

SridevSumanUttarakhand University
Badshahithaul, TehriGarhwal
Syllabus

(B.Sc. Microbiology - Three year course, Semester system)

Marks-Distribution

Theory: 80 marks External, 20 Internal Assessment (80+20 = 100) each paper

Practical: 40 marks end term Practical + 10 Internal (40 + 10 = 50) each semester

B.Sc. 1st Year

Semester I

Paper 1st : Fundamentals of Microbiology - 50

Paper 2nd : Bacteria, Virus and Protozoa - 50

Lab Course: Practical - 50

Semester II

Paper 1st : Algae, fungi & Plant Pathology - 50

Paper 2nd : Microbial Physiology & Biochemistry - 50

Lab Course: Practical - 50

B.Sc. 2nd Year

Semester III

Paper 1st : Microbial Genetics & Molecular Biology - 50

Paper 2nd : Biostatistics, Bioinformatics & Computer - 50

Lab Course: Practical - 50

Semester IV

Paper 1st : Environmental Microbiology - 50

Paper 2nd : Industrial Microbiology - 50

Lab Course: Practical - 50

B.Sc. 3rd Years

Semester V

Paper 1st : Medical Microbiology & Immunology = 50

Paper 2nd : Food & Dairy Microbiology - 50

Lab Course: Practical - 50

Semester VI

Paper 1st : Soil Microbiology - 50

Paper 2nd : Microbial Biotechnology - 50

Lab Course: Practical - 50

SRIDEV SUMAN UTTARAKHAND UNIVERSITY
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Class	Semester	Paper	Marks Distribution		Total Marks
			Theory	Practical	
I Year	I	I. Fundamentals of Microbiology	50	50	300
		II. Bacteria, Virus & Protozoa	50		
	II	III. Algae, Fungi & Plant Pathology	50	50	
		IV. Microbial Physiology & Biochemistry	50		
II Year	III	V. Microbial Genetics & Molecular Biology	50	50	300
		VI. Biostatistics, Bioinformatics & Computer application	50		
	IV	VII. Environmental Microbiology	50	50	
		VIII. Industrial Microbiology	50		
III Year	V	IX. Medical Microbiology & Immunology	50	50	300
		X. Food & Dairy Microbiology	50		
	VI	XI. Soil Microbiology	50	50	
		XII. Microbial Biotechnology	50		

B.Sc. Microbiology (First year)

I Semester

Paper I: General Microbiology

Unit I

History of microbiology, scope and relevance of microbiology, classification of microbial world; bacteria, cyanobacteria, archaea, actinomycetes, fungi, algae and protozoa.

Unit II

Principle, types and application of microscopes, LAF cabinet, autoclave, oven, colony counter, spectrophotometer, pH meter, anaerobic chamber; Principle, basic apparatus and applications of electrophoresis, thermocycler (PCR), centrifuge, blotting, Chromatography & its types.

Unit III

Isolation, cultivation and identification techniques for microorganisms, aerobic and anaerobic cultivation, biochemical methods for identification, culture media & its type, maintenance & preservation of pure cultures.

Unit IV

Study of Morphology of microbes by staining methods –staining, Simple (Leffer's polychrome methylene blue & negative staining) Gram's staining, Ziel-neelson staining, Flurochrome staining, Leishman's staining, Giemsa's staining, special staining methods to demonstrate granules, capsules & spores.

B.Sc. Microbiology (First year)
Paper II :Bacteria,Virus& Protozoa

Unit I

Morphology and ultra structure of bacteria; structure, properties and function of cell wall, cell membranes, flagella, cilia, pili, gas vesicle, chromosomes, carboxysomes, magnetosomes and phycobilisomes, nucleoid.

Unit II

General virology ; nomenclature and classification of viruses, Morphology and ultrastructure, capsids and their arrangements, types of envelopes and their compositions. Viral genome, their types and structures. Virus related organisms (viroids,virusoids and prions).

Unit III

Bacterial viruses : Bacteriophage structural organization, life cycle, one step growth curve, transcription, DNA replication, eclipsed phase, phage production, burst size, lysogenic size, bacteriophage typing, application in bacterial genetics.

Unit IV

Flagellate protozoa : the Mastigophora, ameboid protozoa: the Rhizopoda, ciliate protozoa: the ciliophora. Protozoal disease: malaria, Giardiasis, Trichomoniasis, Toxoplasmosis, Pneumocystis pneumonia and disease caused by Leishmania, Trypanosomes.

B. Sc. Microbiology (First Year)
II semester
Paper III: Algae, Fungi and Plant pathology

Unit I

Algae; General account of habitat, cell structure, pigments, flagellum, reserve food. Conflicts of taxonomic position of Cyanobacteria. Algal growth and reproduction.

Unit II

Cultivation of algae in laboratory. Nitrogen fixation, Biological and economic aspects of algae, algal biotechnology. Fossil records of algae. Algal blooms and eutrophication.

Unit III

Fungi: Habitat, fungal structure and thallus organization, wall structure, hyphal growth, sexual and asexual reproductive structures. Nutrition and reproduction in fungi, Mycorrhiza, lichens, Heterothallism, sex hormones in fungi. Evolutionary tendencies in lower fungi. Economic importance. Fungal diseases.

Unit IV

Concept of plant disease; signs and symptoms associated with microbial plant pathogens. Microbial enzymes, toxins, growth regulators and suppressor of plant defense in plant diseases, effects of pathogens on plant physiology, concept of passive and active resistance and mechanism in plants. Concepts of monocyclic & polycyclic disease, physical, chemical and biological control, integrated eco friendly approach of plant disease control.

B.Sc. Microbiology (First year)
II semester
Paper IV: Microbial Physiology & Biochemistry

Unit I

Enzymes as biocatalyst, enzymes classification, properties. Enzymes kinetics :MichaelisMenton equation for simple enzymes, Effects of pH and temperatures, on enzymes action, enzyme inhibition. Electron carriers, artificial electron donors, inhibitors uncouplers, energy bond and phosphorylation.

Unit II

Microbial metabolism: anabolism and catabolism, energy production in aerobic, anaerobic process and photosynthesis, chemiosmotic hypothesis of ATP synthesis. Bacterial electron transport chain. Autotrophy, Heterotrophy, chemolithotrophy, fermentation. Transport of nutrients by active and passive transport.

Unit III

Respiratory metabolism – Glycolysis, EMP pathway, ED pathway, Glyoxallate pathway, Kreb's cycle-oxidative and substrate level phosphorylation. Reverse TCA cycle – Gluconeogenesis, fermentation and carbohydrates –homo and heterolactic fermentations.

Unit IV

Assimilation of nitrogen –dinitrogen, nitrate nitrogen, ammonia assimilation, synthesis of major amino acids, synthesis of Polysaccharides –peptidoglycan, biopolymers as cell components.

B.Sc. Microbiology (II year)
III semester
Paper 5th: Microbial Genetics & Molecular Biology

Unit I

Nucleic acid as genetic information carrier: Experimental evidence. DNA structure current concepts. DNA replications, general principles and various modes of replications.

Unit II

Gene as a unit, mutation and recombination. Molecular nature of mutations. Mutagenesis. Spontaneous mutation. DNA damage and repair: type of DNA damage (deamination, oxidative damage, alkylation, pyridine dimers). Repair mechanisms – methyl directed mismatch repair, very short patch repair, nucleotide excision repair, base excision repair, recombination repair, SOS system.

Unit III

Gene expression and protein synthesis: Structural features of RNA (rRNA, tRNA, and mRNA) and relation of function. Transcription; general principles, type of RNA polymerases, steps: initiation, elongation and termination. Inhibitors of RNA synthesis. Polycistronic and Monocistronic RNA. Basic features of genetic code. Protein synthesis and its steps: initiation, elongation and termination. Inhibitors of protein synthesis. Gene conversion site specific recombination, transposable elements, insertion sequences, transposons.

Unit IV

Gene transfer mechanisms – Transformations, Transductions, conjugation and Transfection, mechanisms and applications. Plasmids: F factor description and their use in genetic analysis. Bacteriophage: Lytic phages-T4. Lysogenic phage – lambda X174 :uses in microbial genetics.

B.Sc. Microbiology (II year)

III semester

Paper 6th : Biostatistics, Bioinformatics & Computer application

Unit I

Introduction: definition of statistics, the sample and population, statistical inference, parameter and statistics. Measures of central tendency: Mean median, mode and their relationship, standard deviation, chi square test, student's t test and goodness of fit. Probability: Random experiment, events, sample space, independent and dependent events. Probability density functions and its properties. Probability distributions (Basic idea and applications)- Binomial, Poisson and normal.

Unit II

Probability density functions and its properties. Probability distributions (Basic idea and applications)- Binomial, Poisson and normal. Analysis of variance: Analysis of co-variance: Introduction, procedures and tests, multiple comparisons. standard curves; correlation, linear regression (fitting of best line through a series of points), Multiple colinearity. Standard curves and interpolation of unknown Y- values.

Unit III

What is bioinformatics, importance of bioinformatics, Biological database; primary and secondary database. DNA sequence database, DNA sequence analysis, pair wise alignment, multiple sequence alignment.

Unit IV

Computer basics: Component of computer system. Memory: primary and secondary. CPU, Operating system: definition, importance, Disk operating system. Network: Types of network. Local Area Network (LAN), Wide Area Network (WAN), Metropolitan Air Network (MAN). Internet: basic idea.

B.Sc. Microbiology (II year)
IV semester
Paper VII Environmental Microbiology

Unit I

Air pollution: sources, types, effects of pollutants, control measures brief account of air borne transmission of microbe; viruses, bacteria and fungi, their diseases and preventive measures. Aeroallergy and Aeroallergens. Assessment of air quality.

Unit II

Aquatic Microbiology: water ecosystem and its type, marine microorganisms and their importance, Eutrophication, brief account of major water borne diseases and their control measures. Water treatment –wastes types, solid and liquid wastes characterization, Primary secondary , tertiary solid waste treatment, Bioaccumulation, Bioremediation, Bioleaching of copper and uranium.

Unit III

Soil microbiology : classification of soil, physical and chemical characteristics, micro flora of various soil types, brief account of microbial interactions, symbiosis-mutualism, commensalisms, competition, Ammensalism, synergism, parasitism, predation.

Unit IV

Biogeochemical cycles and the microorganisms –carbon, nitrogen, phosphorous and sulfur, Biofertilizers : Vesicular Arbuscular Micorrhizae (VAM); Ecto, Endo, Ectendo Mycorrhizae.

B.Sc. Microbiology (II year)
IV semester
Paper VIII : Industrial Microbiology

Unit I

Isolation of industrially important microbial strains, strain improvement, preservation and maintenance of industrial microbes, scale-up. Criteria used for selection of micro-organisms for fermentation. Growth kinetics of industrially important microorganisms.

Unit II

Fermentation process: Batch, fed – batch and continuous fermentations; solid state and submerged fermentations. Components in a typical bioreactor and types. Maintenance of pH, temperature, dissolved oxygen and aeration.

Unit III

Substrate for industrial fermentation ; Molasses, corn steep liquor, sulfite waste liquor, whey, yeast extract. Detection and assay of fermentation product. Down stream Processing, immobilization & its applications. Antifoams. Mycotoxins with reference to Aflatoxins. Microbial production of industrial products ; citric acid , ethanol ,acetone , penicillin, streptomycin , vitamin B12 , riboflavin , amylase, single cell protein .

Unit IV

Food as a substrate for micro organisms , microbial spoilage of different food – stuffs , principles and methods of food preservation . Microbiology of milk , dairy products and fermented foods . Food – borne diseases.

B.Sc. Microbiology (Third year)
V semester
Paper IX : Medical Microbiology & Immunology

Unit I

Historical background of medical microbiology, Classification of medically important microorganisms, Disease cycle, transmission of pathogen and its routes. Infection and its type. Host parasite relationship, pathogenicity and virulence in relation with bacteria, Virus fungi and parasites.

Unit II

Silent features of the diseases caused by bacteria; Clostridium, Bacillus, Staphylococcus, streptococcus, E.coli, Klebsiella, Salmonella, Pseudomonas, Vibrio, Neisseria, Mycobacteria. Viral disease – Hepatitis, HI, dengue fever, small pox, polio. Protozoan diseases- Malaria & Amoebiasis.

Unit III

Protein toxins – types and disease, early diagnosis and detection of disease by serological methods –RIA, ELISA, complement fixation, agglutination, chemotherapy types and action mechanism of anti microbial assay and drug resistance vaccines interferons.

Unit IV

Immune responses and its types – innate (non specific), acquired (cell mediated and humoral) immunity. Antigens – structure and properties, Immunoglobulin structures properties & functions Antigen – antibody reactions – ELISA, RIA, Agglutination & precipitate Complements structures and functions Major Histocompatibility complex (MHC) Structure and functions. Autoimmunity and hypersensitivity reactions.

B.Sc. Microbiology (Third year)
V semester
Paper X: Food and Dairy Microbiology

Unit I

Microorganisms important in food microbiology- Molds, Yeasts and Bacteria- general characteristics, classification and importance. Asepsis- removal of microorganisms, anaerobic conditions, high, low temperatures, drying; Factors influencing microbial growth –Extrinsic and Intrinsic factors, chemical preservatives and food additives. Heat processing; D, Z, and F values and working out treatment parameters for canned foods; Canning.

Unit II

Initial microflora of raw milk ; Sources of contamination of milk; cheese, acidophilus milk, kefir and yoghurt, Nutritional and therapeutic benefits of fermented milk products; Probiotic foods; Spoilage of fermented dairy products; Quality control in dairy industry.

Unit III

Food borne infections and intoxications; Bacterial diseases with examples of infective and toxic types – Brucella, Bacillus clostridium, Escherichia, Salmonella, Shigella, Staphylococcus, Vibrio, Yersinia, fungi and viruses; Aflatoxins - structures and functions; Food borne outbreaks – laboratory testing procedures; Preventive measures – Sanitation in manufacture; Food control agencies and its regulations, HACCP, ISO standards.

Unit IV

Food fermentations; bread, vinegar, fermented vegetables; prevention and spoilage of cereals, vegetables, fruits, meat and meat products fish and sea products. Foods produced by Microbes – Fermented foods, microbial cells as food (single cell proteins); Mushroom cultivation Industrial enzymes and their uses in food industry – amylases, proteases, cellulases; Oriental foods – Mycoprotein, Tempeh, soya sauce; Traditional foods.

B.Sc. Microbiology (Third year)

VI semester

Paper XI : Soil Microbiology

Unit I

Soil as a habitat for microorganisms; Soil microbes – algae, bacteria, actinomycetes, fungi protozoa and nematodes, Microbial balance in soil. Molecular markers for ecological studies of soil micro organisms.

Unit II

Rhizosphere and rhizoplane micro organisms; reasons for increased microbial activity in rhizosphere. composition of root exudates factors affecting exudation, rhizosphere microorganisms, rhizosphere effect. Factors affecting microbial community in soil-soil moisture, organic and inorganic chemicals. soil organic matter.

Unit III

Organic matter decomposition; Organic matter dynamics in soil- microbial decomposition of cellulose, hemi cellulose, lignin. Factors affecting organic matter decomposition (litter quality, temperature, aeration, soil pH, inorganic chemicals, moisture); Pesticide degradation in soil, effects of pesticides on soil microflora, soil microbial biomass as an index of soil fertility.

Unit IV

Microbial interactions; negative interactions. Ammensalism, competition, parasitism and predation (mycoparasitism, mycophagy, namatophagy – predaceous fungi), commensalism positive interactions – mutualism, synergism, associative symbiosis, cyanobacterial bacterial (Rhizobium legume symbiosis), actinomycetes (actinorrhiza –Frankia non root legume symbiosis) and fungal symbiosis – types and significance of mycorrhiza. Concept of beneficial microorganisms.

B.Sc. Microbiology (Third year)
VI semester
Paper XII : Microbial Biotechnology

Unit I

Biotechnological innovations in the chemical industry, biocatalyst in organic chemical synthesis. Efficiency of growth and product formation, growth stoichiometry, maintenance of energy requirement and maximum biomass yield. P/o quotients metabolites over production and growth efficiency.

Unit II

Shake flask cultures. Fermentation by batch, fed batch and continuous cultures, microbial growth and kinetics; Growth and product formation, heat evolution, effect of environment (pH, Temperature, D_{o2}, high nutrient concentration). Media formulation, kinetics of thermal death of micro organism, batch and continuous sterilization.

Unit III

Fermentor design – stirred tank, airlift fermentor, hollow fiber bioreactor and immobilized cell reactors, Instrumentation and control; Large scale production; Aeration and agitation – oxygen transfer kinetics, Rheology of fermentation broths – concepts of Newtonian, and Non – Newtonian fluids, Plastic fluids, apparent viscosity, foam and antifoam.

Unit IV

Industrial production of antibiotics (β – lactam and rifamycin), citric acid, acetic acid, lactic acid, ethanol, enzymes (pectinase, amylases, lipases, proteases, cellulases). Amino acids (glutamic acid and lysine), vitamins (Riboflavin and cyanocobalamin). Aseptic operation and containment of recombinant organisms.