

B.Sc. (Hons.) Microbiology Year I Semester I

Group I : MB-1

Paper I : INTRODUCTION TO MICROBIOLOGY

Unit-1

- 1.1 History of Microbiology : Contributions of Anton van Leeuwenhoek, Joseph Lister, Paul Ehrlich, Edward Jenner, Louis Pasteur, Robert Koch, Martinus w. Beijerinck, Sergei N. Winogradsky, Alexander Fleming, Selman A. Waksman, Elie Metchnikoff.
- 1.2 The spontaneous generation controversy, outbreak of bacterial and viral diseases, Germ theory of disease. Use of Petridish and agar, isolation of pure cultures and its significance, immunization, microbes and fermentation, developments in Microbiology in 20th century.
- 1.3 Classification: Binomial Nomenclature, Whittaker's five kingdom and Carl Woese's three domain classification systems and their utility, acellular (Prions, Viroids, Viruses) and cellular microorganisms.

Unit-2

- 2.1 Bacteria: General characteristics with emphasis on their morphology and cell structure.
- 2.2 Fungi: General characteristics of fungi with emphasis on their occurrence, distribution and structure.
- 2.3 Algae: General characteristics of algae with emphasis on their occurrence, distribution and cell structure.
- 2.4 Viruses: General characteristics and structure of viruses with special reference to TMV, Poliovirus, T4 and lambda phages, hepatitis B virus.

Unit-3

- 3.1 Protozoa: Occurrence, morphology, nutrition, perennation, locomotion, reproduction and economic importance of protozoa. A brief account of *Amoeba*, *Plasmodium*, *Leishmania*, *Trypanosoma*, *Tetrahymena*, *Euglena*, *Paramecium*.
- 3.2 Environmental and Agricultural Microbiology: Microbes in soil environment, Biogeochemical (C, N, P, S) cycling.
- 3.3 Microbial interactions (mutualism, symbiosis, commensalisms, predation, parasitism, amensalism, competition).

Unit-4

- 4.1 Food and Dairy Microbiology: Production and importance of SCP, fermented foods, bread, fermented milk and milk products.
- 4.2 Biomagnification, biodegradation, biofilms.
- 4.3 Definition of aeromicrobiology, air-borne pathogens and allergens. Biofertilizers, bioinsecticides, bioremediation, role of microbes in BOD reduction and secondary sewage treatment.

Unit-5

- 5.1 Introduction to cell biology: Cell theory, Prokaryotic and Eukaryotic cell.
- 5.2 Cell wall and Cell membrane: Composition and architecture of cell wall. Structural models and composition of cell membrane.
- 5.3 Overview of cell organelles: Nucleus, Mitochondria, Chloroplast, Golgi app., Endoplasmic reticulum, Lysosomes and Ribosomes.
- 5.4 Cell division: Amitosis, Mitosis and Meiosis.

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Practicals

1. Study the life history and contributions of the following scientists using photographs:
Anton van Leeuwenhoek, Joseph Lister, Paul Ehrlich, Edward Jenner, Louis Pasteur, Robert Koch, Martinus W. Beijerinck, Sergei N. Winogradsky, Alexander Fleming, Elie Metchnikoff, Anand M. Chakraborty.
2. Study of different parts and functions of light microscope.
3. Cell-a detailed study with the help of microscope and photographs.
 - (i) Prokaryotic cell
 - (ii) Eukaryotic cell
 - (iii) Different types of cells.
 - (iv) EM of cell organelles.
4. Study the following with the help of temporary mounts:
 - a) *Rhizopus*, *Mucor*, *Aspergillus*, *Penicillium*.
 - b) *Chlamydomonas*, *Volvox*, *Spirogyra*.
5. Study the permanent mounts of protozoa :
Balantidium, *Paramecium*, *Plasmodium*, *Euglena*, *Giardia*, *Leishmania*, *Trypanosoma*.
6. Study the following viruses using electron micrographs :
TMV, Poliovirus, T4 phage and lambda phages, HIV, Hepatitis B virus..
7. Study of Mitosis and Meiosis with temporary and permanent slides.

Reference Books

1. Microbiology, by Pelczar, Chan and Krieg. Mc.Graw Hill Book Company.
2. Microbiology, by Prescott, Hailey and Klein. Wm.C Brown Publishers.
3. Principles of Microbiology, by R. M. Atlas. Macmillan Publishing Co. New York.
4. Brock Biology of Microorganisms by M. T. Madigan, J. M. Martinko and J. Parker. Prentice Hall, Englewood Cliffs, New Jersey.
5. Microbiology: A laboratory Manual, by Cappucino and Sherman. Benjamin/Cummings Publishing Co. Inc.
6. De Robertis and De Robertis. Cell and Molecular Biology. Lippincott Williams & Wilkins.

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B.Sc. (Hons.) Microbiology Year I
Semester I

Group I : MBI

Paper II: BACTERIOLOGY

Unit-1

- 1.1 Introduction: Historical landmarks in Bacteriology.
- 1.2 Classification of bacteria: Aim and principles of classification, Bacterial species concept, nomenclature and different systems of classification of Prokaryotes, Concept of eubacteria and archaeobacteria, Differences between the two groups.
- 1.3 Archaeobacteria: habitat, , groups (halophiles, methanogens, thermoacidophiles and hyperthermophiles).

Unit-2

- 2.1 Eubacteria: Groups, characteristics, and importance.
- 2.2 Cell organization: Cell size, cell arrangement and cell shape.
- 2.3 Cell wall: structure and function of Gram negative and Gram positive cell wall , periplasmic space, peptidoglycan layer, teichoic acid, porin types and function, outer membrane and LPS chemistry, endotoxins, sphaeroplast, protoplast, and L-forms.
- 2.4 Cell membrane: structure, function and chemical composition,

Unit-3

- 3.1 Cytoplasm- ribosomes, mesosomes and cytoplasmic inclusions, Pili and flagella –structure, function and arrangement, taxes types.
- 3.2 Endospore –structure, formation , chemical composition & and function
- 3.3 Bacterial nutrition and growth: Requirements for microbial growth- Physical growth requirements (temperature, pH, oxygen concentration, water activity, radiations and light, pressure)

Unit-4

- 4.1 Chemical growth requirements: nutritional types, culture medium and its types
- 4.2 Definition of growth, growth curve, generation time and growth rate
- 4.3 Measurement of growth by quantitative cell mass, cell number and a cell constituent.
- 4.4 Asexual methods of reproduction.

Unit-5

- 5.1 DNA replication in bacterial cell
- 5.2 General principles of bacterial recombination- homologous and non-homologous
- 5.3 Methods of recombination in bacteria – Transformation, transduction and conjugation

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Practicals:

1. Preparation of different types of media: Synthetic media & Natural media
Complex media - nutrient agar, Enriched media - Blood agar, Enrichment media- for chemoautotroph, Indicator media – MacConkey and EMB agar
2. Staining –simple and negative staining
3. Differential staining: Gram's staining, Capsule staining, Spore staining
4. Isolation of pure bacterial culture by streaking method
5. Enumeration of bacterial sample by - spread plate and pour plate methods
6. Turbidity by spectrophotometer
7. Motility by hanging drop method
8. Measurement of bacterial cell by ocular and stage micrometers

Reference Books :

1. Stanier RY, Ingraham JL, Wheelis ML, Painter PR. General Microbiology McMillan.
2. Prescott LM, Harley JP, Klein DA. Microbiology. W.M.C. Brown Publishers.
3. Black JG. Microbiology-Principles and explorations. Prentice Hall, Upper Saddle River, New Jersey.
4. Nester EW, Pearsall NN, Roberts CE, Nester MT, Lidstorm ME. Microbiology. Saunders College Publishing, Philadelphia.
5. Pelczar Jr. MJ, Chon E.C.S, Kreig NR. Microbiology concepts and applications. MacGrant Hill Book Co.
6. Weistreich GA, Lechtman MD. Microbiology. McMillan Publishing Co.
7. Kathleen PT, Arthur T. Foundations in Microbiology. Basic Principles. McGraw Hill Companies.
8. Gerard JJ, Tortora Fanke, Berdell R, Funke, Christine L Case. Microbiology. An Introduction. Study Guide. Benjamin- Cummings Publishing Company.
9. Boyd RF. General Microbiology. Times Mirror/Mosby College Publishing.
10. Batzing BL. Microbiology. An Introduction. Brooks/cole Thomson Learning.
11. Atlas RM. Principles of Microbiology. Mosby.
12. Madigan MT, Martinko JM, Parker J. Brock Biology of Microorganisms. Prentice Hall Int. Inc.
13. Batzing BL. Microbiology. An Introduction. Books/Cole. Thomson Learning.

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B.Sc. (Hons.) Microbiology Year I
Semester I

Group-II : MB II

Paper –III: LOWER PLANTS

Unit-1

- 1.1 General characters : General account on : habitat and habit , algal cell structure, algal pigments, flagella and food reserves.
- 1.2 Types of the life cycle and Classification.
- 1.3 Introduction to cyanobacteria , occurrence, salient features, thallus organization and reproduction in *Nostoc*, *Oscillatoria* and *Scytonema*

Unit –2

- 2.1 Habitat, structure, reproduction and life cycle of following forms:
Chlorophyta - Volvox, Coleochaete, Chara.
- 2.2 Xanthophyta: Occurrence, salient features, thallus organization and reproduction in *Vaucheria*.
- 2.2 Bacillariophyta : Occurrence, salient features, thallus organization and reproduction of pennate and centric diatoms.

Unit –3

- 3.1 Phaeophyta : Occurrence, salient features, thallus organization and reproduction with reference to *Ectocarpus* and *Fucus*
- 3.2 Rhodophyta : Occurrence, salient features, thallus organization and reproduction in *Polysiphonia* and *Batrachospermum*.
- 3.3 Economic importance of algae

Unit-4

- 4.1 General characters and classification of Bryophyta
- 4.2 Hepaticopsida : *Marchantia*
- 4.3 Anthoceropsida : *Anthoceros*
- 4.4 Bryopsida : *Polytricum*

Unit-5

- 5.1 Pteridophyta : Important Characteristics and Classification
- 5.2 Psilophytopsida : *Rhynia*
- 5.3 Lycopsidea : *Lycopodium*
- 5.4 Sphenopsida : *Equisetum*

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Practicals:

1. **Algae** : Study of the following genera through temporary and permanent slides—*Nostoc Chlyamdomonas, Volvox, Spirogyra, Coleochaete, Chara, Ectocarpus*.
2. **Fungi**: Study of the vegetative and reproductive structures through temporary and permanent slides—*Mucor, Rhizopus, Saccharomyces, Aspergillus, Penicillium, and Alternaria*
3. **Brophytes, Pteridophytes** : A detailed study of external and internal characters of types given in the syllabus.

Reference Books:

1. Algae by Lindia E.Graham, Lee W. Wilcox. Prentice Hall Inc.
2. Introduction to Phycology. G.R. South & A. ckwell Science.
3. Kumar H.D. Introductory Phycology Affiliated East Western Press N.P.
4. Lee, R.E. Phycology, 3rd ed. Cambridge Press
5. Prempuri 1973, Bryophytes - A Board perspective. Atmaram & Sons.
6. Smith G.M 1955, Cryptogamic Botany Vol.II. McGraw Hill.
7. Sporne K.R 1976, Morphology of Pterdophytes, B1 Publications
8. Webster, J. Introduction to fungi, Second edition. Cambridge University Press.
9. Alexopoulos, C.J., Mims, C.W. and Blackwell, M. Introductory Mycology, Fourth edition. John Wiley and Sons, Inc.

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B.Sc. (Hons.) Microbiology Year I
Semester I

Group-II : MB II

Paper IV: GYMNOSPERMS AND ANGIOSPERM

Unit-1

- 1.1 General characters and classification of Gymnosperms
- 1.2 Study of the structure and life cycle of Cycas.
- 1.3 Study of the structure and life cycle of Pinus.
- 1.4 Study of the structure and life cycle of Gnetum.

Unit-2

- 2.1 Brief study of the following fossils: Lepidodendron, Calamites, Williamsonia
- 2.2 Classification of Angiosperms : salient features of the system proposed by Bentham and Hooker and Engler and Prantl

Unit -3.

- 3.1 Method of describing a flower in Botanical language.
- 3.2 Description of some members of Dicotyledenous families : Brassicaceae, Malvaceae, Fabaceae, Solanaceae.

Unit -4

- 4.1 Description of some members of Monocotyledenous families : Liliaceae, Poaceae.
- 4.2 Anatomy of Dicot and Monocot roots.
- 4.3 Anatomy of Dicot and Monocot stems.

Unit -5

- 5.1 Abnormal anatomical structures and secondary growth in *Boerhaavia*, *Tinospora*, *Nyctanthus*, *Salvadora*, *Dracaena*.
- 5.2 Economic importance of some-
 - Food, fodder and oil yielding plants
 - Fiber Crops
 - Medicinal and Aromatic plants

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Practicals

1. Description of plant in technical terms.
2. A detailed study of the range of vegetative and floral characters of plants belonging to the families mentioned in the theory part.
3. Section cutting of Monocot and Dicot stem and root
4. Study of some economically important plants mentioned in the theory part.

Reference Books :

1. Gupta, RK (1972). Textbook of Systematic Botany. Atma Rama & Sons.
2. Hill, A.W.,(1951). Economic Botany. McGraw Hill.
3. Lawrence, G.H.M (1967). Taxonomy of vascular plants. Oxford & IBH Publishing Company.
4. Rao K.N.R and Krishnamurthy K.V, Angiosperm, S. Viswanathan Pvt. Ltd.
5. Rendle A.B. (1930) The classification of flowering plants. Cambridge.
6. Vashishta, P.C. (1974) Taxonomy of Angiosperms. S.Chand & Co.
7. Chamberlain C.J Gymnosperm, Structure and Evolution.
8. Sporne K.R Morphology of Gymnosperms, B.I Publications.
9. Vasishta P.C (1976) Gymnosperm, Chand & Co.
10. Bhatnagar, S.P. and Moitra, A. (1996) Gymnosperms, New Age International Limited, New Delhi.
11. Cutter, E.G. (1971) Plant Anatomy : Experiment and Interpretation. Part II, Organs, Edward Arnold, London
12. Esau, K . (1977) Anatomy of Seed Plants, 2nd edition John Wiley & Sonjs, New York.

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B.Sc. (Hons.) Microbiology Year II
Semester II

Group III : MB III

Paper I : CONCEPTS OF GENETICS

Unit -1

- 1.1 Introduction: Historical developments in the field of genetics. Organisms suitable for genetic experimentation and their genetic significance.
- 1.2 Mendelian genetics : Mendel's experimental design, monohybrid, di-hybrid and trihybrid crosses, Law of segregation & Principle of independent assortment. Rediscovery of Mendel's principles, Chromosome theory of inheritance,.

Unit -2

- 2.1 Allelic interactions : Concept of dominance, recessiveness, incomplete dominance, co-dominance, pleiotropy, multiple alleles.
- 2.2 Non allelic interactions: Interaction producing new phenotype-complementary genes, epistasis (dominant & recessive), duplicate genes.
- 2.3 Chromosome organization: Structure and characteristics of bacterial and eukaryotic chromosome- chromosome morphology, concept of euchromatin and heterochromatin, packaging of DNA molecule into chromosomes, chromosome banding pattern, karyotype, giant chromosomes

Unit-3



- 3.1 Chromosomal mutations: Definition and types of mutations, causes of mutations, Ames test for mutagenic agents.
- 3.2 Variations in chromosomes structure - deletion, duplication, inversion and translocation (reciprocal and Robertsonian), chromosomal aberrations in human beings,
- 3.3 Variations in chromosome number abnormalities- Aneuploidy and Euploidy.

Unit-4

- 4.1 Sex determination and sex linkage : Mechanisms of sex determination, Environmental factors and sex determination, Barr bodies, dosage compensation, genetic balance theory, sex limited gene expression and sex linked inheritance.
- 4.2 Extra chromosomal inheritance: Criteria for extra nuclear inheritance, cytoplasmic inheritance and maternal effects.

Unit -5

- 5.1 Genetic linkage, crossing over and chromosome mapping : Linkage and recombination of genes in chromosomes, crossing over, Cytological basis of crossing over, Molecular mechanism of crossing over, Crossing over at four-strand stage, Genetic mapping : Two and three factor cross.
- 5.2 Quantitative genetics : Quantitative traits, quantitative and multifactor inheritance.
- 5.3 Population genetics : Inbreeding and out breeding, Hardy Weinberg law.


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Practicals

- (1) Mendelian rules and its deviations in mono and dihybrid crosses.
- (2) Demonstration of - Barr Body
- (3) *Rhoeo* translocation and other chromosomal aberrations.
- (4) Karyotyping with the help of photographs.
- (5) Genetic studies using *Neurospora*.

Reference Books

- (1) Gardner EJ, Simmons MJ, Snustad DP. Principles of Genetics. John Wiley & Sons, Inc.
- (2) Weaver RF, Hedrick PW. Genetics. W.M.C. Brown Publishers.
- (3) Klug WS, Cummings MR. Concepts of Genetics. Prentice Hall International Inc.
- (4) Griffith AJF, Miller JH, Suzuki DT, Lewontin RC, Gelbert WM. An introduction to Genetic Analysis. W.H. Freeman and Co. New York
- (5) Lewin Benjamin. Genes – Oxford University Press.
- (6) Hartl DL, Jones EW. Genetics, Principles and Analysis. Jones and Bartlett Publishers.
- (7) Russell PJ. Genetics. Addison Wesley Longman Inc.
- (8) Gupta P.K. Genetics. Rastogi Publications.

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B.Sc. (Hons.) Microbiology Year II
Semester II

Group III : MB III

Paper II : CONCEPTS OF BIOCHEMISTRY

Unit -1

- 1.1 Water, pH and buffers: Water structure and interactions, dissociation of water, and its ionic product, K_w . Water as a solvent. Hydrophobic, hydrophilic and amphiphilic substances. Acid -Base reactions, Bronsted acids, pH, the Handerson Hasselbach equation.
- 1.2 Bioenergetics: Laws of thermodynamics, Gibb's Free energy, Standard free energy and Energy rich compounds.

Unit -2

- 2.1 Amino acids: Classification and structure of amino acids, Optical and chemical properties of amino acids, pK_a value and titration curve.
- 2.2 Proteins: Covalent structure, functions and three dimensional structure of proteins. Protein purification and sequencing techniques.

Unit -3

- 3.1 Enzymes: Historical perspective of enzymes, enzyme nomenclature, Michaelis Menten kinetics. Lineweaver-Burke plot, Substrate specificity, effect of pH, temperature.
- 3.2 Enzyme inhibition, enzyme regulation, cofactors, coenzymes, prosthetic groups, Isozymes.

Unit -4

- 4.1 Carbohydrates: Classification of carbohydrates, Monosaccharides: configuration and conformation, Fischer and Haworth projection formulae. Disaccharides: lactose, maltose, and sucrose. Polysaccharides: structural and storage.
- 4.2 Lipids: Classification. Biosynthesis and degradation of Fats and Fatty acids..

Unit -5

- 5.1 Nucleic acids: Building blocks: bases, sugar and phosphates. Nucleosides and nucleotides, polynucleotides,
- 5.2 DNA and RNA. Primary and secondary structure (A, B, Z), Properties of DNA: absorption, denaturation renaturation and cot values. RNA: Structure of RNA.

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Practicals

1. Preparation of buffers of different pH values.
2. Qualitative tests for starch, sugars, proteins, fats & lipids.
3. Quantitative estimation of proteins.
4. Quantitative estimation of carbohydrates.
5. Paper chromatographic separation of amino acids
6. Enzymes-study the activity of any two enzymes and see the effect of pH, temperature on any one of them.
7. Use of dialysis for separation of macromolecules.
8. Various structural models proposed for DNA, RNA and proteins.

Reference Books

1. Stryer, L. Biochemistry. W.H. Freeman and Company, New York
2. Lehninger, A.L., D. Nelson D. and Cox, M.M. Cox, Principles of Biochemistry, Worth Publishers.
3. Zubay, G. Biochemistry. 4th Ed Mc Graw Hill. McMillan Publishing Company, New York.
4. Conn Eric E., Stumpf, Paul K. Bruning, George, & Doi, Roy, H. 1987. Outlines of Biochemistry. John Wiley and sons.

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B.Sc. (Hons.) Microbiology Year II
Semester II

Group IV : MB IV

Paper III : ENVIRONMENTAL SCIENCES

Unit – 1

- 1.1 The Multidisciplinary nature of environmental studies, Definition, scopes and importance, Need for public awareness.
- 1.2 Natural Resources : Renewable and non-renewable resource. Natural resources and associated problem of forest, water, mineral, food, energy and land resources.
- 1.3 Role of an individual in conservation of natural resource. Equitable use of resources for sustainable lifestyles.
- 1.4 Environmental Ethics : Issues and possible solutions. Water conservation , rain water harvesting and watershed management .Resettlement and rehabilitation of people

Unit – 2

- 2.1 Ecosystems - Concept of an ecosystem. Structure and function of an ecosystem. Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids
- 2.2 Types, characteristic features, structure and function of the following ecosystem. Forest ecosystem, Grassland ecosystem, Desert ecosystem, aquatic ecosystems (ponds, streams, lakes, rivers ,oceans ,estuaries)

Unit -3

- 3.1 Concept of Biodiversity : Definition of genetic, species and ecosystem diversity.
- 3.2 Biogeographical classification of India- Value of diversity: consumptive use, productive use, social, ethical, aesthetic and option values.
- 3.3 Biodiversity at global, national and local levels , hotspots of biodiversity, threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts.
- 3.4 Endangered and endemic species of India, Conservation of biodiversity.

Unit -4

- 4.1 Definition of Environmental Pollution. Causes , effects and control measures of Air, Water, Soil, Marine, Thermal and Noise pollution.
- 4.2 Climate change : global warming, acid rain , ozone layer depletion, and nuclear accidents.
- 4.3 Solid waste Management: Causes , effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution.

Unit -5

- 5.1 Disaster management: floods, earth quake, cyclone and landslides.
- 5.2 Wasteland reclamation, Consumerism and waste product.
- 5.3 Population explosion: Family welfare programme. Environment and human health. HIV/ AIDS. Women and child welfare. Role of information Technology in Environment and human health.
- 5.4 Environmental legislation : Environment Protection Act . Air (Prevention and control of pollution) Act, Water (Prevention and control of Pollution) Act, Wild life protection Act, Forest Conservation Act.

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Practicals:

.To study local fauna and flora

To study biological diversity etc by quadrat method.

- Visit to local area to document environmental and therefore grass land Hill Mountain
- Visit to local polluted site: Urban/ Rural/ Industrial/ Agricultural
- Study of common plants, insects , birds.
- Study of simple ecosystems-ponds, river hill slopes, etc.

To study food chain and food web with help of photographs.

To study soil water and air pollution.

Reference Books:

1. S.K.Choudhuri: Environmental Legislation in India. Oxford & IBH Publ. Delhi.1996
2. E.A.Keller : Environmental Geology. Charles E. Merrill Publ. Co. Columbus, U.S.A 1976
3. S.S. Purohit , Q.J.shammi and A.K.Agarwal : A txt book of Environmental Science. Student Edition, Jodhpur. 2004
4. Santra Sc. 2005. Environmental Science, New Central Book Agency, Kolkata.
5. B.K. Sharma: Environmental Chemistry. Goel Publ. House, Meerut. 2001
6. P.D. Sharma: Ecology and Environment. Rastogi Pub. Meerut 1995.
7. R.K. Trivedi: Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards. Enviro Media (R).
8. K.S. Valdiya: Environmental Geology- Indian Context. Tata McGraw Hill Publ. Co. Ltd., New Delhi. 1987.
9. H.D. Wagner: Environmental Management. W.B. Saunders Co. Philadelphia, U.S.A. 1998.

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B.Sc. (Hons.) Microbiology Year II
Semester II

Group IV : MB IV

Paper IV: INTRODUCTION TO BIOSTATISTICS AND COMPUTER

Unit -1

- 1.1 Organization of statistical data: Compilation of records and their summarization use of tables, charts and graphs.
- 1.2 Definition of mean, median and mode
- 1.3 Definition of Measures of dispersion: Range, mean deviation, standard deviation, variance mean square deviation , coefficient of variation,

Unit -2

- 2.1 Definition of Probability: Classical probability, axiomatic probability.
- 2.2 Introduction to the following statistical terms: Random variables, discrete and continuous random variable.
- 2.3 Definition of population, sample, parameter, statistic, interval estimate, confidence interval, attribute data, measurement data,.

Unit -3

- 3.1 Random sampling, tests of significance.
- 3.2 Student's distribution, F distribution, paired 't' test for difference of means
Chi-square of distribution , calculation of F value
- 3.3 Computer Fundamentals : Computer basics.

Unit -4

- 4.1 Operating systems: Windows and Unix. *Hardware*, software, disk operating system.
- 4.2 Multimedia network concepts, C-programming; object oriented programming
- 4.3 How the Internet works: Local area network, wide area network.

Unit -5

- 5.1 HTML & XML concepts
- 5.2 MS-DOS, MS-WORDS-EXCEL, MS-Power point
- 5.3 Applications of computers in biostatistical problems.

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Practical:

1. Computer Operation.
2. Problems based on theory

Reference Books :

1. Kenny, JF and Keeping, ES (1964) 'Mathematics of Statistics'. Part I & II. Affiliated East—West Press Ltd., New Delhi
2. Bansi L (1968) 'Mathematics of Probability of Statistics' R Chand 7 Co. Delhi
3. Suedecor, GW and Cochram, WG (1968) 'Statistical methods' Oxford & IBH, Delhi
4. Steel, GD and Torrie JH 'Principles & Procedures of Statistics' McGraw Hill Book Co., New York.
5. 5.Atwood, T. and Smith, D.J.: Introduction to Bioinformatics. Pearson Education.

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B.Sc. (Hons.) Microbiology Year II
Semester III

GROUP VI : MB VI

Paper III : BASICS OF CHEMISTRY I (Organic and Analytical)

Unit I

- 1.1 Structure of Organic compounds, chemical bonding, bond length, bond angle, and bond dissociation energy.
- 1.2 Hydrogen bond resonance, electronic effects inductive, Mesomeric, electrometric & Hyper conjugation, Nucleophiles and electrophiles.
- 1.3 Reaction intermediates Carbonium ions, carbanions, Free radicals and Carbenes, Homolytic fission and Heterolytic fission.

Unit II

- 2.1 Introduction, Nomenclature, isomerism, Preparation and general properties of Aliphatic hydrocarbons Alkanes, Alkenes, Cycloalkanes, Alkyl and aryl halides

Unit III

- 3.1 Aromatic hydrocarbons, Alcohols, Phenols, Carboxylic acids, Amines, Aldehyde and Ketones, Aromaticity & Huckles rule.

Unit IV

- 4.1 Stereochemistry, Simple molecules, Hybridization, Conformation & Configuration,
- 4.2 Geometrical isomerism, Optical activity, Enantiomers and diastereomers, Racemization..

Unit V

- 5.1 Spectroscopy: Introduction, Electromagnetic spectrum, Principle of Spectroscopy, the Spectrometer,
- 5.2 Ultraviolet Visible(UV) absorption spectroscopy, Principal and applications of infra red spectroscopy,
- 5.3 Nuclear Magnetic spectroscopy and Mass spectroscopy.

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Practicals

1. Preparation of the compounds involving single state reactions: nitration, benzylation, and brominations, suggested examples are : m-dinitrobenzene, benzanilide and tribromoaniline.
2. Purification of organic compounds by crystallization.
3. Systematic identification of functional group of organic compounds (Monofunctional only).

Reference Books

1. Morrison & Boyd, 1992, Organic Chemistry, Addison-Wesley Pub. Co. 6th Edition.
2. Finar, I.L., 1988, Organic Chemistry, vol. I & II, Wiley John & Sons.
3. Soni, P.L., 2001, Organic Chemistry, S. Chand & Co., Delhi.
4. P.S. Kalsi, 2000, Organic Chemistry, (Recent edition)
5. Tondon, M.M., Organic Chemistry, (Recent edition)

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B.Sc. (Hons.) Microbiology Year II
Semester III

Group V: MB-V

Paper I : MICROBIAL ECOLOGY

Unit-1

- 1.1 Definition of environment, Interaction between environment and biota, Concept of habitat in biosphere.
- 1.2 Food Chain, Food web, Ecosystem, Community, homeostasis and ecosystem management.
- 1.3 Biodiversity and its conservation.

Unit-2

- 2.1 Environmental factors influencing the growth and survival of microorganisms. Physical factors - temperature, light, osmotic pressure and hydrostatic pressure. Chemical factors - pH, O₂ and CO₂
- 2.2 Soil environments - Microorganisms, soil structure, soil profile. Physico-chemical conditions, Microbial composition, sampling techniques.

Unit -3

- 3.1 Biological factors - Inter-reactions of microbial population and community i.e. Symbiosis, Parasitism, Antagonisms, Commensalisms
- 3.2 Extremophiles - acidophilic, alkalophilic thermophilic, barophilic and osmophilic microbes, Halophiles microbes
- 3.3 Eutrophication and its management

Unit-4

- 4.1 Biodeterioration : Concept of biodeterioration, Biodeterioration of Wood, pharmaceutical products
- 4.2 Bioleaching : Introduction, application of bacterial leaching, leaching techniques, prospective of bioleaching, Coal desulphurization.
- 4.3 Role of microorganism in organic matter decomposition (Cellulose, Hemicellulose, Lignins)

Unit-5

- 5.1 Biogeochemical cycles - Nitrogen cycle - Nitrogen fixation, nitrification, denitrification
- 5.2 Sulphur iron and phosphorous cycles
- 5.3 Rhizosphere - Rhizosphere microorganisms. Biochelators (siderophores).

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Practical:

1. Enumeration and isolation of soil microorganisms agar plate technique
2. Direct microscopic and enrichment culture technique – bacteria & fungi, from different soil types.
3. Isolation of *Rhizobium* etc
4. Techniques for microbial sampling of air from various sources
5. Bacterial examination of water for potability
6. MPN index - IMVIC test - Endo agar
7. Testing of water, soil, and sewage for physico-chemical parameters including COD and BOD.

Reference Books:

1. Baker, K.H. and Herson, D.S. 1994. Bioremediation. Mc Graw Hill Inc., New York.
2. Bagyaraj and rangasamy. Agricultural Microbiology.
3. Martin Alexander. (1999). Biodegradation and Bioremediation. Academic Press.
4. Burns R.G. & Slater J.H. (1982). Experimental Microbial Ecology, Blackwell Scientific Publication.
5. Conyne, Marks S (2001) Soil Microbiology: An Exploratory Approach, Delmar Thomson Learning.
6. Robert L Tate III (2000) Soil Microbiology, John Wiley & Sons Inc New York (2nd Ed)

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B.Sc. (Hons.) Microbiology Year II
Semester III

Group V : MB V

Paper II : MICROBIAL PHYSIOLOGY AND METABOLISM

Unit -1

- 1.1 Nutritional classification of microorganisms and Nutrient uptake : Passive and facilitated diffusion, active transport, Specific transport systems-ATP linked ion motive pumps, porins.
- 1.2 Overview of cell growth : Growth curves, growth rate and generation time, Primary and secondary metabolite production during different growth phases, synchronous growth. Batch culture and Continuous culture.

Unit -2

- 2.1 Effect of environment on microbial growth : Osmolarity, water activity, oxygen, pH, temperature, radiation.
- 2.1 Carbon Metabolism: Glycolysis, Entner-Doudoroff pathway, pentose phosphate pathway, Tricarboxylic acid cycle, glyoxalate cycle and gluconeogenesis.

Unit -3

- 3.1 Mitochondrial and bacterial electron transport chain : Aerobic and anaerobic respiration. Oxidative phosphorylation : mechanism and hypotheses.
- 3.2 Bacterial fermentations: Alcoholic, lactic acid, butyric acid, mixed acid, 2,3-butanediol, propionic acid and acetic acid fermentations.

Unit -4

- 4.1 Nitrogen metabolism: Nitrogen cycle. Nitrate reduction: assimilatory vs. dissimilatory, nitrification, denitrification.
- 4.2 Biological nitrogen fixation, symbiotic and free living organisms, Mechanism of nitrogen fixation, properties of nitrogenase, ammonia assimilation.

Unit -5

- 5.1 Photosynthesis: A historical account, oxygenic vs. anoxygenic photosynthesis. Mechanism of photosynthesis in bacteria, cyanobacteria algae and halobacteria. Carbon dioxide fixation: Calvin Cycle.
- 5.2 Chemolithotrophy: Nitrifying bacteria, iron bacteria, hydrogen bacteria, sulphur bacteria, Reverse electron transport.

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Practicals

1. Physiology of microbial growth; a prokaryotic and a eukaryotic system. Growth kinetics using solid and liquid media, colony measurement, dry weight method and turbidometric method.
2. Effect of physico-chemical factors (physical and chemical) on growth of micro-organisms: pH, temperature, nitrogen and carbon sources.
3. Aerobic and anaerobic respiration in microbes.

Reference Books

- 1 Microbiology, by Prescott, Hailey and Klein. Wm.C Brown Publishers.
2. Microbial Physiology by Moat.A.G. and Foster J.W. 4th edition 2002 John Wiley & Sons.
3. General Microbiology by Stanier R.Y., Ingrahm J.I. Wheelis M.L. and Painter P.R. McMillan Press.
4. Lehninger, A.L., D. Nelson D. and Cox, M.M.Cox ,Principles of Biochemistry, Worth Publishers.

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B.Sc. (Hons.) Microbiology Year II
Semester III

GROUP VI : MB VI

Paper-IV : BASICS OF CHEMISTRY II (In-organic and Physical Chemistry)

Unit I

- 1.1 Atomic and Molecule Structure: Idea of De- Broglie matter waves , Heisenberg Uncertainty Principal, atomic orbital, quantum numbers, radial and angular waver functions and probability distributions curves.
- 1.2 Shapes of s,p,d,orbitals, Aufbau and Pauli exclusion Principles, Hund's multiplicity rule, Electronic configuration of the elements, Effective nuclear charge.

Unit II

- 2.1 Periodic properties : Atomic radii, ionic radii, ionization energy affinity and electro negativity
- 2.2 Coordination Compounds and Complexation , Complexes and chelating agents,
- 2.3 Essential and trace elements in biological processes, Metalloporphyrins with special reference to heamoglobin and myoglobin

Unit III

- 3.1 Solution , Ideal and non-ideal solutions, Dilute solutions, Concentration Expressions, Solubility Expressions .
- 3.2 The Solution process, Colligative properties of solutions, Raoult's law, Abnormal molar Masses, Acids and Bases, Hard and soft acids and bases (HSAB), Non-aqueous solvents.

Unit IV

- 4.1 Thermodynamics-Principles, The Hender-Hasselbalch equation, Buffering , First law of thermodynamics, Enthalpy, Second law of thermodynamics
- 4.2 Entropy Free energy, Chemical equilibrium, law of mass action , Le Chatlier's principle.

Unit IV

- 5.1 Chemical kinetics and its scope, Rate of Reaction, Factors influencing the rate of reaction ,.
- 5.2 Zero order ,second order, Pseudo-order , half life and mean life. Various theories of chemical kinetics ,
- 5.3 Arrhenious equation and catalysis.

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Practicals

Physical

1. Determination of viscosity of liquids.
2. Adsorption (acetic acid on charcoal)
3. Enthalpy of Neutralization.
4. Determination of enthalpy of solution dilution.
5. Preparation of buffer solutions and measurement of their pH values using indicators and pH meters. Knowledge of ionization constant of weak acids and bases involved.
6. Conductometric titration of acids and bases.
7. Determination of order of reactions for first and 2nd order reactions.

Inorganic

1. Preparation of complex salts (two preparations)
2. Qualitative Analysis : Mixture containing not more than 4 ions including interfering radicals.
3. Oxidation reduction titration (KMnO_4 and $\text{K}_2\text{Cr}_2\text{O}_7$) – using internal indicators.

Reference Books

1. Soni, P.L., 2001, Inorganic Chemistry, S.Chand & Co., Delhi.
2. Scoog and Wetsomn, Analytical Chemistry, (Recent edition).
3. .Soni, P.L., Physical Chemistry , (Recent edition).
4. Bogel, V. Analytical Chemistry , (Recent edition).
5. Chatwal G.R. , Organic Chemistry, (Recent edition).

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B.Sc. (Hons.) Microbiology Year II
Semester IV

Group-VII : MB VII

Paper-I: VIROLOGY

Unit-1

- 1.1. Introduction: Discovery and origin of viruses.
- 1.2. Definition, Nature, General properties, structure and morphology of virus.
- 1.3. Characteristics and Classification of plant viruses.

Unit-2

- 2.1 Characteristics and Classification of animal/ human virus
- 2.2 Measurements of virus.
- 2.3 Concepts of viroids, satellite viruses, virusoids and prions.

Unit-3

- 2.1 Nomenclature of different groups of viruses infecting bacteria, fungi, algae.
- 3.1 Structure & Characters of Tobacco mosaic virus.
- 3.2 Salient features of pox, herpes, hepatitis, rhabdo, influenza.

Unit-4

- 4.1 Viral genomes: Structure and organization.
- 4.2 Viral multiplication cycle(one step growth curve).
- 4.3 Replication strategies: Interaction of viruses with cellular receptors, different modes of entry, different transcriptional methods of replication of viruses

Unit-5

- 5.1 History, structure and morphology of bacteriophage.
- 5.2 Classification of bacteriophage.
- 5.3 Detailed description of lytic cycle.
- 5.4 Detailed description of lysogenic cycle.

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Practicals:

1. To study structure of different groups of viruses with the help of electron micrographs.
2. To study symptoms of human viral infections through photographs.
3. To study cytopathic effects in viral infections through color plates.

Reference Books:

1. Virology by JA Levy, H Fraenkel Conrat & RA Owens (1994). 3rd Edn., Prentice Hall, New Jersey.
2. Basic Virology by EK Wagner & MJ Hewlett (1999). Blackwell Science, Oxford.
3. Introduction to Modern Virology by NJ Dimmock & SB Primrose (2000). Blackwell Science, Oxford.
4. Principles of Virology, Molecular Biology, Pathogenesis & Control by SJ Flint *et al* (2000). ASM Press, Washington, DC.
5. 6 Human Virology by Leslie & Howard (2000). Oxford University Press, Oxford.
6. Fundamentals of Plant Virology by REF Mathews (1992). Academic Press, San Diego.
7. Mathews Plant virology by Roger Hull, Academic Press, New York.
8. Plant Viruses- A Text Book of Plant Virology by L Bos(1999). Backhuys Publishers, Leiden.
9. A Colour Atlas of Virology Jan Versteeg (1985). Wolfe Medical Publications Ltd., Wesert.
10. Virology Methods Manual edited by BW J Mahy & H.O. Kangro (1996). Academic Press, London.
11. Virology - A Laboratory Manual FG Burleson, TM Chambers and DL Wiedbrank (1992). Academic Press, San Diego.
12. Methods in Plant Virology SA Hill (1984). Blackwell.

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B.Sc. (Hons.) Microbiology Year II
Semester IV

Group-VII : MB VII

Paper-II : BIOLOGICAL TECHNIQUES AND INSTRUMENTATION

Unit -1

- 1.1 Microbiological techniques: Types of media, selective and enrichment media, principles of sterilization and equipments, cell counting, Growth and its measurement, maintenance of cultures, plating.
- 1.2 pH measurement: Principle, calibration and working of pH meter.

Unit -2

- 2.1 Microscopy: General principles, Light microscopy (Bright field, dark field, phase contrast and fluorescence microscopy), preparation and staining of specimens, Electron microscopy (SEM and TEM)

Unit -3

- 3.1 Chromatographic techniques: General principles, Thin layer chromatography, Paper chromatography, Column chromatography, Adsorption chromatography, Partition chromatography, Gas liquid chromatography, Ion exchange chromatography, Affinity chromatography, Exclusion chromatography and High Performance Liquid Chromatography.

Unit -4

- 4.1 Centrifugation: General principles, centrifuges of various types, rotors, density gradient centrifugation.
- 4.2 Electrophoresis: General principles, Gel electrophoresis, Sodium dodecylsulphate (SDS) polyacrylamide gel electrophoresis. Isoelectric focusing.
- 4.3 Enzyme techniques: Enzyme units and enzyme purification, enzyme assay techniques, immobilized enzymes.

Unit- 5

- 5.1 Spectroscopic techniques: General principles, Visible and UV spectrophotometry, IR spectrophotometry and NMR spectrometry.
- 5.2 Radioisotope techniques: Radioactivity, detection and measurement and counting radioactivity, applications of radioisotopes in biology and safety aspects.

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Practicals

1. To learn the operation of following laboratory equipments
pH meter, centrifuge, spectrophotometer, autoclave, hot air oven, laminar air flow, incubator, microscope.
2. To learn paper chromatography and TLC.

Reference Books

1. Microbiology, by Prescott, Hailey and Klein. Wm.C Brown Publishers.
2. Lehninger, A.L., D. Nelson D. and Cox, M.M.Cox ,Principles of Biochemistry, Worth Publishers.
3. Wilson K. and Goulding K, A Biologist's Guide to Principles and Techniques of Practical Biochemistry, English Language Book Society.
4. Microbiology, by Pelczar, Chan and Krieg. Mc.Graw Hill Book Company.

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B.Sc. (Hons.) Microbiology Year II
Semester IV

Group-VIII : MB VIII

Paper-III : ENTREPRENEURSHIP DEVELOPMENT

Unit -1

- 1.1 Entrepreneurship: Definition, characteristics, importance.
- 1.2 Types and functions of an entrepreneur, qualities of a good entrepreneur; entrepreneurial motivation factors.
- 1.3 Women entrepreneur: Opportunities and problems, search and selection of business idea

Unit -2

- 2.1 Preparation of project report: Preparation of preliminary project report, main elements of a detailed project report, selection of types of organization and factors influencing the choice of organization, sole proprietorship, partnership, co-operative society.

Unit-3

- 3.1 Role of regulatory institutions: District industries centre, Madhya Pradesh Pollution Control Board, food and drug administration, electricity board, municipal corporation.

Unit-4

- 4.1 Role of promotional institutions: Khadi and Village industries commission, Madhya Pradesh Finance Corporation and Scheduled Banks, women economic development corporation of Madhya Pradesh.

Unit -5

- 5.1 Incentives and subsidies: Concepts and needs [control investment subsidy, interest subsidy, subsidy for power, margin money assistance], special incentives to women entrepreneurs.
- 5.2 Major Government Schemes- PMRY, S.J.R.Y., R.D.S.Y. and Deendyal swarojgar yojna.

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Practicals :

Visit to Industry/ NGO/ Educational Institution/ Research Organization / Regulatory or promotional institutions etc. and submission of written Report and its presentaion.

Reference Books:

1. C.B. Gupta: Entrepreneurship Development.
2. G.S. Sudha: Udyamita.
3. Vasant Desai: Dynamics of entrepreneurial Development and Management.
4. G.A. Kaulgud: Entrepreneurship Development.

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B.Sc. (Hons.) Microbiology Year II
Semester IV

Group-VIII : MB VIII

Paper-IV : COMMUNICATION SKILLS

Unit -1

- 1.1 Nature, role and importance of communication in an organization- verbal and non-verbal. Organization Communication Network- formal & informal. effectiveness of communication.

Unit -2

- 2.1 Process of communication. Barriers and Gateways in communication. Global communication.
2.2 Reading skills

Unit -3

- 3.1 Written communication-Basic principles. Business report writing- organization, interpretation and techniques of report writing, précis writing.

Unit -4

- 4.1 Public speaking and oral reporting- making formal speeches, conduct and participation in meetings, agenda and minutes of meetings.

Unit -5

- 5.1 Non-verbal communication, resume preparation, letters of appointment, communication on disciplinary matters. Interviews. Listening skills, conversation skills, feedback skills, counseling skills, negotiation skills.

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Practicals :

· Development of communication skills in students:

Seminars, Group Discussions, Poster presentations, Reading and Writing skills

Reference Books:

1. Nageshwar Rao and R.P. Das: Communication Skills. Himalaya Publication House, Mumbai.
2. Diwan and Agarwal: Business Communication.
3. Pradhan, Bhende and Thakur: Business Communication.
4. A.H. Murphy and C.E. Peck: Effective Business Communication. Tata McGraw Hill, New Dehli.
5. R.K. Madhukar: Business Communication.
6. C.G. Pearce et.al.: Business Communication Principles and Application. John Wiley, New York.
7. M. Treece: Successful Business Communications: Allyn and Bacon Boston.

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B.Sc. (Hons.) Microbiology Year III

Semester -V

Group-IX : MB IX

Paper-I : IMMUNOLOGY

Unit-1

- 1.1 Historical background, innate and acquired immunity
- 1.2 Humoral and cell mediated immunity; organs and cells involved in immune response.

Unit-2

- 2.1 Identification and characterization of T and B cells, cell surface receptors
- 2.2 MHC types & importance.
- 2.3 Antigen characteristics, types of antigens

Unit-3

- 3.1 Adjuvants, immunogenicity, antigenicity
- 3.2 Immunoglobulin structure and properties
- 3.3 Types of immunoglobulin

Unit-4

- 4.1 Theories of antibody diversity
- 4.2 Monoclonal antibodies and their production.
- 4.3 Complement system.

Unit-5

- 5.1 Antigen - antibody reactions
- 5.2 Methods-agglutination, precipitation, complement fixation,
- 5.3 ELISA & Radioimmunoassay, Haemagglutination test, Immunoblotting, FACS.

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Practicals

- 1- Precipitation method principles and methods
- 2- Agglutination method-Widal test
- 3- Blood grouping Principles & Method
- 4- Blood cell counting in haemocytometer.

Reference Books:

1. Barrett, J.T. (1983) Textbook of Immunology: An Introduction to Immunochemistry and Immunology, Mosby, Missouri.
2. Boyd, R.F., (1984) General Microbiology, Times Mirror/Mosby (college publishing, St.Louis).
3. Broude A.I. (1981) Medical Microbiology and Infectious Diseases W.B. Saunders & Co., Philadelphia
4. Chapel and Haeney, (1984) Essentials of Clinical Immunology, Blackwell Scientific Publications.
5. Roitt, I.M. (1998) Essentials of Immunology .ELBS, Blackwell Scientific Publishers, London.
6. Kuby, J (1994) Immunology, II Edition. WH. Freeman and Company, New York.
7. Klaus D. Elgert (1996) Immunology-Understanding of Immune system. Wiley-Liss. NY.
8. Topley & Wilson's (1995) Text Book on Principles of Bacteriology, Virology and Immunology IX Edition (5 volumes) Edward Arnold London.
9. Todd, I.R. (1990): Lecture Notes in Immunology, Blackwell Scientific Publications Ltd., Oxford.
10. Roit IM, Brostoff and Male 2nd, 3rd and 4th ed. 1989, 1994, 1995 Immunology - Gower Medical Publishing Co.,
11. W.E. Paul, (1984) Fundamental immunology, Raven Press, Yew York.
12. R.M. Coleman, M.F. Lombord and R.E. Sicard (1992) Fundamentals of Immunology, 2nd ed. C. Brown publishers.
13. D.M. Weir and J Steward (1993). Immunology, 7th Ed.

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B.Sc. (Hons.) Microbiology Year III

Semester -V

Group-IX : MB IX

Paper-II : Medical Microbiology

Unit-1

- 1.1. Early discovery of pathogenic microorganisms; development of bacteriology as scientific discipline.
- 1.2. Contributions made by eminent scientists.
- 1.3. Classification of medically important micro organisms.
- 1.4. Normal microbial flora of human body; role of the resident flora; normal flora and the human host.

Unit-2

- 2.1. Host parasite relationship: Definition of following terms (infection, invasion, pathogen, pathogenesis, toxigenicity, virulence, carrier, types of carrier, nosocomial infections, opportunistic infections, sepsis, and septicemia)
- 2.2. Transmission of infection, bacterial virulence factors
- 2.3. Establishment, spreading, tissue damage and anti-phagocyte factors.
- 2.4. Mechanism of bacterial adhesion, colonization and invasion of mucous membranes of respiratory, enteric and urogenital tracts.

Unit-3

- 3.1 Diseases caused by certain specific pathogens *Staphylococcus aureus*, *Streptococcus pneumonia*.
- 3.2 Diseases caused by *Mycobacterium tuberculosis*, *Salmonella typhi*, *Vibrio cholerae*.
- 3.3 Disease caused by Plasmodium

Unit-4

- 4.1 Diseases caused by Human Immuno Deficiency Virus, Hepatitis Virus, Rubella Virus, Rabies virus, Rubella virus, Small pox virus.
- 4.2 Dermatophytes, *Candidiasis*, *Aspergillosis*.

Unit-5

- 5.1 Collection and transport of appropriate clinical samples for clinical diagnostics
- 5.2 Culture media isolation of pathogenic bacteria & fungi
- 5.3 Staining techniques: Gram's staining, AFB staining, Capsule staining
- 5.4 Biochemical test: IMViC, TSIA, Oxidase, Catalase, DNAs

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Practicals

- 1- Selection, collection and transport of specimens, blood samples, sera for microbiological and Immunological investigations.
- 2- Preparation of different types of culture media for growing pathogenic bacteria.
- 3- Preparation of Stains , buffers, reagents.
- 4- Staining techniques such as Gram's staining, AFB staining, Capsule staining.
- 5- Isolation and identification of major bacterial pathogens such as *Staphylococcus aureus* and *E. coli* etc
- 6- Isolation and identification of major fungal pathogens such as *Candida*, *Aspergillus*, Dermatophytes etc

Reference Books:

1. G.P. Talwar and S.K.Gupta 1992 -A hand book of practical and clinical immunology. - 2nd Ed: CBS Publication, New Delhi, India.
2. Clark, W.R., (1991): The Experimental Foundations of Modern Immunology, John Wiley and Sons. Inc.
3. Ellen jo Baron. (1994). Bailey and Scott's Diagnostic Microbiology (9th Ed.). Mosby.
4. Franklin, T.J., Snow G.A. (1981): Biochemistry of Antimicrobial Action, Chapman and Hall., New York.
5. Mackie & McCartney (1996) Medical Microbiology-14th Ed. Vol. 1: Microbial infections. Vol. 2: Practical Medical Microbiology. Churchill Livingstone London.
6. Mackie and McCartney 1996.. Vol.II. Practical Medical Microbiology 14th Edition Ed: Simmons: Churchill Livingstone.
7. Javatzé et al Review of Medical Microbiology.
8. Roitt, I.M: (1995) Essential Immunology Blackwell Scientific Publications, Oxford.
9. Roth, J.A. (1985): Virulence Mechanism of Bacterial Pathogens. American Society for Microbiology, Washington D.C.
10. Smith, C.G.C. (1976) Epidemiology and Infections': Medowfief Press Ltd., Shildon, England.
11. Stiehm F. (1980) Immunological Disorders in Infants and Children, W.B. Saunders & Co., Philadelphia.
12. Stites, D.P. Stobo, J.D. feudenberg, H.H., Wells J.V. (1984) Basic and Clinical Immunoloty, Lange Medical Publications., Los Altos., Clifomia.

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B.Sc. (Hons.) Microbiology Year III

Semester -V

Group-X : MB X

Paper-III :MICROBIAL GENETICS AND MOLECULAR BIOLOGY

Unit-1

- 1.1 DNA as genetic material: Experimental evidences. Structure of DNA and different forms of RNA.
- 1.2 DNA replication: Mechanism of DNA replication, models, enzymes and accessory proteins.

Unit-2

- 2.1 Gene transcription: Enzymes and transcription factors, regulatory elements, and mechanism of transcription regulation, post-transcription modification.
- 2.1 Translation : Genetic code, Translational machinery, mechanism of initiation, elongation and termination, post-translational modification.

Unit-3

- 3.1 Mutations: Spontaneous and induced (physical and chemical mutagens), DNA repair mechanisms. Molecular mechanisms of mutations: Point mutations, base substitution- transition and transversion (frameshift mutations deletion, addition), Uses of mutation.
- 3.2 Genetic recombination: Mechanism of genetic exchange.

Unit-4

- 4.1 Transformation, Conjugation, Transduction: Specialized transduction and generalized transduction, Barriers to genetic exchange (host restriction and modification).
- 4.2 Transposable elements : Insertion sequences, transposons. Transposition: Structure of transposon, replicative and non-replicative transposition, Retrotransposons

Unit-5

- 5.1. Plasmids : Properties of some bacterial plasmids, plasmid replication, origin of replication, regulation of plasmid copy number.
- 5.2 Genetic regulation : Regulation of gene expression: Induction, activation and repression, Attenuation. Operons: *lac* and *trp*, operons, phage (lytic to lysogenic), yeast mating types.

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Practicals

1. Preparation of Master and replica plates.
2. To study the effect of chemical (HNO_2) and physical (UV) mutagens on bacterial cells.
3. Study of UV survival curve of bacteria.
4. Screening for drug resistance.
5. Isolation of bacterial chromosomal DNA.
6. Isolation of bacterial plasmid DNA.
7. Gel electrophoresis of DNA and examination of agarose gels.
8. Quantitative estimation of DNA and RNA.

Reference Books

1. David Freifelder: Microbial Genetics. Cold Spring Harberer Lab. Press, New York
2. Russell, P.J.: Essential Genetics, Blackwell Scientific Publishers.
3. Klug, W.S. and Cummings, M.R. Concepts of Genetics. 6th edition.
4. Benjamin Lewin: Genes VII. Oxford University Press Publisher.
5. Gupta P.K. Cell and Molecular Biology. Rastogi Publications.

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B.Sc. (Hons.) Microbiology Year III

Semester -V

Group-X : MB X

Paper-IV : FOOD & DAIRY MICROBIOLOGY

Unit-1

- 1.1 Food as substrate for microorganisms: Micro organisms important in food microbiology -Molds, Yeasts and Bacteria-General characteristics-classification and importance.
- 1.2 Factors influencing microbial growth and survival in food - Intrinsic factors and Extrinsic factors.
- 1.3 Food Spoilage: General principles underlying food spoilage and contamination spoilages

Unit-2

- 2.1 Principles of food preservation. Asepsis - Removal of microorganisms, (anaerobic conditions, high temperatures, low temperatures, drying,).
- 2.2 Principles of food preservation, chemical , Food additives.& Physical preservatives.
- 2.3 Canned food.

Unit-3

- 3.1 Fermented Food: Bread, Vinegar, Oriental Fermented Food, Indian Fermented Food.
- 3.2 Fermented Beverages, Beer and Wine.

Unit-4

- 4.1 Importance of microorganisms in dairy industries. Production of cheese, curd and yogurt.
- 4.2 Microbial spoilage of Milk. Principal & types of Pasteurization.
- 4.3 Milk reduction test: MBRT

Unit-5

- 5.1 Microorganisms as source of food: SCP
- 5.2 Mushroom production
- 5.3 Food Borne Infections: Food poisoning. Infective and toxic, Bacterial and non-bacterial. General methods of their diagnosis.

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Practicals:

- 1- Food adulteration test by biochemical basis
- 2- MBRT Method
- 3- Resozurin reduction test
- 4- Isolation of micro organisms from common food items such as curd and bread.

Reference Books:

- 1- Stanbury, PR, Whitakar, A and Hall, S.J. (1995) Principles of Fermentation Technology, 2nd Edition Pergamon press.
- 2- Frazier, W.C and Westhoff, DC (1988) Food Microbiology 4th Edition, McGraw, Hill. NY.

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B.Sc. (Hons.) Microbiology Year III
Semester -VI

Group-XI: MB XI

Paper I: FUNGI AND PLANT PATHOLOGY

Unit-1

- 1.1. Introduction to fungi: Habitat, fungal cells structure and thallus organization, wall structure, different types of reproductive structures - asexual and sexual
- 1.2. Classification of Fungi
- 1.3. Lichens: A general account
- 1.4. Economic importance of fungi.

Unit-2

- 2.1 Salient features of different groups and detailed study of the following genera
 - i. Chytridiomycota: *Synchytrium*, *Allomyces*
 - ii. Zygomycota: *Rhizopus* and *Mucor*
 - iii. Ascomycota: *Saccharomyces*, *Emericella* (*Aspergillus*), *Talaromyces*, *Penicillium*.
 - iv. Basidiomycota: *Agaricus* and *Ustilago*.
 - v. Deuteromycota: *Candida* and *Fusarium*.
 - vi. Cellular slime molds: *Dictyostelium*.
 - vii. True slime molds (Myxomycetes-exosporous and endosporous).
 - viii. Oomycota: *Saprolegnia*, *phytophthora*, *Pythium*, *Peronospora* and *Albugo*

Unit-3

- 3.1 Introduction: Concept of plant disease, significant landmarks in the field of plant pathology.
- 3.2 Signs and symptoms associated with microbial plant pathogens. Koch's postulates basic procedures in the diagnosis and study of plant diseases.
- 3.4 Factors affecting disease development, Disease forecasting.

Unit-3

- 4.1 Microbial Pathogenicity: Microbial enzymes, toxins, growth regulators & suppressors of plant defenses in plant diseases.
- 4.2 Mechanism of Defense in Plants.
- 4.3 Control of Plant diseases: Physical, chemical and biological control.
- 4.4 Management of plant diseases: Principles & practices involved in the management of plant diseases by different methods, viz., regulatory (quarantine & legislative measures).

Unit-5

- 5.1 Important diseases caused by fungi:
Clubroot of crucifers *Plasmodiophora brassicae*, White Rust *Albugo*, Downy mildew *Peronospora*, Late blight of potato *Phytophthora*, Powdery mildew *Erysiphe*, Ergot of rye *Claviceps purpurea*, Rust of wheat *Puccinia graminis tritici*, Loose smut of wheat *Ustilago tritici*, Fusarium wilts *Fusarium* sp., Red rot of sugarcane *Colletotrichum falcatum*, Tikka disease of *Cercospora arachidola* groundnut.
- 5.2 Important diseases caused by Phyto-pathogenic bacteria.
Angular leaf spot of cotton, Bacterial leaf blight of rice, Soft rot of Potato, Crown galls, Bacterial cankers of citrus, Common scab of potato.
- 5.3 Important diseases caused by Phytoplasmas.
Aster yellow, little Leaf of brinjal, Sandal spike disease, Root wilts of coconut.
- 5.4 Important diseases caused by viruses
Tobacco mosaic, Leaf curl of papaya, Bean mosaic, Tomato yellow leaf curl, Banana bunchy top.

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Practicals

1. Study of the vegetative and reproductive structures of fungi *Mucor*, *Rhizopus*, *Saccharomyces*, *Aspergillus*, *Penicillium*, and *Alternaria*.
2. Isolation of bacteria, algae and fungi from natural sources using specific media:
a) Nutrient agar
b) Potato dextrose agar
3. Study of Pathogenic bacteria. Isolation and characterization of different plant pathogens from diseased Plants. Study of important diseases of crop plants.

Reference Books

1. Agrios, G.N. Plant pathology. 4th edition Academic press, San Diego.
2. Lucas, J.A. Plant pathology and plant pathogens. 3rd edition. Blackw Science, Oxford.
3. Rangaswami, G. Diseases of crop plants in India. 3rd edition. Prentice Hall of India, New Delhi
4. Singh, R.S. Plant diseases management. Oxford & IBH, New Delhi.
5. Waller, J.M., Lenne, J.M. and Waller, S.J, Plant Pathologists pocketbook. 3rd edition. CABI publishers, Wallingford, Oxford.
6. Mehrotra R.S. Plant Pathology Tata McGraw-Hill Limited.
7. Webster, J. Introduction to fungi, Second edition. Cambridge University Press.
8. Alexopoulos, C.J., Mims, C.W. and Blackwell, M. Introductory Mycology, Fourth edition. John Wiley and Sons

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B.Sc. (Hons.) Microbiology Year III

Semester -VI

Group-XI: MB XI

Paper II : RECOMBINANT DNA TECHNOLOGY

Unit-1

- 1.1 Introduction to Recombinant DNA Technology: The molecular biotechnology revolution.
- 1.2 Molecular Biotechnology Biological Systems: Prokaryotic and eukaryotic organisms: *E. coli*, *Saccharomyces*, and eukaryotic cells.
- 1.3 DNA Isolation: Isolation and purification of genomic and plasmid DNA.
- 1.4 Enzymes: Restriction endonucleases. Types, mode of action and nomenclature. DNA ligases and DNA polymerases and DNA modifying enzymes – terminal deoxynucleotidyl transferase, kinases and dephosphatases.

Unit-2

- 2.1 Cloning vectors: Definition and properties of cloning vectors, plasmids, bacteriophage lambda and M13 - based vectors, pBR, pUC and cosmids.
- 2.2 Expression vectors: Definition and properties of expression vectors, *E. coli* promoters (lac, tac), yeast vectors, Ti-based vectors, shuttle vectors.

Unit-3

- 3.1 Direct gene delivery systems: Chemical (CaCl₂) transformation, Microinjection, biolistics (gene gun), electroporation, liposome-mediated delivery.
- 3.2 Cloning strategies in *E. coli*, *Bacillus* and Eukaryotic organisms: Yeast, plants and animals.

Unit-4

- 4.1 Selection and screening of recombinant clones: Insertional inactivation, markers and reporter genes, blotting techniques (Southern, Northern, Western and colony hybridization), DNA fingerprinting and microarrays.
- 4.2 Genomic and c DNA Libraries.

Unit-4

- 5.1 Chemical synthesis of DNA: The phosphoramidite method.
- 5.2 DNA sequencing: Maxam-Gilbert and Sanger's methods and automated sequencing.
- 5.3 Amplification of DNA: PCR and its types.
- 5.4 Applications of Recombinant DNA Technology: Use of recombinant DNA technology in the field of Medicine, Industry, Agriculture and Environment.

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Practicals

1. Isolation of DNA.
2. Estimation of DNA.
3. Estimation of RNA.
4. Demonstration of Electrophoresis.
5. Interpretation of sequencing gels.

Reference Books

1. Glick and Pasternak: Molecular Biotechnology. ASM Press Washington D.C.
2. Old and Primrose: Principles of Gene Manipulation. Blackwell Scientific Publication
3. T.A. Brown : Gene Cloning. IRL Press Oxford Univ. Press
4. T.A. Brown: Genomes. IRL Press, Oxford Univ. Press
5. Sambrook, Fritsch and Maniatis: Molecular cloning- A laboratory manual.
Cold Spring Harbor Laboratory Press.
6. Gupta P.K. Elements of biotechnology. Rastogi Publications.

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B.Sc. (Hons.) Microbiology Year III

Semester -VI

Group-XII : MB XII

Paper III : INDUSTRIAL MICROBIOLOGY

Unit-1

- 1.1 Brief history & development of industrial microbiology
- 1.2 General concepts of industrial microbiology.
- 1.3 Screening of industrially important microbial strains, strain development and strain improvement.
- 1.4 Preservation & maintenance of industrial microbes

Unit-2

- 2.1 Industrial sterilization, fermentation equipment and its uses
- 2.2 Fermentation process - batch, fed-batch & continuous fermentations, submerged and solid state fermentation.
- 2.3 Types of fermenter/bioreactor (constantly stirred tank, packed bed fluidized & air-lift fermenter)

Unit-3

- 3.1 Media and materials required for industrial microbiological processes - sources, formulation, antifoams and optimization
- 3.2 Maintenance of pH, temperature, dissolved oxygen & aeration.
- 3.3 Down stream processing.
- 3.4 Metabolic pathways and metabolic control mechanism

Unit-4

- 4.1 Industrial production antibiotics-Penicillin.
- 4.2 Industrial production of Lactic acid, citric acid and amino acids.
- 4.3 Industrial production of enzymes- amylase and protease.

Unit-5

- 5.1 Industrial production of ethanol
- 5.2 Industrial production of acetic acid
- 5.3 Industrial production of Vitamins
- 5.4 Industrial production of beer & wine alcohol.

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Practicals

1. Study of parts of fermenter, by using fermenter and with the help of photographs.
2. Demonstration of working of mini fermenter.
3. To learn techniques of isolation, improvement and preservation of industrially important microorganisms.
 - 1- Ethanol production from molasses and sugars.
 - 2- Anaerobic and aerobic cultivation of fungi, yeasts and bacteria.
 - 3- Production of:
 - (a) Enzymes- amylases, Proteases, lipases and celluloses.
 - (b) Amino acids- glutamic acid, lysine
 - (c) Antagonistic activity against bacteria, fungi, actinomycetes
 - (d) Organic acids-citric and lactic acid 3.

Biological assay of antibiotics and vitamins.

Reference Books:

1. Arnold L. Demain, Julien E. Davies. (1999). Manual of Industrial Microbiology and Biotechnology. ASM Press.
2. Whitaker and P.F. Stanbury. (1995). Principles of Fermentation Technology. Butterworth- Heinemann.

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B.Sc. (Hons.) Microbiology Year III

Semester -VI

Group-XII : MB XII

Paper IV : BIOTECHNOLOGY

Unit-1

- 1.1 Biotechnology: basic concepts, principle & scope
- 1.2 General introduction of Plant cell & tissue culture
- 1.3 Applications of plant tissue culture
- 1.4 Plant genetic engineering: Transgenic plants

Unit-2

- 2.1 Introduction of Microbial products through genetic engineering
- 2.2 Cloning of human insulin.
- 2.3 Cloning of vaccines by RDT
- 2.4 Introduction of Nano-biotechnology

Unit-3

- 3.1 Biohydrometallurgy and Biomineralization.
- 3.2 Biogas production.
- 3.3 Energy and fuel using microorganisms.
- 3.4 Introduction of biochips & biosensor.

Unit-4

- 4.1 Degradation of Xenobiotic waste.
- 4.2 Removal of oil spills.
- 4.3 Biopolysaccharides
- 4.4 Production of biofertilizers and its importance.

Unit-5

- 5.1 Bioinsecticides.
- 5.2 Role of international organizations in biotechnology. Government programmes for biotechnology development. Biological risks, biosafety, Bioethics,.
- 5.3 Intellectual property rights (IPR) and patenting of biological material.

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Practicals:

To learn the techniques of plant tissue culture
Bio-gas production from cow-dung slurry-demonstration.
Measurement of glucose level using biosensor.
To learn about biofertilizers.

References:

- 1- Crueger, W. and Crueger, A. (2000). Bio-Technology; A Textbook of Industrial Microbiology, Panima Publication Co. New Delhi
- 2- Frazer, W.C. and Westhoff, D.C. (1988). Food Microbiology, 4th edition McGraw Hill, New York.
- 3- Jay, J.M. (1992). Modern Food Microbiology, 4th edition, Van Nostraaand Reinhold Co., New York.
- 4- Stanbury, P.F., Whittaker, A and Hall, S.J. (1997). Principles of Fermentation Technology, Aditya Books (P) Ltd.

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