

DEVI AHILYA VISHWAVIDYALAYA, INDORE

M.Sc. (Microbiology) : Four semester course (Duration: Two years)

M. Sc. Sem. I (2008-2009)

	Subject	M. Marks	Lab course	Maximum Marks
Paper I	Bacteriology	50	Lab course - I	50
Paper II	Virology, Mycology and Phycology	50		
Paper III	Immunology	50	Lab course - II	50
Paper IV	Microbial biochemistry	50		
	Total	200		100
Total Marks Semester-I			300	

M. Sc. Sem. II (2008-2009)

Paper V	Microbial genetics	50	Lab course-III	50
Paper VI	Microbial physiology	50		
Paper VII	Instrumentation	50	Lab course-IV	50
Paper VIII	Fermentation technology	50		
	Total	200		100
Total Marks Semester-II			300	

M. Sc. Sem. III (2009-2010)

Paper IX	Molecular biology and Genetic engineering	50	Lab course-V	50
Paper X	Medical microbiology	50		
Paper XI	Bioinformatics	50	Lab course VI	50
Paper XII	Microbial technology	50		
		200		
Total Marks Semester-III			300	

M. Sc. Sem. IV (2009-2010)

Paper XIII	Environmental and Food microbiology	50	Lab course VII	50
Paper XIV	Biostatistics	50		
Project work*	Project content	--	50	
	Project presentation	--	50	
	Viva voce	--	50	
Total Marks Semester-IV			300	
GRAND TOTAL MARKS		1200		

***PROJECT WORK:** A project work shall be initiated at the beginning of Semester III and continued during Semester IV. A project may be undertaken in any reputed Institute / Industry / PG departments of University or College.

Evaluation of project work: The project report duly signed by the supervisor under whose guidance the work is completed and the Head of the institution where the project is completed shall be submitted to the Head, Microbiology Department of concerned college on or before 1st May. Evaluation of the projects shall be done by a panel of two examiners, one examiner appointed by the university and one internal examiner to be appointed by Principal of concerned college.

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 archaeobacteria, Gram negative and Gram positive eubacteria, Eukaryotes, L- forms. Cell wall synthesis, antigenic properties, Capsule – types, composition and function, Cell membranes – structure, composition and properties.

UNIT-III

Structure function of flagella, pili, gas vesicles, chromosomes, carboxysomes, magnetosomes, phycobilisomes and nucleoid. Cell division, 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 the 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, Author- A.J. Salle,.
2. Biology of Microorganisms. Authors- Brock T.D. Madigan M.T. Prentice Hall int. Inc.
3. Microbiology, Authors- Pelczar M.J. Chan E.C.S. Kreig N.R, Mc Graw Hill
4. Text Book on Principles of Bacteriology, Virology and immunology. Authors- Topley and Wilson Edward Arnold, London.
5. General Microbiology, Authors- Stainer RY. Ingharam JL. Wheelis ML. Painter PR Macmillan Educational Ltd. London.
6. *Illustrated Genera of Imperfect Fungi*. Authors- Barnett, H. L. and Hunter, B. B. 1960. Burgess Publishing Co., Minnesota.
7. *Bergey's Manual of Determinative Bacteriology*. Authors- Breed and Buchanan, 8th Edition, 1974.
8. *Bergey's Manual of Determinative Bacteriology*. Authors- Breed and Buchanan, 9th Edition, 1982.
9. *Bergey's Manual of Systematic Bacteriology*. Authors- Breed and Buchanan 2nd Edition, (Volumes. 1 – 5) (2001 –2003).
10. The genetics of Bacteria and their Viruses, Author- William Hayes Blackwell Scientific Publishers, London.
11. General Microbiology. Author – Robert Boyd.
12. An Introduction to Microbiology, Authors- Tauro, P. Kapoor, K.K. and Yadav, K.S. New Age International (P) Ltd, New Delhi.

Paper II- Virology, Mycology and Phycology

UNIT-I

Discovery, nomenclature, classification and general characters of viruses, Distinctive properties of viruses, 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 T3, T4 and Lambda.

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. Life cycle of *Penicillin*, *Saccharomyces* and *Fusarium*. Structure of fungal cells and growth – Hyphae and non- motile unicells, motile cells, effect of environment on growth, prevention of fungal growth.

UNIT V

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

REFERENCES

1. Introduction to Mycology (3rd Ed.), Authors- Alexopoulos, C.J. and C.W. Mims 1979, Wiley Eastern Ltd., New Delhi
2. Introduction to Modern Virology (IV Edition), Authors- Dimmock NJ. Primrose SB (1994) Blackwell Scientific Publications, Oxford.
3. An Introduction to Mycology, Authors- Mehrotra, R.S. and K.R. Aneja 1990, New Age International Publishers.
4. Fundamentals of Mycology, Authors- J.H. Burnett, Publisher : Edward, Arnold Crane Russak.
5. The Fungi, Authors- M. Charlile and S.C. Walkinson, Publisher, Academic Press.
6. Fundamentals of Mycology, Authors- J.H. Burnett, Publisher : Edward, Arnold Crane Russak.
7. Fundamentals of the fungi. Authors- E. Moore – Landeeker, Publisher : Prentice Hall.
8. Virology-III Edition, Authors- Conrat HF, Kimball PC and Levy JA, Prentice Hall, Englewood Cliff, New Jersey.

Paper – III Immunology

UNIT-I

Structure, composition and types of cells and organs involved in immune system, Innate and acquired immunity. Immunization – Modern methods of producing vaccines. Humoral and cell mediated immune responses.

UNIT-II:

Antigens– Structure and properties, Types– Iso and allo – haptens, adjuvants, antigen specificity, vaccines and toxoids. 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 interaction - *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 and 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

Antibody – Mediated – type I. Anaphylaxis; Type II. Antibody dependent cell cytotoxicity; Type III immune complex mediated reactions; Type IV Cell mediated hypersensitivity reactions. Autoimmunity –, mechanism and diseases.

REFERENCES

1. Essentials of Immunology, Author- Roitt, I.M., ELBS. Blackwell Scientific Publishers, London.
2. Immunology II Edition, Author- Kuby, J. WH., Freeman and Company, New York.
3. Immunology. Author- Klaus D. Elgert, Wiley-Liss. NY.
4. Text Book on Principles of Bacteriology, Virology and Immunology, IX Edition (5 volumes). Authors- Topley and Wilson's, Edward Arnold, London.
5. The Experimental Foundations of Modern Immunology. Authors- Clark, V.R., John Willey and Sons, Incl.
6. Fundamental Immunology. Author – W.E. Paul, Raven Press, New York.
7. Fundamentals of Immunology. Authors – R.M. Coleman, M.F. Lombord and R.E. Sicard 2nd ed. C. Brown publishers.
8. Immunology. Authors – D.M. Weir and J. Steward 7th Ed. (1993).

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, oligosaccharides. Structure, occurrence and biological importance of structural polysaccharides *e.g.* blood group .

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, Synthesis of peptide bonds. Primary, secondary, tertiary and quaternary structure of proteins, 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 non-competitive. Allostereism- kinetic analysis of allosteric enzymes, Principles of allosteric regulation.

UNIT-V

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. Introduction to protein structure. Authors- Branden and Tooze. Garland Publishing Company.
2. Principles of Biochemistry. Author- Lehninger, 3rd edition by Nelson and Cox (Worth) 2000
3. Biochemistry. Author- Stryer 5th edition W.H. Freeman 2001.
4. Harper's Biochemistry, 1999 (McGraw-Hill).
5. Principles of Biochemistry. Authors- Zubey GL. Parson WW and Vance DE (1994), WM.C. Brown Publishers, Oxford, England.
6. Modern Microbiology. Author- Brige EA (1992), WM.C. Brown, Publishers, Oxford, England

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) and relation to function initiator and elongator class of tRNA. Ribosome binding site on mRNA and corresponding site on rRNA, Peptidyl transferase activity of 23S rRNA. 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 the above steps, inhibitors of protein synthesis.

Regulation of gene expression: Operon concept, catabolite repression, instability of bacterial RNA, 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 and transfection mechanisms and their applications. Bacteriophages- lytic phages and lysogenic phages.

REFERENCES

1. Microbial Genetics. Author- Maloy *et. al.*, 1994. Jones and Bartlett Publishers.
2. Molecular genetics of bacteria. Author- J.W. Dale 1994 John Wiley and Sones.
3. Modern microbial genetics. 1991. Authors- Streips and Yasbin. Niley Ltd.
4. Genome Author- T.A. Brown.
6. Gene VII Author- Benzamin Lewin.
7. Molecular Biology. Author – Glick.
8. Molecular and Cellular Methods in Biology and Medicine, Author – P.B. Kaufman,W.Wu. D. Kim and L.J.Cseke.
9. Molecular Cell Biology (W.H. Freeman) by Lodish, Berk, Zippursky.
10. Matsodaira, Baltimore, Darnell, 4th edition, 2000.

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 -Mayer hoff 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 and catabolism of amino acids, Synthesis of major 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, barophilic and osmophilic microbes. Halophiles – membrane variation electron transport – Applications of extremophiles.

REFERENCES

1. Microbial Physiology and metabolism. Author- Caldwell, D.R. 1995, Brown Publishers.
2. Microbial Physiology. Authors- Moat. A.G. and Foster J.W. 1999Wiley.
3. General Microbiology. Authors- Stainer RY, Ingharam JL, Wheelis, ML, Painter PR (1986) Macmillan Education Ltd., London.
4. Prokaryotic Development. Authors- Brun, Y.V. and Shimkets, L.J. 2000. ASM Press.
5. Johri, B.N. 2000. Extremophiles. Springer Verlag. New York
6. Colwd, D. 1999. Microbial Diversity, Academic Press.
7. Biology of microorganisms. Authors- Brock TD. Madigan MT, Prentice Hall Int. Inc.

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

Characterization of macromolecules using X-ray diffraction analysis.

Radioisotope techniques – Detection and measurement of radioactivity, Geiger-Muller counter, Scintillation counter, Autoradiography, Radioimmunoassay and application of isotopes in biological studies.

REFERENCES

1. Biochemistry of nucleic acids. 1992. Authors- Adams *et. al.* Chapman and Hall.
2. Crystallography made crystal clear. 1993. Authors- G. Rhodes. Academic Press.
3. Principles of physical biochemistry. 1998. Authors-Van Holde *et. Al.* Prentice Hall.
4. Principles and Techniques of Biochemistry and Molecular Biology, 6th Ed. Authors-Wilson Keith and Walker John (2005) Cambridge University Press, New York.

Paper VIII- Fermentation technology**UNIT-I**

Development of industrial fermentations. Isolation and screening of industrially important microorganisms. Strategies for strain improvement. Maintenance and preservation of industrially important microorganisms. Inoculum development for industrial fermentation.

UNIT-II

Industrial sterilization process for media, air and equipment. Kinetics of thermal death of microorganisms, Batch and continuous sterilization, Media for industrial fermentations, Optimization of fermentation parameters. Scale up of fermentation process.

UNIT-III

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

UNIT-IV

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, Tray reactor and Plafractor.

UNIT-V

Detection, analysis and quality control of fermentation products and raw materials. Microbiological assays for antibiotics and vitamins, Microbial Limit Test, LAL Test, Sterility testing, Area monitoring, Calibration and validation of autoclave and hot air oven.

REFERENCES

1. Biotechnology. Authors- Crueger, W. and Crueger, A. Panima Publishing Corporation, New Delhi.
2. Biotechnological innovations in chemical synthesis. Bioptol. Publisher : Butterworth Heinemann.
3. Industrial Microbiology, G. Reed (Editor), CBS Publishers (AVI Publishing Company)
4. Biology of Industrial Microorganisms. A.L. Demain.
5. Textbook of Industrial Microbiology, Author- A. H. Patel.
6. Industrial Microbiology, Author- L. E. Cassida
7. Industrial Microbiology, Author- G. Reed.
8. Principles of Fermentation Technology. Standbary P.F.A. Whitaker and Hall. 1995. Pergaman. McNeul and Harvey. 1990.
9. Fundamentals of Biotechnology. Author – Prave, Faust, Sittig, Sukatsch.
10. Bioprocess Engineering. Author – Michael Shiler and Kargi.
11. Molecular cloning Vol. 1-III. Sambrook and Russel. 2001. CSH press.

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. 2000. Ausbel *et. al.*
2. Molecular cloning Vol. 1-III. Sambrook and Russel. 2001. CSH press.
3. Principles of gene manipulation. 1994. Old and Primrose, Blackwell Scientific Publications.
4. Molecular Cloning. 3 volumes. Sambrose and Russell, 2000. CSH Press.
5. Genome analysis. Four volumes. 2000. CSH Press.
6. Principles and techniques of biochemistry and molecular biology, 6th Ed. Authors- Wilson Keith and Walker John (2005) Cambridge University Press, New York.
7. Gene Cloning

Paper X- Medical microbiology**UNIT-I**

Early discovery of pathogenic microorganisms, Development of bacteriology as 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, nosocomial infections.

Preventive and Curative measures for diseases.

UNIT-III

Microbial pathogenicity: Opportunistic and true pathogens, establishment and spreading of infections, anti-phagocytic 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, organotroisms, variation and virulence.

UNIT-IV

Classification of pathogenic bacteria. Gram positive cocci - *Staphylococcus*, *Streptococcus*. Gram negative bacilli - *E.coli*, *Salmonella*, and *Shigella*. Gram positive bacilli - *Clostridium*. Acid Fast Bacteria – *Mycobacterium tuberculosis*, *Mycobacterium lapre*. 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*; *Rickettsiae*, *Chlamdiae*.

REFERENCES

1. Text of book of Microbiology. Author-R. Ananthanarayanan and C.K. Jayaram Panicker, Orient Longman,
2. Medical Microbiology Authors - Mackie and McCartney Vol. 1- Microbial Infection and Vol. 2- Practical Medical Microbiology, Churchill Livingstone, 1996.
3. Microbiology in Clinical Practice. Author- D.C. Shanson, Wright PSG, 1982.
4. Bailey and Scott's Diagnostic Microbiology Authors- Baron EJ, Peterson LR and Finegold SM, Mosby, 1990.
5. Biochemistry of Antimicrobial Action. Authors- Franklin, T.J., Snow G.A.(1981); Champman and Hall.
6. Epidemiology and Infections. Author- Smith, C.G.C. (1976): Medowlief Press Ltd., Shildon, England.
7. Lecture Notes in Immunology, Author- Todd, I.R. (1990 : Blackwell Scientific Publications Ltd., Oxford. Vol. 1 : Microbial infections, Vol. 2 : Practical Medical Microbiology : 1996 Churchill Livingstone London.
8. Bailey and Scott's Diagnostic Microbiology.
9. Cellular Microbiology. 1999. Henderson *et.al.* Wiley.

Paper XI - Bioinformatics

UNIT-I

Introduction to Bioinformatics:

Use of internet, Overview of bioinformatics, its applications and scope. Public domain protein and nucleotide sequence databases (SWISS-PROT, GenBank, EMBL), Protein Structure Database (PDB), Computer tools for sequence analysis: finding and retrieving sequences.

UNIT-II

Biological Data Generation:

Conventional DNA sequencing (Sanger, Maxam and Gilbert), Automated sequencing, Edman degradation for protein sequencing, Mass spectrometry, 2-D separation of total cellular protein.

UNIT-III

Sequence Analysis:

Sequence alignments (Pair-wise and multiple sequence alignment), Sequence similarity search and homology algorithms (BLAST) for protein and nucleic acids, Open reading frames, Annotation of genome, DNA analysis for repeats.

UNIT-IV

Whole genome analysis:

Preparation of ordered plasmid libraries, Cosmid libraries, Bacterial artificial chromosome libraries, Sequencing and sequence assembling using computers, Structure-function relationships, Phylogenetics.

UNIT-V

Microarray:

Printing oligonucleotides and PCR products on glass slide, nitrocellulose paper, whole genome analysis for global patterns of gene expression using fluorescence labeled cDNA or labeled RNA probes. Analysis of SNP using DNA chips. Protein microarray, its advantages and disadvantages.

REFERENCES

1. Bioinformatics 1998, Baxevanis.
2. Bioinformatics 2000, Higgins and Taylor, Oxford University Press.
3. Nucleic Acids Research, 2001. Jan. Genome Database issue.
4. The Internet and the New Biology : Tools for Genomic and Molecular Research by Peruski, Jr. and Peruski (ASM) 1997.
5. Functional Genomics A Practical Approach Edited by Mark Schena, Oxford University Press.

Paper XII-Microbial technology

UNIT-I

Microbial production of commercially important products-I: Alcohol, Acetone, Butanol, Penicillin, Streptomycin, and Steroid bioconversions.

UNIT-II

Microbial production of commercially important products-II :Lactic acid, Acetic Acid, Citric acid, Ascorbic acid, Lysine, Cyanocobalamine and Riboflavin.

UNIT-III

Microbial Production of Enzymes – Protease, Amylase, Cellulase and Lipase.
Immobilized enzymes and cells : Methods of immobilization and applications of immobilized enzymes.

UNIT-IV

Concept and production of : Microbial insecticides, Biofertilizers, Biopolymers, Bioplastics Biosensors, Single cell protein and Single cell oil

UNIT-V

Bioremediation – Oil spills, Metals, Lignin and Hazardous wastes. Application of GMO in bioremediation, Biodeterioration. Biogeotechnology – Bioleaching of metals, Microbial enhancement in oil recovery.

REFERENCES

1. Principles of Fermentation Technology. Authors- Stanbury PFA Whitaker and Hall 1995
2. Fermentation :A Practical Approach. Authors- Pergaman McNeul and Harvey 1990. JRL
3. Basic Food Microbiology. Author- Banwart GJ (1989) CBS Publishers and Distributors, Delhi.
4. Bioremediation. Authors- Baker, KH. and Herson, D.S. 1994. Mc Craw Hill Inc. New York.
5. Textbook of Industrial Microbiology, Author- A. H. Patel.
6. Industrial Microbiology, Author- L. E. Cassida
7. Industrial Microbiology, Author- G. Reed.
8. Fundamentals of Biotechnology. Author – Prave, Faust, Sittig, Sukatsch.
9. Bioprocess Engineering. Author – Michael Shiler and Kargi.
10. Industrial Microbiology. Author – Prescott and Dunn.
11. Manual of Industrial Microbiology and Biotechnology. Author – Demain and Daveis.
12. Industrial Microbiology. Author – M. J. Waits.

Paper XIV – Environmental and Food 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

Aquatic microbiology : Micro flora of fresh water and marine ecosystems, Potability of water : microbial assessment of water quality. Purification of water. Major water borne diseases and their control measures.

UNIT-III

Soil Microbiology : Classification of soils, 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 and sulphur cycle. Symbiotic and non-symbiotic nitrogen fixation, VAM fungi.

UNIT-IV

Waste treatment : Types and characterization of wastes. Physical, chemical and biological waste treatments. Solid waste treatment. Utilization of solid wastes for the production of SCP, mushroom, yeast, ethanol, methane and compost. Liquid waste treatment.

UNIT-V

Food as substrate for microorganisms Factors influencing microbial growth in food. Physical and chemical methods of food preservation. Detection of spoilage and characterization. Food-borne infections and intoxications . Bacterial and non-bacterial food-borne outbreaks, laboratory testing procedures. Preventive measures – Food sanitation in manufacture and retail trade.

REFERENCES

1. Microbial ecology. Author- Alexander, M. (1971) John Wiley and sons, Inc., New York.
2. Introduction to soil microbiology. Author- Alexander. M. (1977), John, Wiley and Sons. Inc., New York.
3. Pollution: Ecology and biotreatment. Authors- Ec Eldowney. S. Hardman, D.J. and Waite. S. 1993. Longman Scientific Technical.
4. Bioremediation. Authors- Baker, KH. and Herson, D.S. 1994. Mc Craw Hill Inc. New York.
5. The environment of the deep sea. Vol. II. Author- W.C. Erneasst, (1982) J.g. Morin Rubey.
6. Advances in microbial ecology Vol-8, Author- K.C. Marshall, (1985) Plenum Press.
7. Experimental Microbial Ecology. Authors- Burns R.G. and Slater J.H. (1982) Blackwell Scientific Publications, Oxford, London.
8. Essays in agricultural and food microbiology, Authors- Norms, J.R. and Pettipher, G.L. (1987) John Wiley and Sons Singapore.
9. Soil Biology. Authors- Burges, A and Raw, F. 1967 Academic Press, London.
10. Introduction to soil Microbiology. Author- Martin Alexander, Wiley International edition, New York.
11. Soil Organic matter and biological activity. Authors- Vanghan, D and Malcolm, R.E. 1985 Martinus Nighoff W. Junk Publishers.
12. The nature and properties of soil. Authors- Harry buckman and Nyle C. brady. 1960 Eurasis Pub. House (Pvt.) Ltd., New Delhi.
13. Biology of microorganisms. Authors- Brock TD. Madigan MT, Prentice Hall Int. Inc.
14. Introduction to environmental microbiology. Author- Michel R. 1999. ASM book.
15. Food Microbiology. Author- Adams M.R. and Moss M.O. (1995), Royal Society of Chemistry Publication, Cambridge.
16. Food Microbiology. Author- Frazier WC and Westhoff Dc (1988), Tata McGraw Hill Publishing Company Ltd., New Delhi.
17. Food poisoning and Food Hygiene. Authors- Hobbs BC and Roberts D. (1993) Edward Arnold (A division of Hodder and Stoughton) London.
18. Dairy Microbiology. Author- Robinson UK, (1990), Elsevier Applied Sciences, London.

Paper XIV - Biostatistics

UNIT-I

Quantitative methods in biology, Sampling methods, scales and variables, data organization, tabulation and graphical representation. Descriptive statistics: Frequency and probability distributions, graphical representation of distributions, measures of central tendency, measures of dispersion, skewness, kurtosis.

UNIT-II

Introduction to Normal, Binomial and Poisson distributions and their applications. Distribution of sample means, standard error and confidence interval.

UNIT-III

Correlation and Regression: Positive and negative correlations, Calculation of correlation coefficient. Linear regression, regression equations, Prediction of unknown variables. Multivariate analysis: multiple regressions, ordination, principal component analysis.

UNIT-IV

Survey design, Factorial design, ANOVA and F test.
Probability: Laws of probability, independence and randomness.

UNIT-V

Hypothesis testing: Comparison of two sample means: t-tests, non-parametric tests. The concepts of null hypothesis, significance level, type I and type II errors, one tailed and two tailed tests. Categorical data and proportion data: Chi square test and test for goodness of fit.

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5. Sampling Techniques, Author- Cochran W. G. – Wiley estern Ltd, New Delhi.
6. Introduction to probability theory and its applications, Author- Feller W. Asia Publishing House, Mumbai.
7. An introduction to Biostatistics. Author- Glover T. and Mitchell K. 2002, McGraw-Hill , N.Y.
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9. Fundamentals of Biostatistics. 2nd Ed. Authors- Irfan Ali Khan and Atiya Khanum, Ukaaz Publications, Hyderabad.
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