

Syllabus -B.Sc. Microbiology

Class:	B.Sc
Subject:	Microbiology
Semester:	I
Paper No. and Name:	I- Introduction to Microbiology

Unit I

- Scope of Microbiology: Microorganisms in human affairs and industry. History of Microbiology: Contributions of Anton van Leeuwenhoek, Joseph Lister, Paul Ehrlich, Edward Jenner, Louis Pasteur, Robert Koch and Alexander Fleming.

Unit II

- Prokaryotic Cell: Cell wall. Distinction between cell wall of Gram positive and Gram negative bacteria. Cell membrane, Cytoplasm, nucleoid, endospore, flagella, pili, glycocalyx. Structure of Archaea cell.

Unit III

- Eukaryotic cell: Cell membrane, cytoplasm. Organelles: Nucleus, Mitochondria, Endoplasmic reticulum, Ribosomes, Golgi bodies, Lysosomes and Chloroplast. External structures-flagella, cilia and cell wall.

Unit IV

- Diversity of Microorganisms: General account of Bacteria, Fungi, Protozoa, Algae and Viruses.

Unit V

- Taxonomy: Naming of microorganisms. Contribution of C. Linnaeus, Taxonomy hierarchy, Whittaker's five kingdom and Carl Woese's three domain classification system. Classification of bacteria and cyanobacteria: Bergery's Manual of Systematic Bacteriology. Classification of Fungi and Protistean Algae.

Class: B.Sc
Subject: Microbiology
Semester: I
Paper No. and Name: II- General Microbiology

Unit I

- Principle and structure of Light Microscope, Numerical Aperture, Resolving Power. Magnification. Principle and structure of electron microscope (SEM and TEM). Comparison between light and electron microscope.

Unit II

- Preparation and staining of specimens for light microscopy: Fixation, Dyes and simple staining, Differential staining- Gram staining, acid-fast staining, Staining specific structures-negative staining, endospore staining, flagella staining.

Unit III

- Microbial Nutrition: Common nutrient requirements, Nutritional types of microorganisms, growth factors. Uptake of nutrients by cells.

Unit IV

- Culture Media: Synthetic or defined media. Commonly used media. Types of Media- Selective, differential and enrichment media. Aseptic Techniques: Disinfection, Sterilization.

Unit V

- Cultivation of bacteria, fungi and viruses. Pure culture: Concept of pure culture. Methods of pure culture of microorganisms – Spread plate, streak plate and pour plate.

Class: B.Sc
Subject: Microbiology
Semester: II
Paper No. and Name: III- Microbial Physiology and Biochemistry

Unit I

- Structure of atoms, chemical reactions, water and solutions. Acid, bases and pH.
- Complex organic molecules: Carbohydrates, Lipids, Proteins, DNA, RNA.

Unit II

- **Enzymes:** Historical perspective of enzymes. Structure of enzymes and classification of enzymes.
- Mechanism of enzyme action. Factors affecting enzyme action. Enzyme inhibition and enzyme regulation.

Unit III

- Bioenergetics: Free energy change, exergonic and endergonic reactions and High energy transfer compounds.
- Anaerobic processes in energy production: Glycolysis. Pentose Phosphate Pathway, Entner-Doudroff Pathway.

Unit IV

- Aerobic processes in energy production: Krebs cycle, Electron Transport Chain and Proton motive force.
- Utilization of energy-Bacterial motility, Transport of nutrients.

Unit V

- Nitrogen fixation: Symbiotic and non-symbiotic types.
- Photosynthesis: oxygenic and anoxygenic types.

Class: B.Sc
Subject: Microbiology
Semester: II
Paper No. and Name: IV- Microbial Growth and Control of Microorganisms

Unit I

- Definition of microbial growth. Cell division. Growth curve in batch culture or closed system. Mathematics of growth-generation time and growth rate constant.

Unit II

- Measurement of growth: Measurement of cell numbers- Counting chambers, electronic counters, Viable counting techniques, membrane filter technique. Measurement of cell mass-dry weight and turbidity measurement. Measurement of cell activity.

Unit III

- The continuous culture of microorganisms: The Chemostat and Turbidostat. Influence of environmental factors on growth- Solutes and water activity, pH, Temperature, Oxygen concentration, Pressure and Radiations.

Unit IV

- Control of microorganisms: Fundamentals of control-Death rate of bacteria, Antimicrobial agents and their mode of action. Physical agents-Temperature, Desiccation, Osmotic Pressure, Radiation, Surface tension and Filtration.

Unit V

- Control by chemical agents: Characteristics of ideal antimicrobial agent. Major groups of antimicrobial agents-Phenol and Phenolic compounds, Alcohols, Halogens, Heavy metals and their compounds. Dyes, Synthetic detergents, Quaternary ammonium compounds, Aldehydes and Gaseous agents.

Class: B.Sc
Subject: Microbiology
Semester: III
Paper No. and Name: V- Microbial Genetics-I

Unit I

- Historical background – Foundation of Genetics (Mendel's Experiments). DNA as genetic material-Experimental evidences: Avery, MacLeod and McCarty and Hershey and Chase experiments.

Unit II

- Structure of DNA and RNA. Replication of DNA.

Unit III

- Mutations –Types of mutations, Substitutions, Deletions and Insertion mutations. Spontaneous mutations. Detection of mutations. Ames Test. Mutagens-physical and chemical.

Unit IV

- DNA repair –Photoreactivation, Excision repair, Mismatch repair, Recombination repair and SOS repair.

Unit V

- Transcription in prokaryotes- The Central Dogma, RNA polymerase. Transcription initiation, Elongation and Termination.

Class: B.Sc
Subject: Microbiology
Semester: III
Paper No. and Name: VI- Microbial Genetics-II

Unit I

- Translation in prokaryotes-Genetic Code, Ribosome. tRNA, Initiation, Elongation and Termination of polypeptide biosynthesis.

Unit II

- Bacterial plasmids-Fertility factors, Resistance factors, Col Plasmids and other types of plasmids. Transposable elements –Is sequences.

Unit III

- Bacterial conjugation –F Factor, Hfr Transfer. Gene mapping. Bacterial Transformation, Transduction-Generalized and specialized transduction.

Unit IV

- Genetic Engineering – Isolation of DNA, Restriction enzymes, Cloning Vectors-plasmids, cosmids and BACs. DNA transfer techniques. Screening of recombinant colonies.

Unit V

- Expression of foreign gene in bacteria. Applications of genetic engineering. PCR and its applications.

Class: B.Sc
Subject: Microbiology
Semester: IV
Paper No. and Name: VII- Environmental Microbiology

Unit I

- Soil and Air – Distribution of Microorganisms. Fresh water and Marine Environment – Winogradsky column. Distribution of microorganisms. Benthic environment.

Unit II

- Microbiology of Extreme environments. Biogeochemical cycles-N-cycle, C-cycle and S-cycle.

Unit III

- Interaction between Microorganisms – Commensalism, Synergism, Mutualism (symbiosis). Lichen symbiosis.

Unit IV

- Microbe –Plant interactions – Root nodule symbiosis, Ectomycorrhiza. Endomycorrhiza, Rhizosphere. Microbe-animal interaction –Rumen.

Unit V

- Waste water treatment – Primary sedimentation, Biological treatment. Anaerobic digestion of sludge.

Class: B.Sc
Subject: Microbiology
Semester: IV
Paper No. and Name: VIII- Food Microbiology

Unit I

- Food Spoilage – Intrinsic factors and Extrinsic factors. Disease transmission by foods –Food poisoning, Aflatoxins, Botulinum toxin.

Unit II

- Food preservation –Asepsis, Pasteurization, Canning, Desiccation, Temperature effects.

Unit III

- Chemical preservation of food-salt and sugar, Organic acids, use of SO₂, ethylene and propylene. Preservation by radiation.

Unit IV

- Microorganisms as source of food –SCP. Fermented Dairy Products-Yoghurt, Curd, Cheese.

Unit V

- Fermented alcoholic beverages: Wine and Beer. Bread and Indian fermented foods.

Class: B.Sc
Subject: Microbiology
Semester: V
Paper No. and Name: IX- Medical Microbiology

Unit I

- Pathogen, Pathogenicity, Virulence, Disease, Determinants of infectious diseases- transmissibility, Attachment and colonization, Entry, growth and multiplication, Toxicogenicity- Exotoxins and endotoxins.

Unit II

- Skin infections: Frunucle, Chicken pox, Measles and Herpes simplex.

Unit III

- Respiratory infections: Diphtheria, Pneumonia, Tuberculosis, Influenza and Rheumatic fever.

Unit IV

- Alimentary infections: Dental plaque, Cholera, Typhoid fever, Giardiasis and Amoebiasis.

Unit V

- Nervous system infections: Leprosy, poliomyelitis, Rabies and meningitis.

Class: B.Sc
Subject: Microbiology
Semester: V
Paper No. and Name: X- Immunology

Unit I

- Immunity. Innate (nonspecific) Immunity: general barriers, Physical barriers and Chemical barriers, Biological barriers.

Unit II

- Specific Immunity: Acquired immunity. Lymphocytes-B cells, T cells and NK Cells.

Unit III

- Antigens, haptens. Immunoglobulins and their types.

Unit IV

- Cell mediated cytotoxicity. Complement system. Autoimmune diseases.

Unit V

- Hypersensitivities –Type I, II, III and IV. ELISA and Hybridoma Technology.

Class: B.Sc
Subject: Microbiology
Semester: VI
Paper No. and Name: XI- Industrial Microbiology

Unit I

- Microbial metabolism – Primary and secondary metabolism. Introduction to microbial products obtained by industrial process. Industrial strains – characteristics and isolation techniques.

Unit II

- Improvement of Industrial strains-Mutation, Genetic engineering techniques. Preservation of cultures- Storage on agar slants, Soil culture, Lyophilization, Storage in Liquid nitrogen.

Unit III

- Fermentation. Batch and continuous culture. Types of Fermenters –Aerated and Agitated fermenters, Air lift fermenter. Basic function of Baffle, Impeller and Sparger.

Unit IV

- Inoculum and Culture media in fermentation. Recovery Process- Biomass separation, centrifugation, Liquid –Liquid extraction, Cell disruption.

Unit V

- Production of Organic acids (Citric acid and lactic acid), Amino acids (Lysine), Alcohol and Penicillin.

Class: B.Sc
Subject: Microbiology
Semester: VI
Paper No. and Name: XII- Applied Microbiology and Biotechnology

Unit I

- Production of Enzymes- Amylase, protease and lipase. Immobilized enzymes and Enzyme immobilization Techniques.

Unit II

- Biofertilizers-Bacterial fertilizers, Algal fertilizer and Mycorrhiza. Bioinsecticides – *Bacillus thuringiensis*.

Unit III

- Biohydrometallurgy and Biomineralization. Biogas production. Energy and fuel using microorganisms.

Unit IV

- Applications of genetically engineered bacteria- production of insulin, vaccines. Degradation of Xenobiotic waste. Removal of oil spills. Biosensors.

Unit V

- Biological risks, biosafety, Bioethics, Intellectual property rights (IPR) and patenting of biological material.