrially important strain from diverse ecosystem.
3. Method of strain improvement, mutagenesis, strain breeding by protoplast fusion, sexual andpara sexual recombination.
4. Fermentation technology: principles of fermentation. Fermenter and bioreactors: monitoringand control of parameters, designing, operation and application.

UNIT-II

1. Downstream processing: filtration of fermentation broths recovery of biological products bydistillation, superficial fluid extraction.
2. Detection, analysis and quality control of fermentation products and raw materials.
3. Industrial production of alcohols: vinegar, wine and alcohol.
4. Industrial production of solvents-glycerol, acetone, and Butanol.

UNIT-III

1. Industrial production of citric acid and glutamic acid.
2. Microbial production of enzyme of industrial important: amylase andproteases.
3. Methods of whole cell immobilization, enzyme immobilization and application.
4. Industrial production of antibiotics, penicillin and streptomycin.

UNIT-IV

1. Hygiene and safety in fermentation industries.
2. Microbial production of Vitamin B and $B_{12.}$
3. Microbial production of Interferon, Insulin, flavours and fragrances.
4. Bioelectronics : Biochips and biosensors.

UNIT-V

1. Microbial production of vaccines.
2. Microbial production of polymers : Dextran and xanthan.
3. Microbial transformations : Steroid biotransformation
4. Intellectual property rights (IPR) and protection (IPP)

M.Sc.II^{Ind} Semester

MB: 204- Biostatistics, Computer Fundamentals and Bioinformatics
(Generic Elective)

Unit I

1. Introduction to Biostatistics, Common terms, notions and Applications
2. Statistical population and Sampling Methods
3. Classification and tabulation of Data
4. Diagrammatic and graphical presentation
5. Frequency Distribution, Measures of central value
6. Measures of variability; Standard deviation, standard Error, Range, Mean Deviation, Coefficient of variation, Analysis of variance

Unit II

1. Basic tests, Test of significance; t-test, chi-square test.
2. Correlation and Regression; Basic of regression, regression analysis, Estimation, Testing, prediction, Checking and residual analysis.
3. Multivariate Analysis.
4. Design of Experiments, randomization, replication, local control, complimentary Randomized, randomized block design
5. Statistical Packages: SPSS, Graph pad etc

Unit III

1. Introduction to Information technology and computer
2. Office applications: MS- Office, MS- Word, MS- Excel and MS- PowerPoint
3. Introduction to data mining
4. Internet- introduction and application

Unit IV

1. Classification and Discriminant Analysis Tools: CART, Random forests,
2. Fisher's discriminant functions.
3. Neural networks.
4. Multilayer perception, predictive ANN model building using back propagation algorithm, exploratory data analysis.

Unit V

1. Databases, Plant Genome Databases, Retrieving and installing a programme (Tree Tool), Multiple sequence alignment programme - Clustal W , X. Genome analysis programs; BLAST, FASTA, CGC, Motif and profile Sequence search.
2. Phylogenetic analysis: Phylogenetic reconstruction, distance matrices, Parsimony, Philip.
3. Methods of prediction of Proteins, DNA, RNA, fold recognition, structure prediction
4. Computer aided drug designing: Basic principles, docking, ADME/TOX
5. Genome mapping applications: EST and Functional genomics
6. Use of genome analysis programs, primer designing tools.

M.Sc.IIIrd Semester

MB : 301 -MEDICAL MICROBIOLOGY

UNIT-I

1. Early discovery of pathogenic microorganisms, development of bacteriology as scientific discipline,contribution made by eminent scientists.
2. Host-parasite relationship governing the infection and establishment of disease, factors affectingvirulence.
3. Normal microflora of human body; normal flora of skin, respiratory, gastrointestinal, genital tract, roleof resident flora
4. Mode of spread of infection; Respiratory, skin, wound & burn infection, venereal infections, alimentary tract infection, blood born infection.

UNIT-II

1. Source of infection, Pathogenicity, Epidemiology & Lab diagnosis of Pneumococcus, Neisseria ,Corynebacterium, & Clostridium.
2. Source of infection, Pathogenicity, & Epidemiology & Lab diagnosis of members of the familyEnterobacteriaceae, Coliform; Proteus, Shigella, Salmonella .
3. Vibrio, Mycobacterium, Staphylococcus, Pseudomonas, Pasteurella, Yersenia, Brucella.
4. Actinomycetes, Rickettsiaceae , Clamydiae, Spirocheates.

UNIT-III

1. Morphology , pathogenesis, immune response, diagnosis and prevention of
2. Pox viruses , Herpes Simplex type I and type II, Picorna viruses.
3. Paramyxo viruses, Measles & Mumps viruses & Rhabdo viruses.
4. Hepatitis viruses, Arboviruses, Orthomyxoviruses.
5. Oncogenic viruses & HIV viruse & Prions.

UNIT-IV

1. Pathogenesis, Life Cycles, Immunity, Disease produced, Diagnosis & Prophylaxis of
2. Plasmodium vivax, falciparum, malariae.
3. Entamoeba histolytica & Coli
4. Toxoplasmosis , Trypanosomiasis & Leishmaniasis.
5. Roundworm & Tapeworm; Taenia solium & segineta.

UNIT-V

1. Fungal infection: description & classification of pathogenic fungi
2. Infection caused by dermatophytes (Microsporum, Trichophyton & Epidermatophyton)
3. Definition, Causative agent, Source of infection, Epidemiology, Symptomatology & Diagnosis ofAspergillosis & Candidiasis
4. Source of infection, Epidemiology, Symptomatology, & Diagnosis of Blastomycosis, Histoplasmosis

M.Sc.IIIrd Semester

MB: 302- RECOMBINANT DNA TECHNOLOGIES

UNIT-I

1. Enzymes used in DNA technology: Restriction and modification enzymes, nucleases, polymerases, ligase, kinases and phosphatases .
2. Cloning vectors: Plasmids , Phagmids, Cosmids, Artificial chromosomes, Shuttle vectors , Expression vectors
3. Cloning Techniques: Isolation & purification of genomic & plasmid DNA & RNA ,Gel electrophoresis of nucleic acids (RNA & DNA); Pulse field gelelectrophoresis.
4. Construction of genomic and cDNA libraries.

UNIT-II

1. Screening of clones from libraries :Expression based screening , Interaction basedscreening ,Preparation of probes , Restriction mapping.
2. Principles of hybridizations and hybridization based techniques: Colony, plaque, Southern, Northern and in situ hybridizations.
3. Western and southwestern blotting ,Microarray based detections and RNA interferon.
4. Characterization of clones : DNA sequencing , S1 nuclease and RNase mapping.

UNIT-III

1. Oligonucleotide synthesis.
2. Principles & applications of Polymerase Chain Reaction (Types).
3. DNA fingerprinting.
4. Mutagenesis : Site directed mutagenesis, Transposon mutagenesis.

Unit IV

1. Gene transfer techniques: Electroporation and microinjection, Transfection of cells: Principles and methods.
2. Germ line transformation in Drosophila and transgenic mice: Strategies and methods.
3. Construction of knockout mutants.
4. Promoter characterization: promoter analysis through reporter genes, electrophoretic mobility, shift assay, DNA foot-printing.

UNIT-V

1. Applications of Recombinant DNA Technology : Monitoring of gene expression in livecells, Crop and livestock improvement .
2. Molecular diagnostics, Biosafety & ethical considerations.
3. Gene therapy: somatic and germ line gene therapy; DNA drugs and vaccines.
4. Transgenic technologies and there use in microbial technology.

M.Sc.III[rd] Semester

MB: 304- M ICROBIAL PHYSIOLOGY AND METABOLISM
(Generic elective)

UNIT-I

1. Basic concept of bioenergetics and metabolism.
2. First and second law of thermodynamics, concept of free energy, entropy andenthalpy.
3. High energy phosphate compounds, role of ATP, ATP cycle, structural basis offree energy change during hydrolysis of ATP.
4. Biological oxidation and reduction reaction, role of reducing power.

UNIT-II

1. Carbohydrate metabolism: glycolysis and its regulation, Feeder pathway of glycolysis and carbohydrate –homo and heterolactic fermentation. Glycogenesis, Glycogenolysis. Gluconeogenesis ; pathways and regulation.
2. Pentose phosphate pathway, kreb's cycle and glyoxalate pathway.
3. Substrate level phosphorylation and oxidative phosphorylation, electron transfer reaction in mitochondria,electron carriers and multienzyme complex I to IV.
4. ATP synthesis: chemiosmotic theory, shuttle system, regulation of oxidative phosphorylation and uncouplers, inhibitors of oxidative phosphorylation.

UNIT-III

1. Photosynthesis: structure of chloroplast, light reaction and dark reaction; Kelvin cycle, C3 and C4 pathway.
2. Mechanism of energy generation in cyanobacteria, green bacteria and purple sulphur bacteria and chemolithotrops.
3. Lipid metabolism digestion absorption; oxidation of unsaturated fatty acid and odd chain fatty acid, ketone bodies.
4. Lipid biosynthesis: biosynthesis of fatty acids, triacylglycerol and phospholipids and regulation of fatty acid metabolism.

UNIT-IV

1. Amino acid metabolism: biosynthetic families of amino acids.
2. Breakdown of amino acids into six common intermediates and urea cycle and regulation of amino acid metabolism.
3. Nucleotide metabolism; biosynthesis of purines and pyrimidines nucleotide by denovo and salvage pathways.
4. Degradation of purines and pyrimidines nucleotides.

UNIT-V

1. Nitrification, denitrification and pathways of nitrate and ammonia assimilation.Nitrogen cycle.
2. Assimilation of nitrogen: denitrogen fixation- free living and symbiotic,diazotrophic organisms.
3. Biochemistry of nitrogen fixation: nitrogenase complex, function of nitrogenase, regulation of nitrogenaseby oxygen and combined nitrogen sources.
4. Genetics of nitrogen fixation; nif genes and their regulation.

. **M.Sc.IIIrd Semester**

MB: 303 (A) ENVIRONMENTAL MICROBIOLOGY. (Discipline Centric Elective)

UNIT-I

1. **M**icrobial ecology: basic concepts, types and microbial habitats, factors affecting microbial population.
2. Microbial interactions: competition, amensalism, parasitism, mutualism, commensalisms, synergism.
3. Biogeochemical cycles: carbon, nitrogen, phosphorus and sulphur cycle
4. Conservation and management of microbial diversity: biodeterioration and biodegradation.

UNIT-II

1. Microbiology of air: microorganism of air, enumeration of air micro flora.
2. Significance of air micro flora.
3. Brief account of air borne transmission of bacteria, fungi , pollens and viruses.
4. Air borne diseases and their prevention.

UNIT-III

1. Soil microbiology: microflora of soil: soil microorganisms associated with plants: rhizosphere, mycorrhizae.
2. Role of microorganisms in organic matter decomposition (cellulose, hemi cellulose, lignin).
3. Bioleaching; introduction, application of bacterial leaching leaching techniques, properties of bioleaching.
4. Microbial degradation of xenobiotics , petroleum and oil spilles in environmental decay behaviours and degradative plasmid.

UNIT-IV

1. Water microbiology: aquatic microorganisms; fresh water and sea water microflora. Microorganisms and water quality, water pollution.
2. Water purity test and indicator organisms, method used in environmental studies –BOD, COD, DO.
3. Common water born disease and their control measure.
4. Water purification: flocculation, chlorination and purification.

UNIT-V

1. Microbiology of waste water and effluent treatments, aerobic process : primary , secondary and tertiary treatment : trickle filter ,oxidation ponds and stabilization ponds , principle of aerobic digestion.
2. Bioremediation of contaminations.
3. Extremophiles –acidophilic, alkalophilic, thermophilic microbes with adaptation and application in ecosystem.
4. Microbial biofilms : physiology ,morphology, biochemisty of microbial biofilms, mechanism of microbial Adherence , beneficial and harmful role ofbiofilms.

M.Sc. IIIrd Semester

MB 303: (B) MICROBIAL DIAGNOSIS IN HEALTH CLINICS (Discipline Centric Elective)

UNIT-1

Importance of Diagnosis of Diseases

Bacterial, Viral, Fungal and Protozoan Diseases of various human body systems. Disease associated clinical samples for diagnosis.

UNIT-2

Collection of Clinical Samples

How to collect clinical samples(oral cavity,throat,skin,blood,CSF,urine and faeces) and precautions required. Method of transport of clinical samples to laboratory and storage.

UNIT-3

Direct Microscopic Examination and Culture

Examination of sample by staining-Gram's stain, AFB stain, Giemsa stained thin blood film for Malaria. Preparation and use of Culture media- Blood agar, Chocolate agar, Lowenstein-Jensen medium, MacConkey agar, Cooked meat media for anaerobic culture. Distinct colony properties of various bacterial pathogens.

UNIT-4

Serological and Molecular Methods

Serological Methods- Agglutination, ELISA, Immuno fluorescence Nucleic acid based methods-PCR, Nucleic acid probes, Western blotting

UNIT-5

Kits for Rapid detection of Pathogens

Typhoid, Dengue, Malaria and Blood groups.

Importance, Determination of resistance/sensitivity of bacteria using Disc diffusionmethod.

Determination of Minimal Inhibitory Concentration(MIC)of an antibiotic by serial double dilution method.

M.Sc.IV Semester

MB: 401 -AGRICULTURAL MICROBIOLOGY

UNIT I

1. Microorganisms of soil
2. Rhizosphere and phyllosphere microflora
3. Brief account of Microbial interactions: antagonism, symbiosis, mutualism, commensalisms, synergism and parasitism.
4. Nutrient cycle : Carbon cycle , nitrogen cycle, phosphorous cycle and sulphur cycle.

UNIT II

1. Role of enzymes and toxins in pathogenesis.
2. Fungal diseases of plants: Rusts of wheat, linseeds; late blight of potato; red rot ofsugarcane.
3. Bacterial diseases of plats : Citrus canker, blight ofrice
4. Viral diseases of plants : Leaf curl of Papaya, vein clearing of lady's finger

UNIT III

1. Physical and chemical control of plant diseases.
2. Bacterial control of insect pests : Bacillus thuringiensis as bacterial insecticide
3. Viral control of insect pests : Nuclear polyhedrosis visuses (NPV) and cytoplasmic polyhedrosisviruses (CPV)
4. Fungal control of insect pests : Entomopathogenic fungi : Metarhinium anisopliae, Beauveria bassiana, Verticillium lecani, Hirsutella thompsoni

UNIT IV

1. Storage fungi : Categories of storage fungi, conditions during storage in relation to damage of seeds, harmful effects
2. Mycotoxins and their effect on human being.
3. General idea about quarantine
4. Production of biogas and alcohol from agricultural wastes

UNIT V

1. Biofertilizers : Types, production and application
2. Mycorryzae : Types and their application in agriculture and forestry.
3. Vermicomposting
4. Reclamation of waste agricultural land by microorganisms.

M.Sc.: IV Semester

MB: 402: (A) FOOD MICROBIOLOGY (Discipline Centric Elective)

UNIT I

1. Microorganisms important in food microbiology: molds, yeast and bacteria –general characteristics, classification and importance.
2. Principles of food preservation, preservation by use of high temperature, lowtemperature, drying and dessication.
3. Chemical preservatives and additives.
4. Preservation by radiation.

UNIT II

1. Factors influencing microbial growth in food: Extrinsic and intrinsic factors.
2. Microbial spoilage of food. Chemical changes caused by the microorganisms during spoilage.
3. Spoilage of fish, meat, poultry, eggs, fruits and vegetables.
4. Detection of spoilage and characterization.

UNIT III

1. Classification of food borne diseases.
2. Food borne infections : Brucella, Bacilllus, Clostridium perfringens, vibrio, yersinia Escherichia, Salmonella, Shigella.
3. Food intoxication: Staphylococcal intoxication, Clostridial poisoning.
4. Food adulteration and prevailing food standards in India .

UNIT IV

1. Microbiology of Milk : Sources of microorganisms in milk and types of microorganisms in milk.
2. Microbiological examination of milk (standard platecount, direct microscopic count, reductase, and phosphatase test).
3. Dehydration and pasteurization of milk.
4. Dairy products from microorganisms : Butter , yoghurt and cheese .

UNIT V

1. Microorganisms as source of food : Single Cell Protein (SCP)
2. Mushrooms and food value of mushrooms
3. Food conversions : Lactic acid conversions, soyabean conversions and Bakery
4. Microbiological estimation of food : Sample collection,

M.Sc. IV Semester

MB: 402 (B) Enzyme Technologies(Discipline Centric Elective)

UNIT-1

Introduction to enzymes -Enzyme classification and nomenclature, Characteristics of enzymes production . Mode of action and kinetics of enzyme catalyzed reactions (K_{min} V_{max}) .Types of mechanism of enzyme inhibition ,Biotechnological importance of enzymes.

UNIT-2

Microbial sources of enzymes- Primary and Secondary screening of Microorganisms for enzyme production .Qualitative and Quantitative assay of enzyme activity. Enzymes units Amylases , Cellulases , Hemicellulases ,Proteases . Natural and Synthetic substrates for enzyme assay .

UNIT-3

Microbial enzyme production ; submerged and solid state fermentation (SSF). Important parameters in enzyme production . Enzyme purification Techniques – Precipitation chromatographic separation –gel filtration ,anion and cation exchange ,zymography.

UNIT-4

Techniques used in characterization of enzymes- determination of molecular weight (SDS PAGE ,Gel filtration) . Isolelectric point,pH & temperature optima and stability . Inhibition pattern , Product analysis of enzyme action using TLC HPLC and MALDI – TOF

UNIT -5

Molecular Biology of enzymes- aminoacid sequencing ,structure and function relationship. Protein engineering and directed evolution . Cloning and over expression of microbial enzymes in heterologous host.