

DEVI AHILYA VISHWA VIDYALAYA, INDORE
M.Sc. (Microbiology): Four semester course
(Duration: Two years)

M. Sc. Sem. I					
Paper	Subject	Maximum Marks		Minimum Passing Marks	
		Theory	C. C. E.	Theory	C. C. E.
I	Bacteriology	85	15	28	05
II	Virology, Mycology and Phycology	85	15	28	05
III	Immunology	85	15	28	05
IV	Microbial Biochemistry	85	15	28	05
	Lab course – I (Paper I and II)	50		17	
	Lab course – II (Paper III and IV)	50		17	
	Total Marks	500			
M. Sc. Sem. II					
Paper	Subject	Maximum Marks		Minimum Passing Marks	
		Theory	C. C. E.	Theory	C. C. E.
V	Microbial Genetics	85	15	28	05
VI	Microbial Physiology	85	15	28	05
VII	Instrumentation	85	15	28	05
VIII	Fermentation Technology	85	15	28	05
	Lab course – III (Paper V and VI)	50		17	
	Lab course – IV (Paper VII and VIII)	50		17	
	Total Marks	500			
M. Sc. Sem. III					
Paper	Subject	Maximum Marks		Minimum Passing Marks	
		Theory	C. C. E.	Theory	C. C. E.
IX	Molecular Biology and Genetic Engineering	85	15	28	05
X	Medical Microbiology	85	15	28	05
XI	Biostatistics and Computer applications	85	15	28	05
XII	Bioinformatics, Proteomics and Genomics	85	15	28	05
	Lab course – V (Paper IX and X)	50		17	
	Lab course – VI (Paper XI and XII)	50		17	
	Total Marks	500			
M. Sc. Sem. IV					
Paper	Subject	Maximum Marks		Minimum Passing Marks	
		Theory	C. C. E.	Theory	C. C. E.
XIII	Pharmaceutical Microbiology	85	15	28	05
XIV	Food and Dairy Microbiology	85	15	28	05
XV	Environmental Microbiology	85	15	28	05
XVI	Bio-Nanotechnology	85	15	28	05
	Project Work	100		40	
	Lab course – VII (Paper XIII and XIV)	50		17	
	Lab course – VIII (Paper XV and XVI)	50		17	
	Total Marks	600			
	Grand Total Marks	2100			

M. Sc. (Microbiology) Semester-I

Paper I – Bacteriology

UNIT-I

Classification of microorganisms – Haeckel's three kingdom concept, Whittaker's five kingdom concept, Three domain concept of Carl Woese, Basis of microbial classification, Classification and salient features of bacteria according to the Bergey's manual of determinative bacteriology.

UNIT-II

Morphology and ultra structure of bacteria – morphological types – cell walls of archaebacteria and eubacteria (Gram negative and Gram positive), L- forms. Cell wall synthesis, antigenic properties.

Capsule – types, composition and function.

Cell membrane – structure, composition and properties.

UNIT-III

Structure and function of flagella, pili, gas vesicles, chromosomes, carboxysomes, magnetosomes, phycobolismes and nucleoid.

Spores and Cysts.

Reserve food materials – Polyhydroxybutyrate, polyphosphate granules, oil droplets, cyanophycin granules and sulphur inclusions.

UNIT-IV

Cultivation of bacteria – Aerobic and anaerobic cultivation, Shake flask and still cultivation.

Nutritional types of bacteria.

Bacterial growth- Culture media, Growth curve, Batch, continuous and synchronous cultures. Measurement of bacterial growth- Growth kinetics, Generation time and growth rate.

Factors affecting microbial growth.

UNIT-V

Control of bacteria – Microbial death curve under adverse conditions.

Concepts of bioburden, thermal death constant and decimal reduction time.

Control of microbes by physical and chemical agents and mechanisms of their microbicidal activity.

REFERENCES:

- | | |
|--|----------------------------|
| 1. Fundamental Principles of Bacteriology | Salle |
| 2. Biology of Microorganisms | Brock, Madigan |
| 3. Microbiology | Pelczar, Chan & Kreig |
| 4. Text Book on Principles of Bacteriology, Virology & Immunology | Topley and Wilson |
| 5. General Microbiology | Stainer, Ingharam, Wheelis |
| 6. <i>Illustrated Genera of Imperfect Fungi</i> | Barnett and Hunter |
| 7. <i>Bergey's Manual of Determinative Bacteriology</i> (VIII Edition) | Breed and Buchanan |
| 8. <i>Bergey's Manual of Determinative Bacteriology</i> (IX Edition) | Breed and Buchanan |
| 9. <i>Bergey's Manual of Systematic Bacteriology</i> (II Edition) | Breed and Buchanan |
| 10. The genetics of Bacteria and their Viruses | William Hayes |
| 11. General Microbiology | Robert Boyd |
| 12. An Introduction to Microbiology | Tauro, Kapoor, and Yadav |
| 13. Microbiology-A Practical Approach | Patel & Phanse |

M. Sc. (Microbiology) Semester-I

Paper II- Virology, Mycology and Phycology

UNIT-I

Discovery, nomenclature and general characters of viruses.
Classification of virus – Baltimore, ICTV.
Morphology and ultra structure, capsids and their arrangements, types of envelopes and their composition.
Viral genome, their types and structures.
Virus related agents- Viroids and prions.

UNIT-II

Bacteriophages: Organization and life cycle.
One step growth curve; Phage DNA transcription and phage DNA replication, eclipse phase; Phage production; Burst size, Lysogenic cycle, Bacteriophage typing.
Application in bacterial genetics.
Brief details on T phages and Lambda phages.

UNIT-III

Cultivation of viruses in embryonated eggs, experimental animals and cell cultures.
Assay of viruses: Physical and chemical methods- Protein, nucleic acid, radioactivity tracers, electron microscopy.
Infectivity assay- Plaque method and end point method.

UNIT IV

Mycology: Classification and general features of fungi, Structure of fungal cells and growth – Hyphae and non- motile unicells, motile cells, effect of environment on growth, prevention of fungal growth.
Life cycle of *Penicillium*, *Saccharomyces* and *Fusarium*.

UNIT V

Phycology: Distribution of algae, Classification of algae, Algal nutrition, reproduction, green algae, diatoms, euglenoids, brown Rhodophyta, Microalgae.

REFERENCES

- | | |
|---|------------------------|
| 1. Introduction to Mycology (III Edition) | Alexopoulous and Mims |
| 2. Introduction to Modern Virology (IV Edition) | Dimmock and Primrose |
| 3. An Introduction to Mycology | Mehrotra and Aneja |
| 4. Fundamentals of Mycology | Burnett |
| 5. The Fungi | Charlile and Walkinson |
| 6. Fundamentals of Mycology | Burnett |
| 7. Fundamentals of the fungi | Moore and Landeekeerl |
| 8. Virology (III Edition) | Conrat, Kimball |

M. Sc. (Microbiology) Semester-I

Paper – III Immunology

UNIT-I

Structure, composition and types of cells and organs involved in immune system.

Innate and acquired immunity.

Humoral and cell mediated immune responses.

Immunization – Modern methods of vaccine production.

UNIT-II

Antigens – Structure, properties and types. Haptens and adjuvants.

Immunoglobulins- structure, heterogeneity, types and subtypes.

Physico-chemical and biological properties of immunoglobulins.

Theories of antibody production. Generation of antibody diversity.

Complement – Structure, components, properties and functions of complement components,

Complement pathways and biological consequences of complement activation.

UNIT-III

Antigen-Antibody interactions - *In vitro* methods - Agglutination, Precipitation, Complement fixation.

Immunofluorescence, ELISA, Radioimmunoassays, Immuno blotting.

In vivo methods: Skin tests and immune complex tissue demonstrations and their applications in diagnosis of microbial diseases.

Hybridoma technology - Production and applications of monoclonal antibodies.

UNIT-IV

Structure and functions of MHC and the HL-A systems.

HL-A and tissue transplantation – Tissue typing methods for organ and tissue transplantations in humans, Graft versus host reaction and rejection.

Tumor immunology – tumor specific antigens, immune response to tumors, immunodiagnosis of tumors – detection of tumor markers – alpha foetal proteins.

UNIT-V

Type I IgE – Mediated Hypersensitivity,

Type II Antibody – Mediated Cytotoxic Hypersensitivity.

Type III Immune Complex – Mediated Hypersensitivity.

Type IV Delayed – Type Hypersensitivity.

Autoimmunity – mechanism and diseases.

REFERENCES

- | | |
|--|-----------------------------|
| 1. Essentials of Immunology | Roitt |
| 2. Immunology (II Edition) | Kuby |
| 3. Immunology | Klaus |
| 4. Text Book on Principles of Bacteriology,
Virology and Immunology, IX Edition (5 volumes) | Topley and Wilson's |
| 5. The Experimental Foundations of Modern Immunology | Clark, John Willey |
| 6. Fundamental Immunology | Paul |
| 7. Fundamentals of Immunology | Coleman, Lombord and Sicard |
| 8. Immunology | Weir and Steward |

M. Sc. (Microbiology) Semester-I

Paper IV- Microbial Biochemistry

UNIT-I

Monosaccharides and their relationship, structure of sugars, stereoisomerism and optical isomers of sugars. Reactions of aldehyde and ketone groups, Ring structures and tautomeric forms, Mutarotation, Reaction of sugars to -OH groups. Important derivatives of monosaccharides, disaccharides and trisaccharides. Structure, identification and importance of mono and oligosaccharides. Structure, occurrence and biological importance of structural polysaccharides e.g. Blood group lipopolysaccharides.

UNIT-II

Definition and classification of lipids. Building blocks of lipids, fatty acids, glycerol, sphingosine. Fatty acids distribution in nature, classification, physico-chemical properties, separation, characterization and chemical properties. Saponification and iodine number. Properties and function of phospholipids. Lipoproteins - classification, composition and their importance. Role of lipids in cellular architecture and functions.

UNIT- III

Amino Acids- structure, classification and properties. Handerson and Hasselbach equation for ionization of amino acids. Chemical reactions of amino acids, Lab synthesis of poly peptide. Primary, secondary, tertiary and quaternary structure of Haemoglobin and Myoglobin. Ramchandran plot. Determination of amino acid sequence in proteins / polypeptides.

UNIT-IV

Enzymes as biocatalysts- Enzyme classification. Mechanism of enzyme action - specificity, active site, activity unit and isozymes. Factors affecting enzyme efficiency, enzyme activators, coenzymes and cofactors. Enzyme kinetics - Michaelis - Menton equation for simple enzymes, determination of kinetic parameters, multi-step reactions and rate limiting steps. Enzyme inhibition- reversible, irreversible, competitive and noncompetitive. Allostereim- kinetic analysis of allosteric enzymes, Principles of allosteric regulation.

UNIT-V

Vitamins - Discovery, role and chemistry of fat soluble vitamins A, D, E and K. Water soluble vitamins – Pantothenic acid, niacin, pyridoxine, biotin, riboflavin, cyanocobalamine, folic acid and ascorbic acid.

REFERENCES

- | | |
|---|-------------------------|
| 1. Principles of Biochemistry- IV Edition | Lehniger |
| 2. Biochemistry - V Edition | Stryer |
| 3. Harper's Biochemistry | Murrey |
| 4. Principles of Biochemistry | Zubey, Parson and Vance |
| 5. Modern Microbiology | Brige and Brown |
| 6. Introduction to protein structure | Branden and Tooze |
| 7. Experiments in Biotechnology | Nighojkar and Nighojkar |

M. Sc. (Microbiology) Semester-II

Paper V -Microbial Genetics

UNIT-I

Fine structure of prokaryotic and eukaryotic genome.

DNA structure and types

DNA replication- general principles, various modes of replication, Proof-reading, Continuous and discontinuous synthesis, Synthesis of leading and lagging strands. Superhelicity in DNA. Mechanism of action of topoisomerases. Inhibitors of DNA replication.

UNIT-II

Gene as a unit of mutation, molecular nature of mutation.

Mutagens, spontaneous mutation, DNA damage (Deamination, oxidative damage, alkylation, pyrimidine dimers)

Repair pathways- methyl directed mis-match, repair, very short patch repair, nucleotide excision repair, base excision repair, recombination repair and SOS repair.

UNIT-III

Gene Expression, Structural features of RNA (rRNA, tRNA and mRNA)

Transcription- General Principles, basic apparatus and types of RNA polymerases. Initiation, elongation and termination steps

Inhibitors of RNA synthesis. Polycistronic and monocistronic RNAs. Control of transcription by interaction between RNA polymerases and promoter regions. Use of alternate sigma factors, controlled termination, attenuation and anti-termination RNA.

Maturation and processing of RNA: Methylation, cutting and trimming of rRNA; capping, polyadenylation and splicing of mRNA; cutting and modification of tRNA degradation system.

UNIT-IV

Basic features of the genetic code.

Protein synthesis: steps, details of initiation, elongation and termination, role of various factors in these steps, inhibitors of protein synthesis.

Regulation of gene expression: Operon concept, catabolite repression, positive and negative regulation; inducers and co-repressors

Negative regulation in *E. coli*- lac operon; positive regulation – *E.coli* ara operon; regulation by attenuation of *his* and *trp* operons

UNIT-V

Gene transfer mechanisms- Transformation, conjugation, transduction, transfection: mechanisms and their applications

Bacteriophages- lytic phages and lysogenic phages.

REFERENCES

- | | |
|---|-------------------------|
| 1. Microbial Genetics | Maloy |
| 2. Molecular genetics of bacteria | Dale |
| 3. Modern microbial genetics | Streips and Yasbin |
| 4. Genome | Brown |
| 6. Gene IX | Lewin |
| 7. Molecular Biology | Glick |
| 8. Molecular and Cellular Methods in Biology and Medicine | Kaufman, Kim and Seke |
| 9. Molecular Cell Biology | Lodish, Berk, Zippursky |

M. Sc. (Microbiology) Semester-II

Paper VI - Microbial Physiology

UNIT-I

Photosynthesis: Bacterial photosynthesis: scope, electron carriers.
Photosynthetic reaction center, cyclic flow of electrons.
Bacterial photophosphorylation in various groups of phototrophic bacteria.
Electron donors other than water in anoxygenic photosynthetic bacteria.

UNIT-II

Respiratory metabolism: Embden -Mayerhoff pathway- Entner –Duodroff pathway- Glyoxalate pathway-
Kreb's cycle- oxidative and substrate level phosphorylation- reverse TCA cycle- gluconeogenesis- Pasteur
effect, anaerobic respiration.
Biochemistry of methanogens.

UNIT-III

Lipid Metabolism: Lipids as energy reserves, Fatty acid oxidation- alpha, beta and omega oxidations.
Energy yields from fatty acid oxidation. Oxidation of unsaturated fatty acids and fatty acids with odd
numbered carbon atoms, Ketogenesis
Biosynthesis of fatty acid and triacylglycerols.

UNIT-IV

Biosynthesis of amino acids.
Catabolism of amino acids.
Synthesis of polysaccharides, peptidoglycan and biopolymers as cell components.

UNIT-V

Unculturable and culturable bacteria : Conventional and molecular methods for the study of microbial
diversity.
Extremophiles– Mechanism and adoption of acidophilic, alkalophilic, thermophilic, psychrophilic,
barophilic and osmophilic microbes.
Halophiles – membrane variation electron transport.
Applications of extremophiles.

REFERENCES

- | | |
|--|-----------------------------|
| 1. Microbial Physiology and metabolism | Caldwell. |
| 2. Microbial Physiology | Moat and Foster |
| 3. General Microbiology | Stainer, Ingharam, Wheelis. |
| 4. Prokaryotic Development | Brun and Shimkets. |
| 5. Extremophiles | Johri. |
| 6. Microbial Diversity | Colwd. |
| 7. Biology of microorganisms | Brock and Madigan. |

M.Sc. (Microbiology) Semester-II

Paper VII- Instrumentation

UNIT -I

Microscopy – Theoretical considerations and instrumentation of Light, Phase-contrast, Interference, Polarization and Fluorescence microscopes. Transmission and Scanning electron microscopy.

UNIT –II

Centrifugation: Differential and density gradient centrifugation, Zonal and isopycnic separation, Preparative and analytical centrifugation.

UNIT –III

Chromatography: Paper and Thin layer chromatography, Adsorption column chromatography, Ion – exchange chromatography, Gel exclusion chromatography, High performance liquid chromatography. Affinity chromatography and Gas chromatography.

UNIT-IV

Electrophoresis: Horizontal and vertical gel electrophoresis.

Spectrophotometry: Colorimetry, Spectrophotometry.

Spectroscopy: Absorption and emission spectroscopy.

Theory, instrumentation and applications of visible, ultraviolet and infra red spectroscopy.

UNIT-V

Radioisotope techniques – Detection and measurement of radioactivity, Geiger-Muller counter, Scintillation counter and Autoradiography

Radioimmunoassay and application of isotopes in biological studies.

REFERENCES

- | | |
|---|--------------------------------|
| 1. Principles and Techniques of Biochemistry and Molecular Biology, 6 th Ed. | Wilson and Walker |
| 2. Biophysical Chemistry -Principles and Techniques | Upadhyay, Upadhyay
and Nath |
| 2. Biochemistry of nucleic acids. 1992 | Adams |
| 3. Crystallography made crystal clear. 1993 | Rhodes |
| 4. Principles of physical biochemistry. 1998 | Van Holde |

M.Sc. (Microbiology) Semester-II

Paper VIII- Fermentation Technology

UNIT-I

Screening of industrially important microorganisms.
Strategies for strain improvement.
Maintenance and preservation of industrially important microorganisms.
Inoculum development for industrial fermentation.
Industrial sterilization process for media, air and equipment.
Media for industrial fermentations

UNIT-II

Scale up of fermentation process.
Harvest and product recovery –Removal of insoluble- Filtration, centrifugation, cell disruption methods.
Product isolation- Extraction and adsorption methods.
Product purification- Chromatographic methods, Precipitation, crystallization and drying devices.

UNIT-III

Concept of submerged, surface and solid state fermentations.
Batch and continuous fermentation processes.
Basic design of fermentation equipment.
Monitoring and controls of fermentation parameters.
Fermentor types and their applications– Plug flow reactor, Air lift fermentor, Packed bed reactor, Fluidized bed reactor and Tray reactor.

UNIT-IV

Microbial production of commercially important products – I
Solvent – Ethanol
Organic acids - Citric acid, Acetic acid, Lactic acid.
Enzymes – Amylase and Protease.
Steroid bioconversions.

UNIT-V

Microbial production of commercially important products – II
Antibiotics – Penicillin and Streptomycin.
Vitamins – Cyanocobalamine and Riboflavin.
Amino Acids – Lysine and Glutamic acid.
Microbial assay of growth promoters and growth inhibitors, MIC.

REFERENCES

- | | |
|---|---|
| 1. Biotechnology | Crueger and Crueger. |
| 2. Industrial Microbiology | Cassida |
| 3. Principles of Fermentation Technology | Standbary, Whitaker |
| 4. Industrial Microbiology | Reed |
| 5. Biology of Industrial Microorganisms. | Demain. |
| 6. Textbook of Industrial Microbiology | Patel. |
| 7. Fundamentals of Biotechnology | Prave, Faust, Sittig. |
| 8. Bioprocess Engineering | Shuler and Kargi. |
| 9. Molecular cloning Vol. 1-III | Sambrook and Russel. |
| 10. Biotechnological innovations in chemical synthesis. | Bioprotol. Publisher:
Butterworth Heinemann. |

M.Sc. (Microbiology) Semester-III

Paper IX – Molecular Biology and Genetic Engineering

UNIT-I

Core techniques and essential enzymes used in r-DNA technology.

Restriction digestion, ligation and transformation.

Cloning vectors – Plasmids, phages and cosmids.

Cloning strategies – Cloning and selection of individual genes, gene libraries – cDNA and genomic libraries.

UNIT-II

Specialized cloning strategies – Expression vectors, promoter probe vectors, vectors for library construction - artificial chromosomes, Rationale for the design of vectors for the over-expression of recombinant protein, selection of suitable promoter sequences, ribosome binding sites, transcription terminator, fusion protein tags, purification tags, protease cleavage sites and enzymes, plasmid copy number and inducible expression system.

UNIT-III

DNA sequencing methods – Dideoxy and chemical method, sequence assembly.

Automated sequencing and physical mapping of genomes.

Gene amplification - PCR and its applications.

Ribozymes and RNAi.

UNIT-IV

Expression of cloned DNA – Expression in heterologous system.

Identification of cloned gene – Study of the transcript of a cloned gene.

Hybridization techniques.

Modification of cloned DNA – Site directed mutagenesis, Efficient expression of cloned genes.

UNIT-V

Applications of r-DNA technology- Requirement and production of recombinant molecules in pharmaceutical, health, agricultural and industrial sectors and research laboratories.

Transgenic animals, *Agrobacterium* mediated transformation, Bt cotton, Gene Therapy.

Safety of recombinant DNA technology, IPR and patenting.

REFERENCES

- | | |
|---|---------------------|
| 1. Current protocols in molecular biology. | Ausbel |
| 2. Molecular cloning Vol. 1-III. | Sambrook and Russel |
| 3. Principles of gene manipulation | Old and Primrose. |
| 4. Genome analysis Four volumes | CSH Press. |
| 5. Principles and techniques of biochemistry and molecular biology, 6 th Ed. | Wilson Walker. |
| 6. Gene Cloning | Brown |

M.Sc. (Microbiology) Semester-III

Paper X- Medical Microbiology

UNIT-I

Early discovery of pathogenic microorganisms, Development of bacteriology as a scientific discipline. Contributions made by eminent scientists.

Classification of medically important microorganisms; Normal microbial flora of human body; role of the resident flora; normal flora and the human host.

UNIT-II

Epidemiological studies of diseases - Sources of infection for humans- vehicles, reservoirs of infection.

Exogenous infection: Patients, carriers, infected animals and soil endogenous infection.

Mode of spread of infection: Respiratory, skin, wound and burn infection, venereal infections, alimentary tract infection, arthropod borne blood infections, laboratory infections and nosocomial infections.

Preventive and curative measures for diseases.

UNIT-III

Microbial pathogenicity: Opportunistic and true pathogens, establishment and spreading of infections, antiphagocytic factors, mechanism of bacterial adhesion, colonization and invasion of mucous membranes of respiratory, enteric and urogenital tracts.

Toxigenicity: invasiveness, role of aggressins, hyaluronidase, coagulase, fibrinolysins or kinase; depolymerizing enzymes mucinase, lipases, proteases, nucleases, collagenase, neuraminidase, depolymerising enzymes, variation and virulence.

UNIT-IV. Gram positive cocci - *Staphylococcus*, *Streptococcus*.

Gram negative bacilli - *E.coli*, *Salmonella*, and *Shigella*.

Gram positive bacilli - *Clostridium*.

Acid Fast Bacteria – *Mycobacterium tuberculosis*, *Mycobacterium leprae*.

Spirochaete – *Treponema pallidum*.

UNIT-V

Fungal infections – Description and classification of pathogenic fungi, dermatophytes.

Viral infections – Mumps, Measles, Rabies, Polio, Hepatitis and AIDS.

Diseases caused by *Anctiomycetes*; *Rickettsia* and *Chlamdiae*.

REFERENCES

- | | |
|--|----------------------|
| 1. Text of book of Microbiology | Ananthanarayanan |
| 2. Medical Microbiology Vol. 1- Microbial Infection
Vol. 2- Practical Medical Microbiology | Mackie and McCartney |
| 3. Microbiology in Clinical Practice | Shanson, Wright |
| 4. Bailey and Scott's Diagnostic Microbiology | Baron, Peterson. |
| 5. Biochemistry of Antimicrobial Action | Franklin, Snow |
| 6. Epidemiology and Infections | Gordon Smith |
| 7. Lecture Notes in Immunology Vol. 1: Microbial infections,
Vol. 2: Practical Medical Microbiology | Todd |
| 8. Cellular Microbiology | Henderson |

M. Sc. (Microbiology) Semester- III

Paper XI– Biostatistics and Computer Applications

UNIT –I

Basic definitions and applications of biostatistics.

Sampling: Representative sample, sample size, sampling bias and sampling techniques.

Data collection and presentation: Types of data, methods of collection of primary and secondary data, methods of data presentation, graphical representation by histogram, polygon and pie diagram.

UNIT –II

Measures of central tendency: Mean, Median, Mode.

Measures of variability: Standard deviation, standard error, range, mean deviation and coefficient of variation.

Correlation and Regression: Positive and negative correlation and calculation of Karl- Pearsons co-efficient of correlation. Linear regression and regression equation and multiple linear regression, ANOVA, One and two way classification. Calculation of unknown variable using regression equation.

UNIT – III

Tests of significance: Small sample tests (Chi-square t test, F test), large sample test (Z test) and standard error.

Introduction to probability theory and distributions, (concept without deviation). Normal, binomial, poison distributions (only definitions and problems).

Computer oriented statistical techniques.

UNIT - IV

Introduction to computers: Computer application, basics, organization.

Computer classification and generations.

Concept of file, folders and directories, commonly used DOS & Windows commands.

Concept of hardware, software, memory and their types.

UNIT - V

Introduction to MS Office software concerning MS Word processing. Excel spreadsheets and Power point presentation software.

Networking fundamentals, client, server, LAN, WAN, ftp, Telenet, INTERNET, NICNET, WWW, html and e- mail.

REFERENCES

- | | |
|--|-------------------------|
| 1. Statistics in biology, Vol. 1 | Bliss |
| 2. Practical Statistics for experimental biologist | Wardlaw |
| 3. How Computers work - 2000. | White |
| 4. How the Internet Work 2000 | Preston Gralla |
| 5. Statistical Methods in Biology - 2000 | Bailey |
| 6. Biostatistics - 7th Edition | Daniel |
| 7. Fundamental of Biostatistics | Khan |
| 8. Biostatistical Methods | Lachin |
| 9. Statistics for Biologist | Campbell |
| 10. Internet | CDC publication, India. |

M. Sc. (Microbiology) Semester- III

Paper XII – Bioinformatics, Proteomics and Genomics

UNIT – I

Introduction to bioinformatics-History, aim and scope of bioinformatics.

Database concept, DBMS.

Biological databases and their function, Classification of biological databases.

Nucleotide and Protein sequence databases (GenBank, EMBL, DDBJ, PIR, SWISSPROT).

Structure and Structure classification databases (PDB, SCOP, CATH).

Specialized databases (ESTs, EXPASY, Prosite, Pfam)\Genome databases and composite database (NCBI).

UNIT – II

Sequence comparison, sequence identity, similarity and homology.

Scoring/substitution matrices (PAM, BLOSUM).

Pair wise Local and Global alignment algorithms (Needleman and Wunsch, Smith and Waterman),

Multiple Sequence alignment, Sequence database searching tool (BLAST and FASTA), Basic knowledge of their variants and statistical significance.

UNIT – III

Studying Open reading frames (ORFs), Motifs, Domains, Patterns, Profiles and their importance.

Importance of phylogenetics, nomenclature of trees and construction of phylogenetic trees using distance based method (UPGMA).

UNIT – IV

DNA Microarray- Printing of oligonucleotides and PCR products on glass slides and nitrocellulose paper.

Whole genome analysis for Global patterns of gene expression using fluorescent-labelled cDNA or end labelled RNA probes.

Analyses of single nucleotide polymorphism using DNA chips.

UNIT - V

Proteome analysis- Two dimensional separation of total cellular proteins.

Isolation and analysis of individual protein spots by Mass Spectroscopy.

REFERENCES

- | | |
|--|-----------------------------|
| 1. Bioinformatics. 1998 | Baxevanis |
| 2. Bioinformatics 2000 | Higgins and Taylor. |
| 3. Nucleic acid Research 2001. | Jan. Genome database issue. |
| 4. The Internet and the new Biology: Tools for Genomics and Molecular Research | Peruski and Peruske (ASM) |
| 5. Functional Genomics. A Practical Approach | Stephen and Rick Liveey. |
| 6. DNA microarrays: A practical approach | Mark Schena |
| 7. Bioinformatics - A Practical Guide to the Analysis of Genes and Proteins
2nd Edition | Baxevanis |
| 8. Bioinformatics: Sequence, structure and Data Bank: A Practical Approach | Higgis. |
| 9. Bioinformatics - from Genomes to drug. | Lenganer. |
| 10. Bioinformatics Methods and Protocols | Misener. |
| 11. Bioinformatics: Sequence and Genome analysis. | |
| 12. Introduction to Bioinformatics | Altwood. |
| 13. Protein Biotechnology. | Felix Franks. |
| 14. Protein Engineering: Principles and Practice | Cleland. |
| 15. Computer analysis of sequence data | Colte. |
| 16. Protein Engineering: Principles and Practice | Cleland. |
| 17. Computer analysis of sequence data | Colte. |

M. Sc. (Microbiology) Semester- IV

Paper XIII – Pharmaceutical Microbiology

UNIT – I

Introduction to pharmaceutical industry: Role of a microbiologist in a pharma industry (Active Pharmaceutical Ingredient Production units, Formulation units, Research and Development, Quality Assurance and Regulatory Aspects). Pharmacopoeias with special reference to Indian, British, United States. Government regulatory practices and policies, FDA perspective. Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP) in pharmaceutical industry. Design and layout of sterile product manufacturing unit. (Designing of microbiology laboratory) Safety in microbiology laboratory.

UNIT – II

Quality assurance and quality management in pharmaceuticals: ISO, WHO and US certification. Microbiological analysis for pharmaceutical industries: Standard operating procedures for microbiological assay of antibiotics, vitamins and amino acids, Water analysis, Microbial limit test, Sterility test, Pyrogen test (BET), Area monitoring, Growth promotion test, Calibration and validation of equipments. Microbial contamination and spoilage of pharmaceutical products (sterile injectibles, non injectibles, ophthalmic preparations and implants) and their sterilization. Chemical disinfectants, antiseptics and preservatives.

UNIT – III

Antibiotics and synthetic antimicrobial agents – Structure, types and modes of action. Beta lactams and non beta lactams. Aminoglycosides, Tetracyclines, Chloramphenicol, Macrolides, Fluroquinilones. Chemosynthetic drugs-Sulphonamides, Trimethoprim, Nitrofurans and Isoniazid. Antifungal and antiviral drugs.

UNIT – IV

Bacterial resistance to antibiotics- Origin, mechanism, transfer, and clinical implications. Molecular principles of drug targeting, Drug delivery system in gene therapy, Microencapsulation. Nanoparticles, Liposomes, Antibodies for drug delivery. Penetrating defenses – How the antimicrobial agents reach the targets (cellular permeability barrier, cellular transport system and drug diffusion).

UNIT – V

Drug development in pharmaceutical process: Production of biopharmaceuticals by genetically engineered cells: Hormones (Humulin, Humatrope), Interferons (Intron A, Referon-A), t- Plasminogen activator (Activase), Monoclonal antibodies and hybridoma technology (Monoclata, Orthoclone OKT3). Other pharmaceuticals produced by microbial fermentations (Streptokinase, Streptodornase). New vaccine technology, DNA vaccines, synthetic peptide vaccines, multivalent subunit vaccines. Vaccine clinical trials. Application of microbial enzymes in pharmaceutical industry.

REFERENCE

- | | |
|--|-------------------------|
| 1. Pharmaceutical Microbiology | Hugo & Russell |
| 2. Analytical Microbiology Volume I & II. | Kavanagh |
| 3. Quinolone antimicrobial agents | Hooper, Wolfson |
| 4. Quality control in the Pharmaceutical Industry Vol.2 | Cooper |
| 5. Biotechnology Vol 4 | Rehm & Reed, |
| 6. Pharmaceutical Biotechnology | Vyas & Dixit. |
| 7. Good Manufacturing Practices for Pharmaceuticals Second Edition | Sydney, Murray, William |
| 8. Advances in Applied Biotechnology Series Vol 10, Biopharmaceuticals in transition. Industrial Biotechnology Association | Webber. |
| 9. Drug Carriers in biology and Medicine | Gregoriadis. |

M. Sc. (Microbiology) Semester- IV

Paper XIV - Food and Dairy Microbiology

UNIT - I

Food fermentations – Bread and Vinegar.
Fermented beverages- Beer and Wine.
Microbial cells as food (single Cell Proteins), Probiotics and Prebiotics.
Mushroom cultivation, genetically modified foods.

UNIT - II

Food infections – Gastroenteritis, Salmonellosis, Shigellosis.
Bacterial food intoxications –Botulism and Staphylococcal intoxication.
Mycotoxins – Aflatoxins.
Microbiological examination of food.
Quality assurance: Microbiological quality standards of food, Government regulatory practices and policies. FDA, EPA, HACCP and ISI.

UNIT –III

General principles of food preservation.
Preservation by using high and low temperature.
Chemical preservatives and food additives.
Use of irradiation for preservation.
Spoilage of food – fresh food, canned food, milk products.

UNIT - IV

Composition of milk.
Normal flora of milk, changes produced by microorganisms in milk.
Pasteurization – basis of pasteurization, methods of pasteurization
Milk borne diseases.
Microbiological analysis of milk- Standard plate count, direct count, reduction tests, phosphatase test
Grades of milk

UNIT - V

Milk starter cultures, Microbiology of cheese – types of cheese, cheese manufacture,
Fermented milk products-yoghurt, cultured buttermilk, acidophilus milk, kefir, kumiss
Applications of microbial enzymes in dairy industry [proteases and lipases].
Utilization and disposal of dairy by-product - Whey

REFERENCES

- | | |
|---|----------------------|
| 1. Food Microbiology 2nd Ed | Adams |
| 2. Basic Food Microbiology | Banwart George |
| 3. Food Microbiology: Fundamentals and Frontiers | Dolle |
| 4. Food Microbiology | Frazier and Westhoff |
| 5. Fundamentals of Dairy Microbiology | Prajapati |
| 6. Essentials of Food Microbiology | Garbult |
| 7. Microbiology of Fermented Foods. Volume I and II. | Wood |
| 8. Microbiology of Foods | Orwin |
| 9. Dairy Microbiology. Volume I and II. | Robinson |
| 10. Food Microbiology: Fundamentals and Frontiers. 2nd Ed | Doyle Beuchat |

M.Sc. (Microbiology) Semester-IV

Paper XV – Environmental Microbiology

UNIT - I

Aerobiology: Droplet nuclei, aerosol.

Assessment of air quality.

Bacterial, fungal and viral diseases transmitted through air and their preventive measures.

UNIT - II

Soil Microbiology: Physical and chemical characteristics of soil.

Micro flora of various soil types, rhizosphere and phyllosphere.

Positive and negative microbial interactions.

Biogeochemical cycles: carbon, nitrogen, phosphorus cycle.

Symbiotic and non-symbiotic nitrogen fixation, Mycorrhiza, Phosphate Solubilizing Bacteria.

UNIT - III

Aquatic Microbiology: Potability of water: microbial assessment of water quality.

Purification of water.

Major water borne diseases and their control measures.

Waste Water treatment: Types and characterization of waste water.

Physical, chemical and biological waste treatments, Solid waste treatment.

UNIT-IV

Immobilized enzymes and cells: Methods of immobilization.

Applications of immobilized enzymes.

Concept and production of: Microbial insecticides, Biofertilizers,

Biopolymers, Bioplastics and Biosensors.

UNIT-V

Bioremediation – Oil spills, Metals, Lignin and Hazardous wastes.

Application of GMO in bioremediation.

Biodeterioration.

Biotechnology – Bioleaching of metals, Microbial enhancement of oil recovery.

REFERENCES

- | | |
|---|---------------------|
| 1. Microbial ecology. | Alexander |
| 2. Introduction to Soil Microbiology. | Alexander |
| 3. Bioremediation | Baker and Herson. |
| 4. Advances in microbial ecology Vol-8 | Marshall. |
| 5. Experimental Microbial Ecology | Burns and Slater |
| 6. Essays in agricultural and food Microbiology | Norms and Pettipher |
| 7. Soil Biology | Burges and Raw |
| 8. Introduction to Environmental Microbiology | Michel |

M. Sc. (Microbiology) Semester- IV

Paper XVI – Bio-Nanotechnology

UNIT – I

Introduction and history of Nanotechnology, Applications of Nanotechnology in Biology, Criteria for suitability of nanostructures for biological applications. Health, environmental and social impact of Nanotechnology, plants and microbes as nanofactories.

UNIT – II

Methods in Nanotechnology I – Spectroscopic techniques – UV – Visible Spectroscopy, Raman Spectroscopy, X - ray diffraction, Fourier Transform Infra Red spectroscopy (FTIR), Terahertz spectrometry, Surface Enhanced Raman Spectroscopy (SERS).

UNIT – III

Methods in Nanotechnology II – Microscopic techniques – Confocal microscopy, Electron microscopy, Scanning probe microscopy: Scanning Tunneling Microscopy (STM) and Atomic Force Microscopy (AFM), optical microscopic methods in nanoscience. Fluorescent *in situ* hybridization (FISH), Fluorescent Biological Labels, Colourimetric assay.

UNIT – IV

Nanoparticles and their synthesis, Nanomaterials: Fullerenes, Carbon Nanotubes (CNT), gold monolayer, quantum dots, core shell nanoparticles. Silver nanoparticles, Magnetic nanoparticles, Nanoshells. Diamondoid, Biodegradable polymers and their uses, Colloids in Nanotechnology.

UNIT – V

Nanobiology, Nanosensors, Nanomedicine, Drug delivery system, Nanomachine, Nanobiosensors, Nano DNA Technology, Optical biosensors, Concept of Nanorobots and Nubots.

REFERENCES

- | | |
|--|-----------------------------------|
| 1. Nano: The Essentials | Pradeep |
| 2. Nanobiotechnology | Balaji |
| 3. The University Textbook of Nanotechnology | Heller, Mehmud, Tumbull |
| 4. Multilayer Thin Films | Decher, Schlenoff |
| 5. Bionanotechnology : Lessons from nature | Goodsell |
| 6. Biomedical nanotechnology | Malsch |
| 7. Nanotechnology – A fundamental approach | Kumar |
| 8. Understanding nanotechnology | Scientific American, Warner books |
| 9. Nanocosm | Atkinson |

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