SYLLABUS

B.Sc. with specialization in Microbiology

Scheme of B.Sc. Semester course

	Semester	**Paper**	**Max Marks**
I Year	I Semester	MB101 Fundamentals of Microbiology and techniques.	70 +30
		MB102: Lab Course I	50
	II Semester	MB201: Biochemistry and Microbial Physiology	70+30
		MB203: Lab Course II	50
II Year	III Semester	MB301: Molecular biology and RDT	70+30
		MB303: Lab Course III	50
	IV Semester	MB401: Food Microbiology & Fermentation technology	70+30
		MB403 Lab Course IV	50
III Year	V Semester	MB501: Enzymology & Immnotechnology	70+30
		MB503: Lab course V	50
	VI Semester	MB601: Environmental Microbiology & Biostatistics	70+30
		MB603: Project Work	50

SEMESTER I

MB101: Fundamentals of Microbiology and Techniques

Unit I

Definition and scope of Microbiology, History of Microbiology – Spontaneous generation Vs Biogenesis. Contribution of scientists; A. Leeuwenhoek, L. Pasteur, R. Koch and E. Jenner. Classification of microorganisms: Three Kingdom and Whittaker's five kingdom system of classification, three domain concept of Carl Woes.

Unit II

Diversity of microbial world – General characteristics of Bacteria; Archaeobacteria, Cyanobacteria, Mycoplasma, Actinomycetes, Fungi (Yeasts & moulds), Protozoa and Viruses. Ultra structure of bacteria, morphological types, cell wall of Archeobacteria, Gram negative & positive bacteria.

Unit III

Growth Kinetics of Bacteria. Nutritional requirements of microorganisms, definition & examples of various types of growth media viz. natural, synthetic, complex, enriched, selective and differential media.. Sterilization; control of microorganisms- Physical and Chemical methods.

Unit IV

Inoculation and transfer techniques – Pure culture technique, Stains and Staining techniques – Simple, Gram's, Acid fast, Capsular, Endospore and Flagellar staining. Methods of preservation of microbial cultures.

Unit V

Microscopic Techniques: principle and applications of Light and Dark field Microscopy Electron microscopy – Transmission and Scanning electron Microscope. Basic principles & applications of pH meter, Colorimeter, Spectrophometer.

MB 102 Lab Course I: Fundamental of Microbiology and Techniques

Practical work:

The practical work will, in general, be based on the prescribed syllabus in theory & the candidates will be required to show the knowledge of the following:

1. Preparation of media, autoclaving and sterilization of glassware.
2. Isolation of phyto- pathogens.
3. Isolation of Microorganisms from soil and water: Bacteria, Fungi and Algae.
4. Purification of microbial cultures.
5. Camera Lucida Drawing.

6. Standard Plate Count.
7. Haemocytometer.
8. Chromatographic techniques: Separation of amino acids by paper and thin layer chromatography.
9. Measurement of pH of fruit juice.
10. Estimation of Protein by colorimeter.

Recommended Books:

1. General Microbiology, Vol. II by Powar and Daginawala, Himalaya publication New Delhi.
2. Microbiology by Pelczar, Reid and chan,Tata Mc graw hill,New delhi.
3. General microbiology by Davis and Harper
4. A Treatise on Media and Methods used in Bacteriological Techniques by Monika Cbrock.
5. Introductory Mycology by C.J. Alexopoulous & Mims, Wiley publication New delhi.
6. Microbiology by P.D. Sharma

SEMESTER II

MB201: Microbial Biochemistry and Physiology

Unit I:

Carbohydrates: Structure, properties & functions of monosaccharide, oligosaccharides & polysaccharides. Lipids; saturated & unsaturated fatty acids.

Unit II :

Structure, properties & functions of amino acids, essential & non-essential amino acids. Proteins; Primary, Secondary and Tertiary Structure. Nucleic Acids: types and function, Structure of nucleic acids – nucleosides, nucleotides, double stranded model of DNA.

Unit III:

Metabolism : ATP Cycle, Photophosphorylation, Oxidative phosphorylation, Substrate level phosphorylation. Major metabolic pathways – Glycolysis, Pentose phosphate pathway, TCA and Glyoxalate cycle.

Unit IV:

Photosynthesis: Photosynthetic bacteria and cyanobacteria, Autotrophic CO_2 fixation and mechanisms of photosynthesis, oxygenic & non-oxygenic reaction centre, Electron transport System, Calvin cycle, Effect of various factors on rate of photosynthesis.

Unit V

Methanogens and Methylotrophs. Sulphur utilizing bacteria. Sulphate reduction pathway, Economic importance of Methylotrophs & sulphur utilizing bacteria.

MB 202 Lab Course I: Microbial Physiology & Biochemistry

The practical work will, in general, be based on the syllabus prescribed in theory. The candidates will be required to show the knowledge of the following:

1 Qualitative estimation of carbohydrates
2 Qualitative estimation of lipids
3 Qualitative estimation of proteins
4 Estimation of glycogen in bacterial cells.
5 Measurement of cellulose activity by viscometric technique.
6 Determination of cellulose and amylase activity by reducing sugar assay test.
7 Measurement of α- amylase activity in extra-cellular fraction of microbial cultures.
8 Estimation of alkaline phosphates activity.

Recommended Books:

1. General MicroBiology by Powar, Himalaya publication New delhi.

2. General Microbiology Vol II by Powar & Daginawala, publication New delhi.

3. Microbial physiology and Biochemistry by Moat.

4. Principles of Biochemistry by Rama Rao

5. Text Book of Biochemistry by O.P. Agrawal

6. Principles of Biochemistry by Lehninger,CBS Publication New Delhi.

7. Biochemistry by Harper,Prentice hall Singapore.

SEMESTER III

MB301: Molecular Biology & Recombinant DNA Technology

Unit I:

Discovery of DNA structure, circular & super helical, DNA - RNA as genetic material,. Concept of gene. Gene transfer mechanisms: Transformation, conjugation and Transduction, DNA Replication – Origin and Mechanism of DNA Replication in prokaryotes & eukaryotes.

Unit II:

Mechanism of transcription: initiation, elongation & termination. Upstream & downstream RNA promoters. Transcription in eukaryotes. Genetic code; Properties of genetic code, Evidence for triplet codon, Wobble hypothesis, Protein Synthesis: mechanism of translation in prokaryotes & eukaryotes.

Unit III:

The Operon: Lac operon, Positive & negative control of transcription. Transposons. Mutation : types of mutation, Molecular basis of mutation, Mutagenesis, Detection of mutants – Ames test, DNA repair mechanisms.

Unit IV:

An introduction of recombinant DNA technology, Cloning vector of rDNA: -Plasmids, Cosmid, Phagmids vector. Enzymes use in Genetic Engineering – Restriction endonucleases, ligases, Alkaline phosphatase, polynucleotide kinase, Taq polymerase, Reverse transcriptase.

UNIT V.

Gene cloning in prokaryotes: Cloning strategies: Construction of genomic libraries and cDNA libraries – Techniques used in RDT- western, northern, and southern blotting. florescent *in situ* hybridization, polymerase chain reaction, DNA finger printing.

MB 302 Lab Course I: Molecular Biology Recombinant & DNA Technology

1. Isolation of DNA

2. Isolation of plasmid DNA

3. Isolation of antibiotics resistant bacteria.

4. Effect of UV radiation on bacterial growth.

Recommended Books:

1 General Microbiology, Vol. II, by Powar and Daginawala ,Himalaya publication New Delhi.
2 Molecular Biology and Biotechnology by H.O. Kumar
3 Elements of Biotechnology by P.K. Gupta,Rastogi publication merut.

SEMESTER IV

MB 401: Food Microbiology & Fermentation Technology

Unit I:

Introduction to microorganisms in food – historical developments. Micro-organisms associated with food, factors affecting growth of micro-organisms in food, Development of Novel Food and food Ingredients: Single cell protein. Importance of microorganisms in dairy industries..

UNIT II:

Contamination & spoilage – cereals, vegetables & fruits, Meat & meat products, milk & milk products, fish & sea foods, Egg & Poultry products, Spoilage of canned foods. Detection of spoilage & Characterization. Food preservation – Principles, Asepsis (anaerobic condition, high temperature, low temperature & drying), Food additives, Canning. Role of radiation in food preservation

UNIT III:

Food borne diseases caused by bacteria viz. Brucella, Bacillus, Clostridium, Escherichia, Salmonella, Staphylococcus, and Vibrio. Ferrmented foods and dairy products (Cheese, Bread, Butter), Vegetable (Sauerkraut). Production of cheese, Butter milk & in bakery industries – leavening of bread, Indian fermented foods.

UNIT IV.
Fermentation equipments and production process. Principal & types of fermenters. The batch fermenters, continuous stirred tank fomenters. Computer control of fermentation process. Strain improvement process. Industrial production of organic acids – Lactic & citric acid.

Unit- V:

Production of alcohol, wine, beer. Production of antibiotics – Penicillin & Streptomycin. Industrial production of vitamins – vitamin B_{12} and Riboflavin. Role of international organization in biotechnology. Government programs for biotechnology development. Hazardous Industrial wastes, Mycotoxin hazards in the production of fungal products.. Patenting of the products in Industries.

MB 402 Lab Course IV: Food Microbiology & Fermentation Technology

Practical:

1 Study of microbial diseases of crop plants.
2 Study of effect of fungicides and insecticides on microorganisms.
3 Study of antagonistic activities amongst microorganisms.
4 Study of fungal contaminants from stored agricultural products.
5 Study of food spoilage microorganisms from sweets and bakery products.
6 Study of effect of the preservatives on the growth of microorganisms.
7 Study of UV radiations on microorganisms.
8 Study of the effect of agrochemicals on soil inhabiting microorganisms.

Recommended Books:

1 Modern Plant Pathology by Bilgramy and Dubey.
2 Food Microbiology by Frazier, Mc graw hill New Delhi.
3 Microbiology by S.S. Purohit, Agrobiosis Jodhpur
4 Microbiology by P.D. Sharma.
5 Industrial Microbiology by L.E. Casida New age publication New Delhi.
6 Fermentation Technology by Whittaker A.ditya book publication New delhi

Semester V

MB501: Enzymology & Immunotechnology

Unit I:

Enzyme: Nomenclature & classification of enzymes. Mechanism of Enzyme action: Enzyme specificity, Active site, Effect of pH, temperature on enzymatic reactions. Coenzymes & Cofactors, substrate enzyme relationship, structure and function of conenzymes ; CoA, NAD/NADP, FMN/FAD, Biotin, Folic acid, vit. B12,

Unit II:

Enzyme Technology : Microbial Production of Industrial enzymes: Cellulase, amylase & protease. Application of enzymes in food & pharmaceutical industries- large scale enzyme extraction, purification & stabilization. Clinical enzymology – Serum enzymes in health and diseases.

Unit III:

History & development of Immunology. Infection: types and sources of infection. Active & passive immunity, Brief introduction to humoral & cellular immunity. Clonal selection theory.

Unit IV.

Antigens: definition and determination of antigenicity. Structure & function of immunoglobulins. Antigen - antibody reaction, Immunological techniques: RIA, ELISA.

Unit V:

Hybridoma techniques: monoclonal antibody production & their applications. Vaccines: types of vaccines, prophylaxis against diseases.

Recommended Books:

1. Biochemistry by Lehninger
2. Enzyme: Biochemistry and Biotechnology Palmer and Trevor
3. Immunology by Kubey.
4. Immunology by G.P. Talwar.

MB502: Practical work:

1. Detection of blood group.
2. Detection of antigen or antibody in serum.
3. Cell counting in blood.
4. Enzyme production by microorganisms.
5. Effect of various parameters viz pH, temperature on enzyme activity.

Semester VI

MB601: Environmental Microbiology & Biostatistics

Unit I:

Soil microorganisms: Types of microbial communities in air, water and soil, microbial diversity: Rhizosphere & phyllosphere. Microbial interaction between microbes – neutralism, commensalism, synergism, mutualism, ammensalism, competition, parasitism and predation. Biogeochemical cycling – Carbon, Nitrogen, Sulphur and Phosphorus.

Unit II:

Microbiology of air and water – Aeromicrobial pathways – Enumeration of bacteria from air. Nitrogen fixation by symbiotic and non-symbiotic microorganisms. Use of microorganisms as biofertilizers. Mass cultivation of *Rhizobium* and *Azotobacter*. Use of blue-green algae as biofertilizers..

Unit III:

Liquid waste disposal. Nature of domestic and municipal waste and sewage. Sewage treatments, Solid waste disposal, Methods of disposal of Agricultural waste. Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Dissolve Oxygen (DO), Bioremediation, Environmental Protection Agency (EPA).

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Unit IV:.

Biodegradation of herbicide & pesticides. Microbial products & plant health: PGPR (plant growth promoting rhizobacteria). Control of plant diseases: Chemical & biological control of plant diseases. Significance of mycorrhizae, toxin producing microbes (antibiotics, aflatoxins etc.), microbial herbicides, and biological control.

Unit V:

Define statistics & its uses. Central tendency: Mean Mode & median. Standard deviation, Standard Error. T- test, Chi square test, Applications of statistical methods in research.

Recommended Books:

1 Introduction to Soil Microbiology by Martin Alexander.
2 General Microbiology by Pelczar, Pied & Chan
3 Biofertilizers in Agriculture by N.S. Subha Rao.
4 Statistics by Mishra & Mishra
5 General Microbiology, Vo. II, by Powar & Daginawala, Himalaya publication New Delhi.
6 Cell Biology by Powar, Himalaya publication New Delhi.

7 General Microbiology, Vol. II, by Powar and Daginawala Himalaya publication New Delhi.

602 :Project Work

To be carried out on a specific defined objective under the supervision of a Teacher the compiled work is to be submitted in the form of dissertation.