Course – 1 Microbial Diversity – 1

Paper 1. Fundamentals of Microbiology (B -101)

Unit - I Historical developments**:** Discovery of microorganisms, Spontaneous Generation Controversy, Germ theory of fermentation, Germ theory of disease.

Unit – II Historical developments: Developments 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, genetics 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, Endosperm 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).

Course – II Microbial Diversity -II
Paper I. Virology (B – 103)

Unit – I Origin and 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 Bactriophages.

Unit – II Replication of viruses-RNA Viruses, ssRNA, dsRNA, DNA Viruses (ssDNA , dsDNA), 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 Alexopolous, Mims and Blackwell.

Unit – II Important genera of Fungi (Synchytrium, Phytophthora, Albugo, Mucor, Rhizopus, Aspergillus, Penicillium, Altemaria, Ustilago, Puccinia); Economics Importance of Fungi.

Unit – III General characteristics of Algae, Classification of Algae and Economics 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).

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 Change in Biological cycles, Water as a reactant, Aqueous in 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 ; Chairality of Biomolecules.

Unit – II Laws of thermodynamics (first and second laws); Kinetics of 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.

COURSE IV. INSTRUMENTATION AND BIOANALYTICAL TECHNIQUES

Paper I Instrumentation and Cultural Techniques

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

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

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

Unit-IV **:** Sterilization techniques, Different type 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.

Practicals based on Courses I & II

- **Viruses :** Diagrammatic representation and ultrastructure of some typical viruses like TMV, Bacteriophage, Cyanophage.
  - EM photographs of RNA and DNA Viruses.
  - Viral diseases of plants and animals (Specimens, Diagrams only).
- **Bacteria :** General morophology (permanent slides and live materials) e. g.
  I. Coccoid
  II. Rod – shaped (Bacillus etc)
  III. Vibrio
  IV. Spirillum
- **Algae :** Thallus range with class representatives (Volvox, Cladophora, Oedogonium, Vaucheria, Spirogyra)
- Fungi : Thallus range with class representatives (Puccinia, Aspergillus, Penicillium, Mucor, Ustilago, Alternaria).
- **Protozoa :** Study with the help of permanent slides. (Amoeba, paramecium)
- **Parpasties :** Study with the help of permanent slides (Plasmodium, Entamoeba)
- **Nematodes :** Study with the help of permanent slides (Meloidogyne, Ascaris).

Practicals based on courses III & IV

- **Compound microscope – Parts and functions.**
- **Different types 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 diffraction.**
- **Enzymes – the effect of temperature on enzyme activity.**

Subsidiary Course – Biology

Paper S- I

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.

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, Fillcinophyta,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 ,Phleom.

Unit- IV : Transport across the cell membranes –Diffusion , Osmosis , Cells and Water potential , Water relations of animal and plant cell, Active transport across the plasma membrane. Secretion from cells by Bulk transport.

Unit-V **:**Autotrophic nutrition- Phytosynthesis : conditions necessary for photosynthesis , Absorption spectrum vs action spectrum , pigments systems , Mechanism of photosynthesis , Factor affecting Photosythesis. Ecological aspects of photosynthesis (Leaf Mosaic, Sun vs shade leaves, compensation point, C3 vs C4 Plants).

Practicals based on Paper S-2

a. A study of important genera of plants with the help of Museum specimens and slides.
b. A study of epithelial tissue, muscular of frog.
c. Macertion of wood/ Match-stick to observe tissues.
d. A study of plant and animal tissues with the help of permanent prepared slides.

Course V –Cell Biology

Paper 1. Ultrastructure

Unit-I	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: Gogi bodies , endoplasmic reticulum (rough and smooth), ribosomes cytoskeletal structure (actin,microtubles etc.) Mitochondria, chloroplasts, lysosomes, peroxisomes , nucleus (nuclearenvelope, 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 protection .cell wall of eukaryotic microbes.
Unit-V	Components- coverings exeternal to the cell wall including capsules, slime layers,S layers, Pill and Fimbria.Cillia and Flagella.

Paper II. Cell –Reproduction and Differentiation

Unit-I	Chromosomes: chemical composition, structural organization of chromatids, centromeres, telomeres,chromatin necleosome organization,euchromatin and heterochromatin,special chromosomes (e.g, polytene and lampbrush chrosomes)
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. Differences 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.

Course VI- Microbial Physiology and Metabolism

Paper I. Microbial Physiology

Unit – I	:	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 culture, 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 memberence; Molecular basis of transport mechanisms.
Unit-IV		Autotropic CO_2 fixation-a general account. Bacterial photosynthesis and eukaryotic ; photosynthetic mechanism.
Unit-V		: Heterotrophic CO_2 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 their industrial applications.
Unit-II	Electron transport mechanism and oxidative phosphorylation in microbes-a general survey.
Unit-III	Inorganic nitrogen assimilation . Role of microbes on 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.

B.Sc. IIND

Course VII- MOLECULAR BIOLOGY AND MICROBIAL GENETICS

Paper I: MOLECULAR BIOLOGY

Unit-I : Molecular basis of life .Structure of DNA, DNA replication in both prokaryotes and eukaryotes ,DNA recombination :molecular mechanism. 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 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 ll 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: Cytopalsmic inheritance. Mitochondrial and chloroplast genetic systems.

Course VIII- BIOMATHEMATICS, FUNDAMENTALS OF COMPUTER AND BIOSTATICS

Paper I: BIOMATHEMATICS

Unit-I : Matrices: Determination , properties of determinats , 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 equation, Cayley-Hamilton Theorem, Eigen valve and eigen vectors.

Unit-II : Solution of algebric and Transcendental Equations, isection method , lteration, False position method, Newton-Raphson method ,and transformation formulae T-ratio of multiple, submultiples , allied and certa Raphson method, and solution of system of linear equation: Gauses Elionination method.

Unit-III : Trignometry: Measurement of angle , T-ratio addition , substraction and tansformation formulae, T-ratio of multiple, submultiples ,allied and certain angles.

Unit-IV : Different Calculus : Limits and functions, definition of differential of standard function, function of a function differential , parameter differentiation successive Differentitation . Parital differentiation, chain rule , differentiation of implicit and explicit functions, exact differentials , maximal and minima.

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

B.Sc. II

Paper II

Computers and Biostatistics

Unit I : 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, compilations, classification, tabulations and applications in life sciences, graphical representation, measures of central tendency and dispersion, stem and leaf plots, Box and whisker plots, copilots, introduction to provability theory and distributions (concepts without derivations)-binomial, Poisson and normal (only definition and problems)

Unit IV : Correlation and Regressions- concepts of sampling and sampling distribution- tests of significance based on chi-square and F For means, proportions variances and correlation efficient, theory of attributes and tests of independence 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-science

B.Sc. II

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 line tics 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 in microbes.

5. Microbial photosynthesis (Experimental demonstration).

6. Physiology of spore germination.

Practicals Based On Courses VII & VIII

1. Numerical and Genitical Problems based on-

   (a.) Mendelian ratio

   (b.) Deviations from Menedelian Ratios.

   (c.) Reciprocal translocations.

2. Use of DOS, Windows.
3. Use of MATLAB, Statistics , SPSS etc for statistical problem- solving like Test of Significance (t-Test, Chi- square test for goodness of fit) Analysis of variance etc.
4. 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 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.

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 Potometer.

(4) Aerobic- anaerobic resiration, 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, Allosteric 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 , Abscisic acid, Ethylene ; germination, flowering dormancy.

Unit-III : Response and coordination in animals , Neurons, Transmission of impules , Sensory system; 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 : Animals behaviour – innate and learnt , Habituation ,imprinting , conditioning Trial error learning insight learning , Solitary vs. social organization, Rhythmic behavioural patterns.

PRACTICALS BASED ON PAPER S-4

1. Study of parmanent 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.

COURSE - IX. IMMUNOLOGY & MEDICAL MICROBIOLOGY

PAPER I. IMMUNOLOGY

Unit I	Historical Developments, Non- specific defense mechanisms – phagocytosis, Types of Immunity.
Unit II	Structure and types of Antigens and antibiodies.
Unit III	Mechanism of humoral and Cellular Immunity.
Unit IV	Antigen-antibody Reactions: Agglutination, Precipitation, Neutralisation, Complement Fixation. A brief idea of Immunodiffusion, Immunoelectrophoresis, ELISA, RIA, production of monoclonal antibodies.
Unit V	Hypersensitivity and allergio reactions. Autommune diseases, Rheumatoid arthritis, Pernicious anaemia, asthma, Hashimoto's thyroiditis, Myasthenia gravis. Vaccines of different generations and Vaccination.

PAPER II. MEDICAL MICROBIOLOGY

Unit I	Infection: Mechanism of Infection, Virulence (Toxigenicity), Transmission of Infection 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 Pathogen city and control i. Anthrax, Tuberculosis, Typhoid, Tetanus. ii. Hepatitis B, AIDS, Rabies.
Unit III	Important fungal diseases – Athlete's Foot, Mycetoma, Aspergillosis, Candidacies.
Unit IV	Important Protozoan diseases – malaria, Amoebiasis, Kala azar.
Unit V	Chemotherapy – Historical account, Mode of action of Antibiotics.

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 examination of milk products (fermented dairy products, buttermilk, sour cream, yogurt, cheese).

Paper II. AGRICULTURAL MICROBIOLOGY

Unit I	Introduction and historical background of soil microbiology. Soil microflora bacteria, fungi, actinomycetes, algae, protoza, 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 soil microorganisms: neutralism, symbiosis, commensalisms, amensalism, parasitism 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, causal organisms and their control measures.

COURSE XI: RECOMBINANT DNA TECHNOLOGY AND INDUSTRIAL MICROBIOLOGY

PAPER I. Recombinant DNA Technology

Unit- I — Introduction to gene cloning and its uses, Requirement of recombinant molecules in medical, agricultures and industrial sectors. Contributions of (a) Arber and smith (b) Boyer (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, animals and plant viral vectors).

Unit – III — Making recombinant DNA: Purification of cDNA from cells, Manipulation of purified DNA, DNA library, Introduction of recombinant DNA in to host cell.

Unit – IV — Expression of foreign genes in prokaryotes Identification of recombinant.

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 – I — 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 fermentation)

Unit – IV — Fermentation equipment and its uses: A detailed account of (A) Different part of fermentor (B)Different types of fermentors principle and operation; (C) 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- Environmental Microbiology

Paper I. Microbial Ecology

Unit – I Microorganisms in their natural environments.

a. terrestrial environment.
b. Aquatic environment.
c. Air/atmosphere
d. Animals 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 micro flora 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 composition of sewages; kinds of sewages 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 I	Treatment of industrial effluents and municipal wastes through Microorganisms.
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 I **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 Networking connecting devices, Topologies: Ring star, Tree, Bus

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 Foregion).

Unit IV SQL commands used in creating, Inserting the values in a table, update codification 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 Jawa 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; c DDNA, Genomic DNA, ESTs, GSTs Origanelle, DNA.Information sources: Major Database. Database retrieval tools, BLAST family of search tools, Resources for gene level sequence.

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 & DRID).
4. Immunoelectrophoresis.

B. Medical Microbiology:

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

C. Food, Dairy & 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 iteams such as curd and bread.
11. Bactrial 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, Cellulases, 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.

Analysis of Soil(Texture, pH, moisture content, water-holdind 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 (dehydrogenises).

Practicals based on Courses XIII

A. Use of unix/Linux its command vi as editor.

B. Data base management system Oracle, SQL command use for create, insert, delete, update etc.

C. Query handling.

D. Perl programming.

E. Submission of sequence to biological database GENBANK, EMBL, DDBJ and PBD etc.

F. Retrieval of DNA and protein sequence of respective database.

G. 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 (Blactamase 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 assts, 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, Cytocentrifuge) Utilisation of colonial morphology for the presumptive identification of microbes.

Paper xv : Biosafety and Bioethics

Unit I Biosafety of transgenics and geneticacally engineered products (Insulin, HGH). International biosafety protocol

Unit II Bioethical issues in transgenice, Bioethics and consumer Acceptance, Bioethics guidelines, International Biosafety Committee.

Unit III Biosafety and Rdna. guidelines in India, Review

Committee on Genetic Manipulation at Genetic Engineering Approval Committee.

Unit IV Patents on biological inventions, licensing revenue, selection of partners, negotiatins on terms and conditions.

Unit V Product selection, product development, R & D, growth of microbes- based lndudtries in different fields.