

Syllabus for Microbiology

Section- 'C'

Unit-1

- Classification of microorganisms.
- Purple and green bacteria, Cyanobacteria, Homoacetogenic bacteria, Acetic acid bacteria, Budding and Appendaged bacteria, Spirilla, Spirochaetes, Gliding and Sheathed bacteria, Pseudomonads, Lactic and Propionic acid bacteria, Endospore forming rods and cocci, Mycobacteria, Rickettsias, Chlamydias and Mycoplasmas.
- Archaea- Archaea as earliest life forms, Halophiles, Methanogens, Hyperthermophilic archaea, Thermoplasma.
- Eukarya- Algae, Fungi, Slime molds and Protozoa.
- Morphology and ultrastructure of bacteria.
- Cultivation of bacteria,- Aerobic, Anaerobic. Cultivation, Nutritional types of bacteria.
- Bacteria growth- Culture media, Growth curve.
- Control of bacteria- Physical and chemical agents, Thermal death constant.
- Economic importance of bacteria, algae and fungi.
- General characters of viruses, their morphology and ultrastructure.
- Viruses- Bacterial, Plant, Animal and Tumour viruses, Discovery, classification and structure of viruses. DNA viruses, Positive strand, Negative strand and Double stranded RNA viruses. Replication. Examples of Herpes: Pox Adenoviruses, Retroviruses, Viroids and Prions. Antimicrobial agents.
- Sulfa drugs. Antibiotics- Penicillins and Cephalosporins, Broad spectrum antibiotics. Antibiotics from prokaryotes, Antifungal antibiotics, Resistance to antibiotics.
- Bacteriophages- Organization, Life cycle, Brief details of T-phages and lambda phage.

Unit-2

- Bacterial photosynthesis.
- Respiration metabolism.
- Biochemistry of methyl.
- Extremophiles- Mechanism of adaptation, Types and their applications.
- Structure, Identification and importance of mono-di-and oligosaccharides.
- Polysaccharides viz. starch, amylose, amylopectin, glycogen, cellulose chitin, pectin, agar.

- Blood Groups.
- Secondary metabolites- Isoprenoids, Terpenes, Porphyrins, Lignins. Alkaloids.
- Amino acids- Structure, Classification and Properties.
- Proteins- Structural aspects, Classification based on solubility as well as biological functions, Properties.
- Enzymes as biocatalysts- Classification, Mechanism of enzyme action, Coenzymes and co-factors, Allosterism, Multiple forms, Isozymes, Multienzyme Complexes, Multifunctional enzymes.

Unit-3

- Structure of DNA, RNAs, Nucleotides, Nucleosides, Purine & Pyrimidine bases.
- Prokaryotic and eukaryotic DNA replication Enzymes and accessory proteins involved in DNA replication, DNA repair.
- Transcription in prokaryotes as well as Eukaryotes- RNA polymerases, General and specific transcription factors, Regulatory elements, 5'- capping, Polyadenylation.
- Protein Biosynthesis in prokaryotes as well as eukaryotes, Co-and post-translational modifications, Intracellular protein trafficking.
- Gene editing tools including CRISPR, ZFNs and TALENs.
- Viral and cellular oncogenes; Tumour suppressor genes from humans; Structure, function and mechanism of action of pRB and p53 tumour suppressor proteins.
- Holiday junction, Gene targeting, Gene disruption, FLP/FRT and Cre/Lox recombination, RecA and other recombinases.

Unit-4

- RFLP, RAPD and AFLP analysis, Molecular markers linked to disease resistance genes.
- Gene transfer mechanisms- Transformation, Conjugation and Transduction.
- Bacteriophages- Lytic and lysogenic cycles, Biology of M13 phage.
- Core techniques and essential enzymes used in recombination DNA technology. Restriction digestion, Ligation and Transformation.
- Cloning vectors- Plasmids, Phages and Cosmids.
- DNA sequencing methods.
- Applications of r-DNA technology.

Unit-5

- Microbiology of water and sewage - Aerobic process: activated sludge, Oxidation ditches, Trickling filter, Towers, Rotating discs, Rotating drums, Oxidation ponds. Microbiology of degradation of xenobiotics in environment.
- Ecological considerations, Decay behaviour & degradative plasmids, Hydrocarbons, Substituted hydrocarbons, Oil pollution, Surfactants, Pesticides.

- Methods of purification of water .
- Treatment of domestic and industrial wastes.
- Microbial spoilage of food material, Preservation of food.
- Diseases caused by spoiled food, Mycotoxins, Food poisoning.
- Air microbiology- Microorganisms in air, Air borne human and plant diseases.
- Biotechnology in pharmaceuticals.

Unit-6

- Microorganisms in production of vitamins and beverages.
- Importance of microbes in dairy industry.
- Scope of industrial microbiology.
- Isolation, preservation and maintenance of industrial microorganisms.
- Types of fermentation processes: Analysis of batch, fed-batch and continuous bioreactions, Analysis of mixed microbial populations.
- Bioremediation of contaminated soils and waste land.
- Biopesticides in integrated pest management. Global environment problems: Ozone depletion, UV-B, Greenhouse effect and acid rain, their impact and biotechnological approaches for management.
- Downstream processing: Introduction, Removal of microbial cells and solid matter, Foam separation, Precipitation, Filtration, Centrifugation, Cell disruptions, Liquid- liquid extraction, Chromatography, Membrane process, Drying and Crystallization.

Unit-7

- Industrial production of chemicals: Alcohol (ethanol), Acids (citric, acetic and gluconic), Solvents (glycerol, acetone, butanol), Antibiotics- Penicillin, Streptomycin.
- Secondary metabolites- Various pathways for secondary metabolites viz. alkaloids, phenolics, lignins, terpenoids, flavonoids porphyrins; Importance of secondary metabolites in medicine and agriculture.
- Rare metabolic conversions, Mass balances, Rates and experiments, Models for growth and Product formation.

Unit-8

- Structure, composition and types of cells and organs involved in immune system. Innate and acquired immunity.
- Immunization- Modern methods of producing vaccines, Humoral and cell mediated immune responses.
- Antigens- structure properties and types.
- Immunoglobulins - structure and types.
- Complement - Structure, Components, Properties and Functions.

- Antigen- antibody interaction- in vitro and in vivo methods.
- Classification of medically important microorganisms, Normal microbial flora of human body.
- Modes of spread of infections.
- Classification of pathogenic bacteria.
- Fungal infections- some important types.
- Viral infection- important examples.
- Mycobacteria- Tuberculosis, Non-TB Mycobacteria: leprosy, M. avium.
- Tropical infections - Malaria, Babesia, Trypanosomes.
- Human microbiome and its role in human health.

Unit-9

- Isolation and screening of industrially important microorganisms.
- Inoculums development for industrial fermentation.
- Industrial sterilization processes for media.
- Batch and continuous sterilization and fermentation.
- Optimization and scale up fermentation.
- Detection, analysis and quality control of fermentation product & raw materials.
- Microbial limit test.
- Various types of microscopes including phase contrast and electron microscopes.
- Chromatography- Paper, Thin layer, Ion exchange, Adsorption, Gel exclusion & Gas chromatographies.
- Spectrophotometry- types & applications.

Unit-10

- Measures of central tendency and dispersion: mean median mode, range standard deviation, variance, idea of two types of errors and level of significance, tests of significance (F & t-test) Chi-square test, Standard deviation; Correlation coefficient.
- Probability, Concept of probability theory , Events, Trials, Mutually exclusive events, Favourable events, Exhaustive events, Bayesian theorem of probability, Addition theorem, Multiplication theorem, Binomial distribution, Normal distribution.
- Design of experiments, ANOVA (one-way and two-way), F-test.
- Simple regression and correlation.