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# SHRI RAM COLLEGE

MUZAFFARNAGAR

(Affiliated to CCS University, Meerut)

## SYLLABUS FOR B.Sc. (MICROBIOLOGY) - I YEAR

Session - 2006-09

### COURSE - I. MICROBIAL DIVERSITY - I

#### Paper I. Fundamentals of Microbiology (B-101)

- Unit-I** : Historical development : Discovery of microorganisms, Spontaneous Generation Controversy, Germ theory of fermentation, Germ theory of disease.
- Unit-II** : Historical development : Development of Pure culture techniques, Discovery of viruses, Immunity, Chemotherapy, Microbial Physiology and Genetics.
- Unit-III** : Scope of Microbiology, Professions related to Microbiology (Career opportunities for Microbiologists).
- Unit-IV** : Different groups of Microorganisms and their general characteristics, Prokaryotic vs. Eukaryotic Organisation.
- Unit-V** : Whittaker's five kingdom concept. Three domain concept of Carl Woese Characters used in microbial taxonomy (morphological, physiological, ecological, genetic, protein content, nucleic acid sequence and base composition)

#### Paper II. Bacteriology (B-102)

- Unit-I** : Eubacteria, Archaeobacteria, Cyanobacteria-General comparison; Morphology and Structure of a typical Bacterium (Eubacterium).
- Unit-II** : Gram staining (Gram-positive and Gram-negative Bacteria) with reference to Cell wall; Capsular, Endospore and Flagellar staining techniques.
- Unit-III** : General characters and Structure of Archaeobacteria, Cyanobacteria, Actinomycetes, Rickettsiae, Chlamydia and Mycoplasma.
- Unit-IV** : Different types of nutrition in Bacteria Reproduction in Bacteria including Transformation, Transduction, Conjugation (Genetical details should be avoided)
- Unit-V** : A classification of Bacteria according to latest edition of Bergey's Manual of Systematic Bacteriology (Brief outline).

#### **Books Recommended :-**

- |                              |                     |
|------------------------------|---------------------|
| 1. Text Book of Microbiology | Dubey & Maheshwari  |
| 2. Test Book of Microbiology | Ananthanarayan      |
| 3. Microbiology              | Pelear M.J. & Athar |
| 4. Text Book of Microbiology | Prescott            |

### COURSE - II. MICROBIAL DIVERSITY - II

#### Paper I. Virology (B-103)

- Unit-I** : Origin & Development of Virology, General structure of viruses, Detailed structure of animal viruses (Pox Virus, Polio Virus, Human Immunodeficiency Virus; AIDS), Plant Virus (TMV) & Bacteriophage; Differences between the structures of different types of Bacteriophages.
- Unit-II** : Replication of viruses - RNA Viruses (ss RNA, ds RNA), DNA viruses (ssDNA, ds DNA), transmission of viruses
- Unit-III** : Classification & nomenclature of viruses.
- Unit-IV** : Importance of Viruses (as Disease causing agents and use in Biotechnology).
- Unit-V** : Viroids and Prions : their nature & importance.

#### Paper II. Mycology, Phycology and Protozoology (B-104)

- Unit-I** : General characteristics of Fungi; Range of thallus organization and reproduction, Classification according to Alexopoulos, Mims and Blackwel.

**Unit-II** ✓ : Important genera of Fungi (*Synchytrium*, *Phytophthora*, *Albugo*, *Mucor*, *Rhizopus*, *Aspergillus*, *Penicillium*, *Alternaria*, *Ustilago*, *Puccinia*); Economic Importance of Fungi.

**Unit-III** : General characters of Algae, Classification of Algae and Economic Importance.

**Unit-IV** : Important genera of Algae (*Chlamydomonas*, *Volvox*, *Cladophora*, *Oedogonium*, *Vaucheria*, *Polysiphonia*).

**Unit-V** : Protozoa and Nematodes (Elementary Idea with only outline classification and importance)

**Books Recommended :-**

- |                              |                      |
|------------------------------|----------------------|
| 1. Text Book of Microbiology | Dubey & Maheshwari   |
| 2. Test Book of Microbiology | Ananthanarayan       |
| 3. Microbiology              | Pelezar M.J. & Athar |
| 4. Text Book of Microbiology | Prescott             |

**COURSE - III. BIOCHEMISTRY & BIOPHYSICS**

**Paper I. Biochemistry (B-105)**

**Unit-I** : Biomolecules : Elements constituting the living matter, Micromolecules and Macromolecules.

**Unit-II** : Water : Polarity and its importance, buffering against pH changes in Biological cycles, Water as a reactant, Aqueous environment and living organisms.

**Unit-III** : Building blocks of Carbohydrates (Sugars and their derivatives), Proteins (Amino acid) Sphingosine, Glycerol and Cholesterol). Nucleic acids (Nucleotides). Optical activity of Biomolecules. Supramolecular assembly. Biomolecular data base.

**Unit-IV** : Structure and Function of macromolecules (Carbohydrates, Proteins, Enzymes, Lipids and Biomembranes, Nucleic acid).

**Unit-V** : A very brief idea of Biochemical Transformations Carbohydrate metabolism (Structure and bond energy of ATP, Catabolism of Glucose and other hexoses, Photosynthesis, Nitrogen fixation).

**Paper II. Biophysics (B-106)**

**Unit-I** : Physics and Biology; The properties of open systems; Scope and methods of Biophysics; Chirality of Biomolecules.

**Unit-II** : Laws of thermodynamics (first and second laws); Kinetics of Simple enzymatic reactions, Conformational properties of enzymes, Physics of enzyme-substrate interactions.

**Unit-III** : Physical aspects of photoreception with special reference to Bacteriorhodopsin.

**Unit-IV** : Electrical properties of Biological compartments; Electricity as a potential signal.

**Unit-V** : Biomechanics, Chemiosmotic Couplings.

**Books Recommended :-**

- |                                |            |
|--------------------------------|------------|
| 1. Fundamental of Biochemistry | J.L. Jain  |
| 2. Fundamental of Biochemistry | Lehninger  |
| 3. Text of Biochemistry        | S.P. Singh |

**COURSE - IV. INSTRUMENTATION AND BIOANALYTICAL TECHNIQUES**

**Paper I. Instrumentation and Cultural Techniques (B-107)**

**Unit-I** : Microscopy : Simple microscopy, Phase contrast microscopy, Fluorescence and Electron Microscopy (SEM, TEM), Scanning Tunnelling Microscopy, Confocal microscopy.

**Unit-II** : Instruments, Basic principles and usage:- pH meter, absorption & emission spectroscopy, principles and laws of absorption and radiation, Densitometry, fluorimetry, colorimetry, spectrophotometry (visible, uv, infrared).

**Unit-III** : Manometry, polarography, centrifugation, osmotic absorption, IR, IMR, X-ray crystallography.

**Unit-IV** : Sterilization techniques, Different types of Culture media.

**Unit-V** : Isolation, Preservation & Identification of common Bacteria and Fungi; Enrichment techniques.



**Paper II. Analytical Techniques (B-108)**

- Unit-I** : Chromatography : Paper chromatography, thin layer chromatography, column chromatography, gas chromatography, gas-liquid chromatography, affinity chromatography, gel filtration chromatography, ion exchange.
- Unit-II** : Electrophoresis : SDS, polyacrylamide electrophoresis, Immunoelectrophoresis Isoelectric focusing.
- Unit-III** : Fermentation : (a) brief idea of different types of fermenters (b) Principles, operation and construction of fermenters.
- Unit-IV** : Radioisotope tracer techniques and autoradiography.
- Unit-V** : Chromosomal techniques, Stains of Nucleic acids, Band Patterns, Karyotyping, Cell Sorting Cell fractionation, Cell growth determination.

**Books Recommended :-**

- |  |                 |
|--|-----------------|
| 1. Instrumental Analysis for science Tech. | F. EVEN         |
| 2. Practical Biochemistry                  | Wilson & Walker |
| 3. Introductory Practical Biochemistry     | Sawhney S.K.    |

**Practicals based on Courses of I & II****1) Viruses :**

- (a) Diagrammatic representation and ultrastructure of some typical viruses like TMV, Bacteriophage, Cyanophage.
- (b) EM photographs of RNA and DNA viruses.
- (c) Viral diseases of plants and animals (Specimens, Diagrams only).

**2) Bacteria :**

- (a) General morphology (Permanent slides and live materials) e.g.
- (i) Coccus
- (ii) Rod - shaped (Bacillus etc.)
- (iii) Vibrio
- (iv) Spirillum

**3) Algae :** Thallus range, with class representatives (*Volvox, Cladophora, Oedogonium, Vaucheria, Spirogyra*)**4) Fungi :** Thallus range with class representatives (*Puccinia, Aspergillus, Penicillium, Mucor, Ustilago, Alternaria*).**5) Protozoa :** Study with the help of permanent slides. (*Amoeba, Paramecium*)**6) Parasites :** Study with the help of Permanent slides. (*Plasmodium, Entamoeba*)**7) Nematodes :** Study with the help of permanent slides (*Meloidogyne, Ascaris*).**Practicals based on Courses of III & IV**

- Compound microscope - Parts and functions.
- Different types of microscopes (Photographs, line diagrams).
- Micrometry
- Sterilization of glassware, culture media
- Composition and preparation of important culture media.
- Isolation of Fungi and Bacteria from different sources.
- Dilution technique and streaking method (pure culture).
- Preparation of buffers of different pH values.
- Qualitative tests for sugars, protein, fat and lipids.
- Paper chromatographic separation of amino acids.
- Anaerobic respiration in yeast.
- Use of dialysis for the separation of micromolecules from macromolecules.
- Various structural models proposed for DNA, RNA and proteins.
- Cell-A detailed study with the help of microscope and photographs.
- (a) Prokaryotic cell. (b) Eukaryotic cell.
- Demonstration of plasmolysis.
- Electrophoretic separation of proteins (using egg proteins test samples).
- Photographs for autoradiography and X-ray diffract on.
- Enzymes- the effect of temperature on enzyme activity.

**SUBSIDIARY COURSE - BIOLOGY**

### Paper S - 1

- Unit-I** : Biology as a Science : Aristotle and beginning of Biology. Impact of microscopy. Impact of Evolutionary theories. Louis Pasteur and applied Biology. Crick and the foundations of Molecular Biology. Genome analysis (only historical account.)
- Unit-II** : Biological methods - Hypothesis, Prediction, Experimentation, Variables, Control, Serendipity.
- Unit-III** : Biodiversity and Systematics; Types of Classification, Binomial Nomenclature. Contributions of Linnaeus. Species concept. Modern trends in taxonomy - chemotaxonomy, molecular systematics, numerical taxonomy (only brief idea).
- Unit-IV** : A brief idea of the characters of important phyla of animals - Porifera, Cnidaria, Platyhelminthes, Nematoda, Annelida, Mollusca, Arthropoda, Echinodermata, Chordata- their classification upto class levels.
- Unit-V** : Use of keys for the identification of animals and plants.

#### Practicals based on Paper S-1

Identification of important genera of animals with the help of Museum specimens and slides.

#### Books Recommended I :-

- |                                   |                           |
|-----------------------------------|---------------------------|
| 1. Evolution                      | P.K. Gupta                |
| 2. Taxonomy                       | V. Singh                  |
| 3. Taxonomy                       | Verma & Dallela           |
| 4. Concept of evolution           | P.S. Verma & V.K. Agarwal |
| 5. Invertebrate Zoology           | R.L. Kotpal               |
| 6. Vertebrate Zoology             | R.L. Kotpal               |
| 7. Invertebrate Practical Zoology | P.S. Verma                |
| 8. Vertebrate Practical Zoology   | P.S. Verma                |

#### SUBSIDIARY COURSE - BIOLOGY

### Paper S - 2

- Unit-I** : A brief idea of the characteristics of important divisions of Bacillariophyta, Chlorophyta, Phaeophyta, Rhodophyta, Bryophyta, Lycopodophyta, Sphenophyta, Filicinophyta, Coniferophyta, Angiospermophyta (also a brief account of concept of Algae, Bryophyte, Pteridophyte, Spermatophyte to be given). Outline classification upto class level.
- Unit-II** : Animal Tissues - Epithelial, Connective, Muscular, Nervous.
- Unit-III** : Plant Tissues - Meristems, Parenchyma, Collenchyma, Sclerenchyma, Xylem; Phloem.
- Unit-IV** : Traffic across the cell membranes - Diffusion, Osmosis, Cells and Water potential, Water relations of animal and plant cell, Active transport across the membrane. Biological pumps. Bulk transport across the plasma membrane. Secretion from cells by Bulk transport.
- Unit-V** : Autotrophic nutrition - Photosynthesis : conditions necessary for photosynthesis, Absorption spectrum vs action spectrum, Pigments systems, Mechanism of Photosynthesis, Factor affecting Photosynthesis. Ecological aspects of photosynthesis (Leaf mosaic, sun vs shade leaves, compensation point, C3 vs C4 Plants).

#### Practicals based on Paper S-2

1. A study of important genera of plants with the help of Museum specimens and slides.
2. A study of epithelial tissue, muscular tissue of frog.
3. Maceration of Wood/Match-stick to observe tissues.
4. A study of plant and animal tissues with the help of permanent prepared slides.

#### Books Recommended of Biology II :-

- |   |                          |
|---|--------------------------|
| 1. Economic Botany                      | Pandey                   |
| 2. A Text Book of Botany (Lower Plants) | V.Singh, Pandey and Jain |
| 3. A Text Book of Botany (Angiosperms)  | Do                       |
| 4. Practical Botany Vol. I & II         | Bendre & Kumar           |



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**SYLLABUS FOR B.Sc. (MICROBIOLOGY)-I IYEAR**

**B.Sc. II (Microbiology)**

**Course V-Cell Biology**

**Paper 1 Ultrastructure**

- Unit 1** : Cell as a basic unit of living systems. The cell theory, broad classification of cell types; a detailed classification of cell types within an organism; cell, tissue, organ and organism as different levels of organization.
- Unit II** : Ultrastructure of the cell; Golgi bodies, endoplasmic reticulum (rough and smooth), ribosomes, cytoskeletal structure (actin, microtubules etc.) mitochondria, chloroplasts, lysosomes, peroxisomes, nucleus (nuclear envelope, nucleoplasm, nucleolus)
- Unit III** : Cell membranes, membrane transport including transport process and proton pumps (preliminary idea).
- Unit IV** : The prokaryotic cell wall (Gram+ve/Gram-ve), cell wall and osmotic potential, cell wall of eukaryotic microbes.
- Unit V** : Components coverings external to the cell, wall including capsules, slime layers, S layers, Pilli and Fimbriae Cilia and Flagella.

**Paper II, Cell Reproduction and Differentiation**

- Unit I** : Chromosomes: Chemical composition, structural organization of chromatids, centromeres, telomeres, chromatin, nucleosome, organization, euchromatin and heterochromatin, special chromosomes (e.g., polytene and lampbrush chromosomes)
- Unit II** : Cell division and cell cycles: mitosis and meiosis, interphase and mitosis, comparison of mitosis with meiosis.
- Unit III** : Cell differentiation plants and animals, differentiate between normal and cancer cells.
- Unit IV** : Cell-Cell adhesion intercellular recognition and cell adhesion, cell junction.
- Unit V** : Chemical signaling in the cells: a brief idea with special reference to bacterial chemotaxis.

**Books Recommended**

1. Molecular Biology - Lodish and Baltimore
2. The Cell - Cooper
3. Cell Biology - De Robertis
4. Cell Biology - Sadava

**Course VI-Microbial Physiology and Metabolism**

**Paper 1 Microbial Physiology**

- Unit 1** : A general account of Microbial Physiology-an overview of metabolic process
- Unit II** : Physiology of growth-Microbial nutrition and growth dynamics in solid, liquid, batch, continuous and chemostat cultures, Kinetics of cell growth, synchronous growth, effect of physical and chemical factors on growth of microbes.
- Unit III** : Transport mechanisms in microbes-mechanism of nutrient transport across the membrane; Molecular basis of transport mechanisms.
- Unit IV** : Autotrophic CO<sub>2</sub> fixation-a general account, Bacterial photosynthesis and eukaryotic photosynthetic mechanism.

**Unit V** : Heterotrophic CO<sub>2</sub> assimilation-a general account.

**Paper II, Microbial Metabolism**

**Unit I** : Carbohydrate metabolism-aerobic and anaerobic respiration, Fermentation: mechanism in different microorganism, differences between fermentation and anaerobic respiration, types of fermentation and their industrial applications.

**Unit II** : Electron transport mechanism and oxidative phosphorylation in microbes-a general survey.

**Unit III** : Inorganic nitrogen assimilation role of microbes in nitrogen cycle in nature. Nitrification and denitrification.

**Unit IV** : Nitrogen fixation, nitrogenase and modern aspects of biological nitrogen fixation by autotrophic and heterotrophic bacteria.

**Unit V** : Secondary metabolites-a general account.

**Books Recommended**

- |                                |   |                      |
|--------------------------------|---|----------------------|
| 1. Microbiology                | - | Prescot              |
| 2. Microbiology                | - | Pelczar              |
| 3. A text book of Microbiology | - | Dubey and Maheshwari |

**Course VII-Molecular Biology and Microbial Genetics**

**Paper 1 Molecular Biology**

**Unit 1** : Molecular basis of life. Structure of DNA, DNA replication in both prokaryotes and eukaryotes, DNA recombination: molecular mechanisms. Genetic basis of transformation, transduction and conjugation.

**Unit II** : Organization of genetic material, transposons.

**Unit III** : Genetic code, properties of genetic code, codon assignment, chain initiation and chain termination codons, wobble hypothesis.

**Unit IV** : Structure of prokaryotic genes: Transcription, Translation, comparison with eukaryotes.

**Unit V** : Prokaryotic gene regulation: Operon model for regulation of lac genes: positive control of the lac operon; molecular details of lac operon.

**Paper II, Microbial Genetics**

**Unit I** : Basic laws of inheritance (Mendel's laws), lethality and interaction of genes, multiple alleles and isoalleles.

**Unit II** : Linkage and crossing over, mapping of genes (with special reference to Prokaryotes), interference, coincidence in prokaryotes and eukaryotes.

**Unit III** : Concept of gene, classical and modern gene concepts, intragenic crossing over and complementation (cistron, recon and muton), benzer's work on r II locus in T4 phage.

**Unit IV** : Mutation-spontaneous and induced, chemical and physical mutagens, induced mutations in plants, animals and microbes for economic benefit of man, DNA damage and repair.

**Unit V** : Extrachromosomal inheritance: Cytoplasmic inheritance, mitochondrial and chloroplast genetic systems.

**Books Recommended**

- |                      |   |              |
|----------------------|---|--------------|
| 1- Molecular Biology | - | Gerald Karp  |
| 2- Genetics          | - | Gardner      |
| 3- Genetics          | - | Strickberger |
| 4- Genetics          | - | P.K. Gupta   |
| 5- Genetics          | - | B.D. Singh   |

**Course VIII-Biomathematics, Fundamentals of Computer and Biostatistics**

**Paper 1 Biomathematics**

**Unit 1** : Matrices: Determinates, Properties of determinants, solution of simultaneous equations by Cramer's rule Matrices, properties of Matrices, linear independence, rank of matrices, consistency of linear equations and solution of linear system

of equations, characteristic equations, Cayley-Hamilton Theorem, Eigen value and eigen vectors.

**Unit II** : Solution of algebraic and transcendental Equations, isection method, iteration, false position method, Newton-Raphson method and transformation formula T-ratio of multiple, submultiples, allied and certa Raphson method and solution of system of linear equations: Gausse Elimination method.

**Unit III** : Trigonometry: Measurement of angle, T-ratio addition, subtraction and transformation formula, T-ratio of multiple, submultiples, allied and certain angles.

**Unit IV** : Differential calculus: Limits and functions, definition of differential of standard function, function of a function differential, parameter differentiation successive differentiation, partial differentiation, chain rule, differentiation of implicit and explicit functions, exact differentials, maximal and minima.

**Unit V** : Integral calculus: Integration as inverse of differentiation indefinite intergrals of standard form, integration by parts, substitution and partial fractions forms, evaluation of definite integrals and its simple applications in Microbiology.

**Books Recommended**

- 1- Mathematics - R.S. Aggarwal (Part - I and II)
- 2- Mathematics - R.D. Sharma (Part - I and II)
- 3- Mathematics - N.P. Bali (Part - I and II)

**Paper II Computers and Biostatistics**

**Unit 1** : Introduction to computers: Classification of computers computer generation-low, medium and high level language-software and hardware-operating system-compilers and interpreters-personal, mini, main frame and super computer, their characteristics and application, BIT, BYTE, WORD, computer memory and its types; data representation and storage-binary codes, binary system and its relationship to Boolean Operations.

**Unit II** : Microsoft Excel-Data entry graphs, aggregate functions, formula and functions (students are expected to be familiar with all operations). Different number systems and conversions input-output devices, secondary storage media.

**Unit III** : Nature and scope of statistical methods and their limitations; compilation, classification, tabulation and applications in life sciences; graphical representation measures of central tendency and dispersion, stem and leaf plots; box and whisker plots, coplots, introduction to probability theory and distributions (concepts without derivations) binomial, poisson and normal (only definition and problems).

**Unit IV** : Correlation and regresion-concepts of sampling and sampling distribution-tests of significance based on chi-square and F for means, proportions, variances and correlation co-efficient, theory of attributes and tests of contingency tables.

**Unit V** : Sampling methods-simple random, stratified, systematic and cluster sampling procedures, sampling and non sampling errors principles of scientific experiments-analysis of variance-one way and two way classification-CRD, RBD and Latin Square Designs.

**Note: The emphasis is solely upon the application, understanding the practice of statistical methods with specific reference to problems in microbiology/life sciences.**

**Books Recommended**

- 1- Computer Fundamentals - P.K. Sinha
- 2- Computer Fundamentals - Rajaraman
- 3- Statistics - Sancheti & Kapoor
- 4- Element of Statistics - Kailash Nath Nagar



### Practical based on courses V and VI

- 1- Cytological preparations:
  - a) Fixation, dehydration and staining
  - b) Squash preparation of Mitotic and Meiotic cells.
  - c) Embedding and sectioning.
- 2- 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.
- 3- Effect of physical and chemical factors on the growth of microorganisms. (pH, temperature, nitrogen and carbon sources)
- 4- Aerobic and anaerobic respiration in microbes.
- 5- Microbial photosynthesis (Experimental demonstration)
- 6- Physiology of spore germination.

### Practical based on courses VII and VIII

- 1- Numerical and Genetical problems based on-
  - a) Mendelian ratio
  - b) Deviations from Mendelian Ratios.
  - c) Reciprocal translocations.
- 2- Use of DOS, Windows
- 3- Use of MATLAB, Statistica, SPSS etc. for Statistical problem-solving like Test of Significance (t-Test, Chi-square test for goodness of fit)
- 4- Analysis of variance etc.
- 5- Computer Programming using C language.

### SUBSIDIARY COURSE - BIOLOGY

#### PAPER S-3

- Unit I** : Holozoic nutrition of animals: Diet, Malnutrition. Digestive System and digestion of food by mammals. Digestion of Cellulosic food by Ruminants.
- Unit II** : Gaseous exchange in plants and animals (Earthworm, Insects, Fish, amphibians, Birds, mammals). Tissue respiration (Glycolysis, Krebs Cycle, Electron Transport Pathway)
- Unit III** : Uptake and transport within plants - movement of water in plants (apoplast, symplast, vascular route), Transpiration, Absorption of water, Ion uptake in plants, Insectivorous plants.
- Unit IV** : Transport within animals - circulatory system (open vs. closed). Human heart, arteries, veins and capillaries.
- Unit V** : Osmoregulation and excretion in animals with special reference to human beings Human kidney, Urine formation, Kidney failure.

#### **Books Recommended**

- |                      |   |                 |
|----------------------|---|-----------------|
| 1- Plant Physiology  | - | Wilkins         |
| 2- Plant Physiology  | - | Devlin          |
| 3- Plant Physiology  | - | Bidwell         |
| 4- Animal Physiology | - | Guyton and Hall |
| 5- Animal Physiology | - | Hawk            |
| 6- Animal Physiology | - | H.C. Nigam      |

#### PRACTICALS BASED ON PAPER S-3

- (1) Demonstration of plasmolysis in *Rheo discolor*.
- (2) Demonstration of Root pressure and guttation, Permanent and temporary wilting seedling growth in clay.
- (3) Determination of iso-hypo and hypertonic solution by plasmolytic methods, stomatal frequency by cobalt chloride method and transpiration by Farmer's Potometer/Ganong's photometer.



- (4) Aerobic-anaerobic respiration, RQ of different seeds.
- (5) Geotropism by clinostat.
- (6) Study of Human heart, circulatory system and excretory system with the help of Charts, Models and Prepared slides.

### SUBSIDIARY COURSE-BIOLOGY

#### PAPER S-4

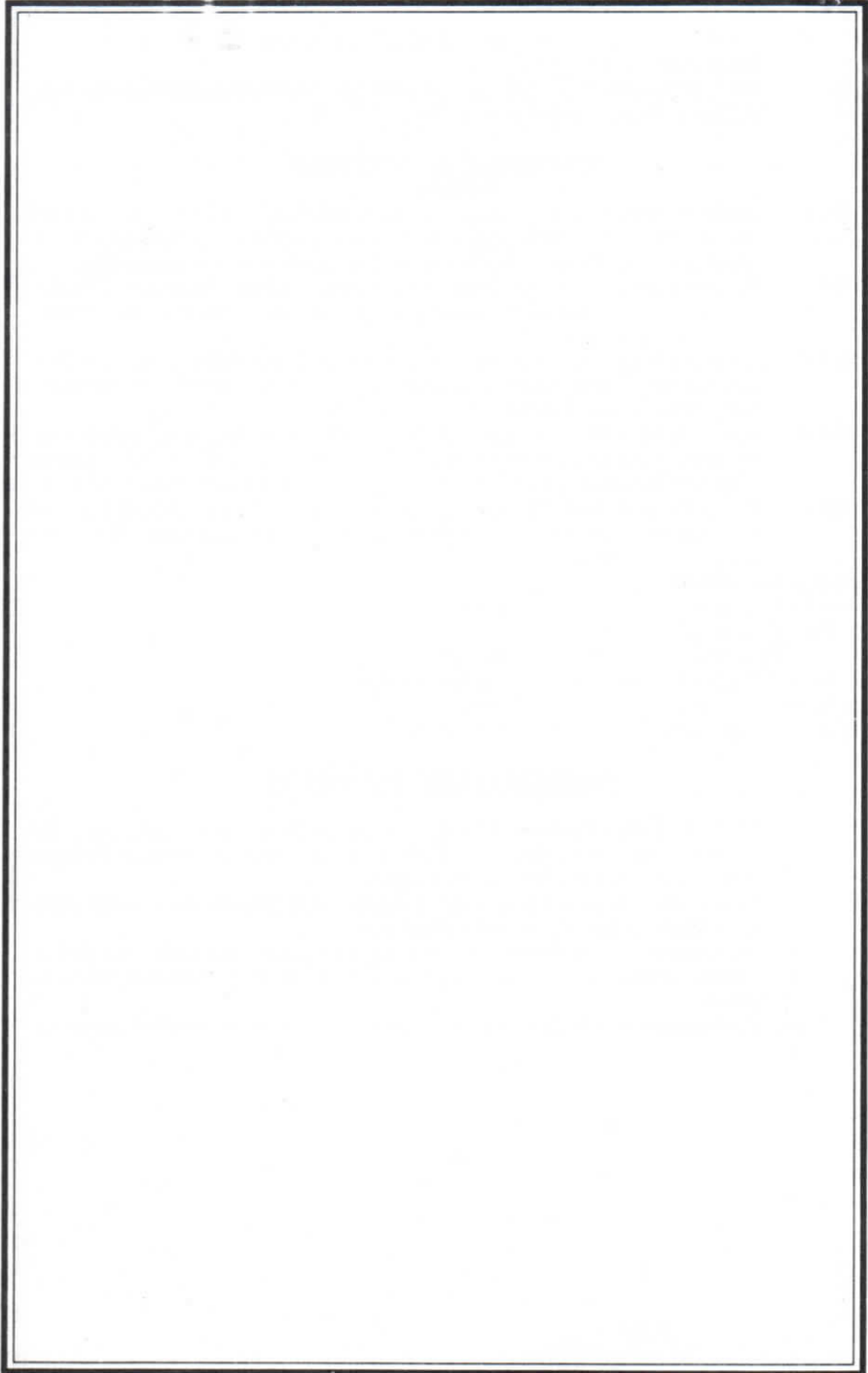
- Unit I** : Growth in living beings - measurement of growth, fresh mass, dry mass, growth rate, Allometric and Isometric growth, limited and unlimited growth, growth and development in flowering plants, growth and development in vertebrates.
- Unit II** : Response and Coordination in plants. Movements in plants, Geotropism, Phototropism, Auxins, Gibberellins, Cytokinins, Abscissic acid, Ethylene; germination, flowering, dormancy.
- Unit III** : Response and Coordination in animals, Neurons, Transmission of impulse, Sensory systems; taste, hearing, balance, sight. Nervous system of mammals, brain. The endocrine system of human beings.
- Unit IV** : Homeostasis, self - regulation - positive vs negative feedback. Temperature regulation in animals - ectotherms vs. endotherms, Metabolism, Skin structure in relation to temperature control. Mechanism to control cold and overheating.
- Unit V** : Animal behaviour - innate and learnt, Habituation, imprinting, conditioning, Trial error learning insight learning, Solitary vs. Social organization. Rhythmic behavioural patterns.

#### **Books Recommended**

- |                      |   |                 |
|----------------------|---|-----------------|
| 1- Plant Physiology  | - | Wilkins         |
| 2- Plant Physiology  | - | Devlin          |
| 3- Plant Physiology  | - | Bidwell         |
| 4- Animal Physiology | - | Guyton and Hall |
| 5- Animal Physiology | - | Hawk            |
| 6- Animal Physiology | - | H.C. Nigam      |

### PRACTICALS BASED ON PAPER S-4

- 1. Study of permanent slides of the (a) T.S. anther, pollen, germinating pollen (b) L. S. Ovule types (c) embryo sac : Polygonum type (d) Endosperm (e) Embryos (f) L. S. Caryopsis (g) Dissection of embryo.
- 2. Examination of locally diseased plants representing bacterial, viral, fungal infections. Study of symptoms and pathogens.
- 3. a) Identification and comment on the plants and plant - products belonging to cereals, pulses, fruits, potato, sugarcane, fiber Plants, timbers and medicinal plants.  
 (b) Submission of collection of economically important plants and their products.





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### SYLLABUS FOR B.Sc. (MICROBIOLOGY)-IIIYEAR

#### B.Sc. III (Microbiology)

#### Course IX-Immunology and Medical Microbiology

##### Paper I Immunology

- Unit 1** : Historical Developments, Non-specific defence mechanisms-Phagocytosis, Types of immunity.
- Unit II** : Structure and types of Antigens and Antibodies.
- Unit III** : Mechanism of Humoral and Cellular Immunity.
- Unit IV** : Antigen-antibody Reactions; Agglutination, Precipitation, Neutralisation, complement Fixation. A brief idea of Immunodiffusion, Immuno-electrophoresis, ELISA, RIA, production of monoclonal antibodies.
- Unit V** : Hypersensitivity and allergic reactions, Autoimmune diseases, Rheumatoid arthritis, Pernicious anaemia asthma, Hashimoto's thyroiditis, Myasthenia gravis, Vaccines of different generations and vaccination.

##### Paper II Medical Microbiology

- Unit 1** : Infection: Mechanism of Infection, Virulence (Toxicity), Transmission of Infectious Disease (Food-borne, Water-borne, Air-borne, Soil-borne, fomites)
- Unit II** : Diagnostic features of following important Bacterial and Viral diseases of human beings including their pathogenicity and control. (a) Anthrax, Tuberculosis, Typhoid, Tetanus (b) Hepatitis B, AIDS, Rabies
- Unit III** : Important fungal diseases-Athlete's Foot, Mycetoma, Aspergillosis, Candidiasis.
- Unit IV** : Important Protozoan diseases-Malaria, Amoebiasis, Kala azar.
- Unit V** : Chemotherapy-Historical account, mode of action of antibiotics.

#### Course X-Food, Dairy and Agricultural Microbiology

##### Paper I Food and Dairy Microbiology

- Unit I** : Important microorganisms in foods (Meats, poultry, vegetables, dairy products, dehydrated foods) moulds, yeasts, yeast-like fungi and bacteria
- Unit II** : Principles of food preservation and spoilage of foods.
- Unit III** : Food-borne diseases, food poisoning and prevention.
- Unit IV** : Microbiological production of foods (Indian foods, fermented meats, leavening of bread, alcoholic beverages, fermented vegetables, single cell protein)
- Unit V** : Microbiology of milk, pasteurization, milk spoilage, microbiological methods of examination of milk and milk products, characters and laboratory examinations of milk products (fermented dairy products, buttermilk, sour cream, yogurt cheese.)

##### Paper II Agricultural Microbiology

- Unit 1** : Introduction and historical background of soil microbiology, soil microflora-bacteria, fungi, actinomycetes, algae, protozoa and viruses, Rhizosphere, Rhizoplane.
- Unit II** : Role of microbes in weathering of minerals and soil formation, components of soil, texture and soil profile.
- Unit III** : Interactions between microorganisms : neutralism, symbiosis, commensalisms, parasitism, amensalism and predation.
- Unit IV** : Integrated pest management, Biofertilizers : BGA rhizobia, Mycorrhiza; Biopesticides.
- Unit V** : Important fungal, bacterial and viral diseases of major cereal and vegetable

crops of the locality-their symptoms, casual organisms and their control measures.

### **Course XI-Recombinant DNA Technology and Industrial Microbiology**

#### **Paper I Recombinant DNA Technology**

- Unit 1** : Introduction to gene cloning and its uses, requirement of recombinant molecules in medical, agricultural and industrial sectors. Contributions of (a) Arber and Smith (b) Boye (c) Temin and Baltimore (d) Jackson, Symons and Berg (e) Southern (f) Mullis
- Unit II** : Tools : (a) Restriction enzymes and other enzymes used in cloning (b) vectors (plasmids, vectors based on bacteriophages, cosmids, YAC vectors, BAC vectors, animal and plant viral vectors)
- Unit III** : Making recombinant DNA: Purification of cDNA from cells, manipulation of purified DNA, DNA library, Introduction of recombinant DNA into host cell.
- Unit IV** : Expression of foreign genes in prokaryotes Identification of recombinants.
- Unit V** : PCR, DNA probes Hybridisation techniques, Analysis of DNA by Southern blotting, Analysis of RNA by Northern blot hybridization, Analysis of proteins by western blot techniques DNA sequencing (Sanger method), Site directed mutagenesis, Production of human growth hormone, insulin and hepatitis B vaccines, Monoclonal antibodies.

#### **Paper II Industrial Microbiology**

- Unit 1** : Characters of industrially important microbes; their acquisition from nature, and genetic manipulation.
- Unit II** : Microbial growth in controlled environments; medium development, scale up.
- Unit III** : Fundamentals of fermentation processes. Definition and types of fermentation process (Single, batch continuous, surface submerged and solid state fermentation)
- Unit IV** : Fermentation equipment and its uses: A detailed account of (a) Different parts of typical fermentor (b) Different types of fermentors principle and operation. Computer application in fermentation process.
- Unit V** : Industrial production of following (a) Antibiotics: Penicillin, Streptomycin and Tetracycline (b) Enzymes: Amylase, Cellulase, Pectinase and Lipase (c) Organic acids: Lactic acid, Citric acid, Lysine.

### **Course XII-Environment Microbiology**

#### **Paper I Microbial Ecology**

- Unit 1** : Microorganisms in their natural environments (a) Terrestrial environment (b) Aquatic environment (c) Air/atmosphere (d) Animal as an environment for microbes: microbial population of alimentary tract, skin and rumen.
- Unit II** : Structure and development of microbial communities and ecosystems (Succession of microflora on decomposing plant materials)
- Unit III** : Biological interactions: (a) Microbe-microbe interactions (b) Microbe-plant interactions (c) Microbe-animal interactions
- Unit IV** : Biogeochemical aspects of microbial ecology: Role of microorganisms in cycling of carbon, nitrogen, phosphorus, sulphur and iron.
- Unit V** : Variations in the compositions of sewage: kinds of sewage systems. Microorganisms in sewage-fungi, protozoa, algae, bacteria and viruses. COD and BOD of sewage and pollution problem.

#### **Paper II Microbes in Environmental Biotechnology**

- Unit 1** : Treatment of industrial effluents and municipal wastes through microorganism.
- Unit II** : Degradation of pesticides and other toxic chemicals by microbes.
- Unit III** : Biopesticides (with special reference to *B.thuringiensis*)
- Unit IV** : Enrichment of ores by microorganisms (Bioaccumulation and biomineralisation)
- Unit V** : Environmental laws, policies and practices.



## Course XIII-Fundamentals of Information Technology and Bioinformatics

### Paper I Fundamentals of Information Technology

- Unit 1** : Introduction to operating system, categorization of operating system, functions of operating system, Unix/Linux commands, pipes, filters, shell programming and Unix utilities.
- Unit II** : Overview of Networking LAN, WAN, MAN and Network connecting devices, topologies: Ring star, Tree, Bus networks and its advantage.
- Unit III** : Fundamental concept of Database and database management systems, structure of DBMS (Hierarchical network, relational and object oriented), Introduction of keys (Primary, Secondary and Foreign)
- Unit IV** : SQL commands used in creating, inserting the values in a table, update, modification and deletion in database.
- Unit V** : Internet programming: Hypertext linking, forms, anchors and image, perl programming scalar data, scalar variable strings, operators, arrays hashes and pattern matching, introduction to CGI using PERL, overview of Java script.

### Paper II Genomics, Proteomics and Bioinformatics

Structural and functional genomics: Genome sequencing (directed, random shot gun). Gene prediction and counting, Genome similarity, DNPs and Comparative genomics, microarray technology, Fluorescence in situ hybridization microarray.

History of Bioinformatics. Sequences and nomenclature : IUPAC symbols, DNA and protein sequences, the concept of directionality, DNA, Genomic DNA, ESTs, GSTs, organelle DNA information sources: Major Database, Database retrieval tools, BLAST family of search tools, Resources for gene level sequences.

Proteomics-Introduction and types-expression structural and functional proteomics.

### Practicals Based on Courses IX & X

#### **(A) Immunology :**

1. Determination of human blood groups.
2. Bacterial agglutination test.
3. Gel immuno-diffusion (SRID and DRID)
4. Immunoelectrophoresis.

#### **(B) Medical Microbiology:**

5. Biochemical tests for identification of pathogenic bacteria (Fermentation of sugars, gelatin liquefaction, Urease activity, indole test, catalase and oxidase, MR and VP test.
6. Antimicrobial testing.
7. Study of pathogenic bacteria (*E.Coli*, *Klebsiella*, *Salmonella*, *Staphylococcus*, *Streptococcus*.)

#### **(C) Food, Dairy and Agricultural Microbiology**

8. Bacteriological analysis of food products, direct microscopic studies and standard plate count in milk.
9. Reductase test for milk, dye reduction test.
10. Isolation of microorganisms from common food items such as curd and bread,
11. Bacterial count of food.
12. Standard plate count of milk.
13. Examination of pure and synthetic milk.
14. Isolation of Nitrogen-fixing bacteria from soil.
15. Isolation of microbes from compost.
16. Production of Biopesticides.
17. Isolation of Mycorrhizal spores from soil.

### Practicals Based on Courses XI & XII

- 1- Demonstration of-
  - a- Ethanol production from molasses and sugars.
  - b- Anaerobic and aerobic cultivation of fungi, yeast and bacteria, for the production of

- (i) Enzymes-Amylases, Cellulase, Proteases.
  - (ii) Amino acids-Glutamic acid.
  - (iii) Antibiotics-Penicillin, Streptomycin
  - (iv) Organic acids-Citric acid and Lactic acid
- c- Biogas production from cow-dung slurry-demonstration
- 2- Analysis of soil (Texture, pH, moisture content, water-holding capacity, percolation, capillary action, nitrogen and organic matter) and water (pH, dissolved oxygen, carbon dioxide and organic matter). Isolation of *Rhizobium* from legume root nodules.
  - 3- Determination of microbial activity in soil and composting plant material.
  - 4- Demonstration of the presence of enzymes in soil (dehydrogenases)

#### Practicals Based on Courses XIII

- 1. Use of Unix/Linux its command vi as editor.
- 2. Date base management, system oracle, SQL commands use for creat, insert delete, update etc.
- 3. Query handling.
- 4. Perl programming
- 5. Submission of sequence to biological database GENBANK, EMBL, DDBJ and PDB etc.
- 6. Retrieval of DNA and protein sequence of respective database.
- 7. Visualization of sequence data using 1D, 3D viewers sequence analysis using BLAST, FASTA, Crystal-X and Crystal-W

#### Special papers for B.Sc. (Hons.) in Microbiology

##### Paper XIV Diagnostic Microbiology

- Unit I** : Microbiology Laboratory Safety. General safety principles, Handling of biological hazards, disposal of infectious waste, reduction of hazardous waste.
- Unit II** : Antimicrobial Susceptibility Testing Traditional and automated antimicrobial susceptibility test methods, interpretation of results, methods of detecting antimicrobial-inactivating enzymes (B-lactamase test, chloramphenicol acetyltransferase tests), Measurement of antimicrobial agents in serum and body fluids.
- Unit III** : Direct microbial antigen detection. Particle agglutination methods and their clinical applications, Serological diagnosis of infectious disease: antibody detection methods and applications, particle agglutination assays, Precipitation assays complement fixation test, microscopic techniques, immunoassays.
- Unit IV** : Identification of microorganisms using chromatographic techniques, diagnostic applications of DNA probes and PCR.
- Unit V** : Microscopic examination of infected materials (Swabs, semisolids, mucoid materials, Thin fluids, Cytoentrifuge). Utilisation of colonial morphology for the presumptive identification of microbes.

##### Paper XV Biosafety and Bioethics

- Unit I** : Biosafety of transgenics and genetically engineered products (Insulin, HGH) International biosafety protocol
- Unit II** : Bioethical issues in transgenics, Bioethics and consumer acceptance, bioethics guidelines, international Biosafety Committee.
- Unit III** : Biosafety and rDNA guidelines in India, Review committee on Genetic manipulation of genetic Engineering approval committee
- Unit IV** : Patents on biological inventions, licensing revenue, selection of partners, negotiations on terms and conditions
- Unit V** : Product selection, product development, R & D growth of microbes, based industries in different fields.