Syllabus: Microbiology

Unit 1 Introduction to Microbiology:

History and development of microbiology, Overview of microorganisms: Bacteria, viruses, fungi, protozoa, algae, Scope and importance of microbiology in medicine, industry, agriculture, and environmental science, Classification of microorganisms: Bergey's Manual of Systematic Bacteriology, Microbial diversity, and microbial habitats.

Unit 2 Microbial Cell Biology:

Structure and function of prokaryotic and eukaryotic cells, Cell wall, plasma membrane, and internal structures, Ribosomes, nucleoids, and plasmids in bacteria, Comparative study of prokaryotic and eukaryotic cell organelles, Microbial cell division: Binary fission, budding, and other mechanisms.

Unit 3 Microbial Genetics:

DNA replication, transcription and translation in prokaryotes. Genetic variation in bacteria: Mutation, recombination, transformation, transduction, and conjugation, Plasmids and their role in horizontal gene transfer, Operon concept: Lac operon and Tryp operon, Genetic regulation and control mechanisms in bacteria.

Unit 4 Microbial Metabolism and Physiology:

Metabolic pathways: Glycolysis, Krebs cycle, Electron transport chain, Fermentation, and anaerobic respiration, Bioenergetics: ATP synthesis and energy conservation, Nutritional requirements of microorganisms: Macro and micronutrients, Enzyme function, regulation, and coenzymes in microbial metabolism.

Unit 5 Microbial Ecology:

Microbial interactions: Symbiosis, commensalism, mutualism, and antagonism, Microbial communities and biofilms, The role of microorganisms in nutrient cycles: Nitrogen, carbon, sulfur, and phosphorus cycles, Microbial succession and its impact on ecosystems, Environmental microbiology: Soil, water, and air microbiomes.

Unit 6 Immunology and Microbial Pathogenesis:

The immune system: Innate and adaptive immunity. Immunoglobulins and their role in microbial defense. Pathogenicity and virulence factors in bacteria, viruses, fungi, and Ag 5.46 protozoa. Mechanisms of host-pathogen interactions and immune evasion strategies. Host defense mechanisms: Phagocytosis, inflammation, and complement system.

Unit 7 Microbial Diseases and Diagnostics:

Classification of infectious diseases: Bacterial, viral, fungal, and parasitic. Clinical microbiology techniques: Microscopy, staining, culture methods, and biochemical tests. Rapid diagnostic methods: PCR, ELISA, immunofluorescence, and molecular diagnostics. Antimicrobial resistance: Mechanisms, detection, and prevention strategies. Emerging infectious diseases and their impact on public health.

Unit 8 Industrial and Applied Microbiology:

Microbial fermentation: Production of antibiotics, enzymes, vitamins, alcohol, and organic acids. Microbial biotechnology: Genetic engineering, recombinant DNA technology, and industrial microbiology. Microorganisms in food processing, preservation, and quality control. Bioremediation: Microbial degradation of pollutants and waste treatment. Role of microorganisms in agriculture: Biopesticides, biofertilizers, and soil health.

Unit 9 Microbial Taxonomy and Systematics:

Principles of microbial classification and identification. Methods in microbial taxonomy: Morphological, physiological, biochemical, and molecular techniques. Molecular markers in taxonomy: 16S rRNA gene sequencing, wholegenome sequencing. Phylogenetic relationships and tree of life. Modern approaches in microbial taxonomy: Metagenomics and metatranscriptomics.

Unit 10 Advanced Topics in Microbial Research:

Microbial genomics: Genome sequencing, functional genomics, and proteomics. Transcriptomics, metabolomics, and systems biology approaches in microbiology. Microbial bioinformatics: Tools and databases for genomic and metagenomic data analysis, CRISPR-Cas system and its applications in microbiology. Microbial diversity studies using next-generation sequencing technologies.