

Department of Microbiology

Program Specific Outcomes (PSO)

B.Sc. (Microbiology):

- PSO1: Students completing this course will have understanding of Microbial world
Through courses like History & developments of Microbiology in last three century,
Fundamentals of Microbiology, Food, Agriculture and Applied Microbiology, Medical
Microbiology, Immunology, Genetics & Molecular Biology, Enzymology & Metabolism,
Fermentation Technology etc
- PSO2: Basic Skills of Microbiology will be developed for further studies.

M.Sc. (Microbiology):

- PSO1: Students pursuing this course will develop knowledge of fundamentals & advances in
Microbiology through various branches of Microbiology.
- PSO2: Students will also develop practice of using different Microbiological techniques.
- PSO3: To enrich students' knowledge and train them in the pure microbial sciences
- PSO4: To introduce the concepts of application and research in Microbiology
- PSO5: To inculcate sense of scientific responsibilities and social and environment awareness
- PSO6: To help students build-up a progressive and successful career
- PSO7: Problem solving skills/problem based analysis – reasoning and thinking will be developed.
- PSO8: Knowledge of Microbiological instruments and their applications.
- PSO9: Understanding of different experimental and analytical techniques like microscopy,
spectroscopy, X-ray diffraction, bioinformatics, molecular biology will be developed.

Course Outcomes (CO)

F.Y. B.Sc. Microbiology Term I:

Paper I: Introduction to Microbiology

- CO1: Understand the frontiers in Microbiology
- CO2: Understanding the history of Microbiology.
- CO3: Understand developments in Microbiology during 19th, 20th & 21st century
- CO4: Learn the morphological & differentiating characteristics of Microorganisms & Classification
schemes for Bacteria and Viruses.

Paper II: Basic Techniques In Microbiology

- CO1: Understanding of units of measurements and various microscopic techniques.
- CO2: Understanding of different types of staining techniques for micro-organisms.
- CO3: Understanding of physical and chemical agents for sterilization and disinfection.

Term II:

Paper I: Introduction To Microbiology

- CO1: Understanding of concepts of bonding, pH, Redox potential, chemistry of biomolecules.
- CO2: Understanding of bacterial cytology in detail.

Paper II: Basic Techniques in Microbiology

- CO1: Understanding of nutritional requirements and cultivation techniques of microorganisms.
- CO2: Understanding of Different growth patterns of bacteria.

Practical Course (Term I & II) Microbiology

- CO1: Study of laboratory instruments & preparation of standard operating procedures (SOPs).
- CO2: Understanding of use of compound microscope.

- CO3: Understanding of various staining techniques.
- CO4: Understanding of techniques for cultivation and isolation of microorganisms.
- CO5: Understanding of techniques for preservation of microorganisms.
- CO6: Understanding of normal flora of human body and importance of personal hygiene.

S.Y. B.Sc. Microbiology Term I:

MB211: Bacterial Systematics & Physiology

- CO1: Introduction to bacterial classification (systematics)
- CO2: Understanding the bacterial metabolism and introduction to bioenergetics.
- CO3: Understanding the structure, function and mechanism of enzymes.

MB212: Industrial And Soil Microbiology

- CO1: Understanding basics of Industrial & Soil Microbiology.
- CO2: Understanding of types & design fermenters & fermentation media.
- CO3: Understanding of screening of industrially important microorganisms.
- CO4: Understanding of soil structure, rhizosphere microflora, composting, humus.
- CO5: Understanding of Microbial biofertilisers & their large scale production.
- CO6: Understanding of bio-geochemical – elemental cycles and role of microorganisms.
- CO7: Understanding of degradation of complex plant materials by microorganisms.
- CO8: Understanding of Microbial interactions.

Term II:

MB221: Bacterial Genetics

- CO1: Understanding the molecules of heredity.
- CO2: Understanding the way by which hereditary material is expressed and duplicated.
- CO3: Understanding the types and mechanisms of mutations.
- CO4: Understanding the types, properties of plasmids.

MB222: Air and Water Microbiology

- CO1: Acquire basic concepts of Air flora, air pollution.
- CO2: Understanding of methods of air sampling & air samplers.
- CO3: Understanding of air sanitation and air borne infections.
- CO4: Understanding of types of water, water purification methods, Bacteriological standards for potable water.
- CO5: Understanding of Indicators of faecal pollution of water. Water borne infections, Bacteriological analysis of water.
- CO6: Understanding of analysis of sewage and waste water, industrial water pollution & health hazards, Biomagnification and Eutrophication.
- CO7: Understanding of recycling of waste water and sludge, solid waste management and Biogas technology.

MB223: Practical Course Based on MB 211, 212, 221, 222

- CO1: Experiments to find the microbial flora of air, diversity estimation.
- CO2: To perform the Growth curve of bacteria and plot graph.
- CO3: To investigate the potability of water by bacteriological tests.
- CO4: To characterize the bacteria on biochemical tests & isolate-identify bacteria upto genus level from soil or air.
- CO5: To analysis the water and waste water for BOD, TS & TSS.
- CO6: To screening industrially important microorganisms.
- CO7: To isolate the mutant after induction by UV light & to perform the UV survival curve of bacteria.
- CO8: Visit to Water purification/Sewage/effluent treatment plant & fermentation industry.

T.Y. B.Sc. Microbiology

Term I:

MB331: Medical Microbiology - I

CO1: Understanding of human body systems.

CO2: Understanding of principles and methods of epidemiology.

CO3: Understanding of diseases caused by bacterial pathogens.

MB332: Genetics and Molecular Biology – I

CO1: Understanding of gene linkage and crossing over.

CO2: Understanding of the process of DNA replication.

CO3: Understanding of prokaryotic and eukaryotic transcription.

CO4: Understanding of prokaryotic and eukaryotic translation.

CO5: Understanding of gene manipulation and recombinant DNA technology.

MB333: Enzymology

CO1: Understanding the structure of active site of enzymes and role of cofactors in enzyme catalyzed reactions.

CO2: Understanding the principles and use of assay methods for measurement of enzyme activity.

CO3: Understanding the principles and methods used for enzyme purification

CO4: Understanding the concept of kinetic parameters and their measurements using graphs and the effects of enzyme inhibitors on these parameters.

CO5: Understanding mechanisms of metabolic regulation at enzyme level.

MB334: Immunology – I

CO1: Understanding of Immunity,

CO2: Understanding of Hematopoiesis.

CO3: Understanding of Organs of Immune system.

CO4: Understanding of First, Second and Third Line of defense.

CO5: Understanding of Antigens & their types.

CO6: Understanding of Immunoglobulins – structure, antigenic nature and molecular diversity of antibody.

CO7: Understanding of Humoral and Cell Mediated Immune Response.

CO8: Understanding of Transplantation & Immunity, types of grafts, rejection mechanisms and prevention.

MB335: Fermentation Technology – I

CO1: Understanding of Strain improvement, methods and applications, r-DNA technology.

CO2: Understanding Media Optimization – various methods.

CO3: Understanding Sterilization of Media – principle, methods and applications.

CO4: Understanding Fermentation process scale up & scale down.

CO5: Understanding Methods of Downstream processing – principles and applications.

CO6: Understanding Quality Assurance of fermentation products.

CO7: Understanding Fermentation Economics & IPR.

MB336: Food and Dairy Microbiology

CO1: Understanding of Dairy development in India, milk chemistry and constituents and types of milk, nutritive value of milk.

CO2: Understanding of Microbiology of milk, microorganisms, fermentation & spoilage of milk and Milk borne diseases.

CO3: Understanding of Pasteurization & storage of milk.

CO4: Understanding Microbiological analysis of milk.

CO5: Understanding Food Microbiology, food sanitation, spoilage & preservation of food.

CO6: Understanding Microbial food poisoning and food infections, fermented foods.

CO7: Understanding of Applications of genetically modified microorganism.

Term II:

MB341: Medical Microbiology – II

- CO1: Understanding of principles of chemotherapy.
- CO2: Understanding of diseases caused by parasites.
- CO3: Understanding of diseases caused by *Candida* and other fungal pathogens.

MB342: Genetics and Molecular Biology - II

- CO1: Understanding of methods of gene transfer-transformation, conjugation, transduction.
- CO2: Understanding of causes for DNA damage and mechanisms of DNA repair.
- CO3: Understanding of Recombination and mutants in Bacteriophages.
- CO4: Understanding of tools and techniques in recombinant DNA technology.

MB343: Metabolism

- CO1: Understanding the mechanisms of transport of solutes across the membranes.
- CO2: Understanding the principles of bioenergetics.
- CO3: Understanding the polymerization of biopolymers and their degradation.
- CO4: Study different types of photosynthetic bacteria, their habitats, their photosynthetic apparatus and the mechanisms of photosynthesis.

MB344: Immunology – II

- CO1: Knowledge of MHC & its role.
- CO2: Understanding Cytokines, types and role.
- CO3: Understanding Antigen-Antibody reactions – different techniques & their applications.
- CO4: Understanding Immuno haematology – Blood grouping, Blood banking, medico-legal aspects of blood grouping.
- CO5: Understanding Public health immunology – vaccinations.
- CO6: Understanding Hybridoma Technology, production and application Monoclonal antibody.

MB345: Fermentation Technology – II

- CO1: Understanding SSF & SF.
- CO2: Understanding Primary & Secondary metabolite production on large scale.
- CO3: Understanding large scale production of enzymes, steroid transformation, milk products, yeasts and mushroom.
- CO4: Understanding Vaccines & Immune Sera production on large scale.

MB346: Agricultural and Environmental Microbiology

- CO1: Understanding Agricultural Microbiology, methods of control of plant diseases.
- CO2: Understanding Biochemistry & production of biofertilizers.
- CO3: Understanding Waste water treatment – bioremediation & bioaugmentation.
- CO4: Understanding Bioleaching of ore – role of microorganisms.
- CO5: Understanding Nanobiotechnology.
- CO6: Understanding Environmental monitoring using biosensors and biochips.
- CO7: Understanding biofuel cells & biodegradable plastic.
- CO8: Understanding bioterrorism.

MB347: Practical Course – I Applied Microbiology

- CO1: Experiments for screening of pesticide degrading microorganism
- CO2: Isolate and identify lactic acid bacteria & antifungal activity of LAB .
- CO3: Perform Laboratory scale fermentation of ethanol/citric acid.
- CO4: To perform Quality Assurance tests – Antibiotic/growth factor assays, Sterility testing. MIC & MBC of antimicrobial compounds.
- CO5: To perform Milk & dairy products tests.
- CO6: To prepare bio-inoculants.
- CO7: To isolate and identify *Xanthomonas* spp. and *Aspergillus* spp.
- CO8: To study the plant pathogens.
- CO9: To use biomass for dye removal.
- CO10: To synthesis nanoparticles using microorganisms.
- CO11: Visit to a Dairy/Fermentation industry/Agriculture college and preparation of visit report.

MB348: Practical Course – II Biochemistry and Molecular Biology

- CO1: Orientation to basic biochemical techniques such as to determining the absorption spectra and molar extinction coefficient by using spectrophotometer, making the buffer, chromatographic

technique.

CO2: Qualitative and quantitative estimation of carbohydrates, proteins.

CO3: Orientation to clinical biochemistry in clinical laboratories.

CO4: Understanding the steps used in enzyme production and purification and determination of kinetic parameters.

CO5: Study the isolation of bacteriophages.

CO6: Orientation to basic molecular biology techniques.

CO7: Understanding the functioning of Biotechnology /biochemical institute.

MB349: Practical Course – III Diagnostic Microbiology and Immunology

CO1: Study of human pathogens isolated from clinical samples like urine, stool, pus and sputum.

CO2: Demonstration of permanent slides of parasites.

CO3: Learn to carry out epidemiological survey.

CO4: Understanding of haematological and serological techniques.

CO5: Understanding of functioning of blood bank by visiting it.

M. Sc. I (Microbiology) Semester I:

MB501: Microbial Diversity & Taxonomy

CO1: Students should learn significance of evolution in development of cell (Prokaryotic and Eukaryotic) and organisms.

CO2: Students should understand how to identify and group bacterial, fungal cell by conventional and molecular tools.

CO3: Modern tools and techniques available for identification of uncultivable bacterial cell.

CO4: Use of bioinformatics and functional genomics in taxonomy.

MB502: Quantitative Biology

CO1: 1.08 TC- Descriptive Statistics. This module will help in determining different parameters (like mean, mode, median etc.) of biological data

CO2: 1.09 TC-Testing of Hypothesis – I It will help to clear different concepts of hypothesis.

CO3: 1.10 TC-Testing of Hypothesis – II To use different statistical tests for different type of data produced, their evaluation and interpretation.

CO4: 1.11 TN- Introductory Biostatistics. Understanding of Importance of statistics in Biology, different sampling methods, organization of data and representation.

CO5: 1.12 TN- Probability and Probability Distributions. It will help to solve general problems related to probability.

MB503: Cell Organization and Biochemistry

CO1: 1.15 TC: Problem solving skills can be developed.

CO2: 1.17 TC: Understanding animal biology with developmental biology.

CO3: 1.20 TN: Understanding of different techniques will improve knowledge.

MB511: Practical Course 1: Microbial Diversity & Systematics

CO1: 1.23 PC- Isolation and identification of Eubacteria. To understand methods isolation of mesophiles, thermophiles and actinomycetes.

CO2: 1.24 PC -Isolation and identification of Fungi. To understand methods isolation of yeast and molds.

CO3: 1.25 PC- Isolation and identification of Cyanobacteria. To understand methods isolation of photosynthetic bacteria.

CO4: 1.26 PC-Molecular Taxonomy. To understand isolation of genomic material, amplification and quantification.

CO5: 1.27 PC Research Methodology - I This module will help understanding concept of research, terms related to research, process of publications and writing different scientific communication.

MB512: Practical Course 2: Cell Biology & Biochemistry

CO1: 1.28 Laboratory safety rules and regulations, SOP preparation for Lab instruments.

CO2: 1.29 To quantify and identify Sugar and amino acids from various samples using various methods

CO3: 1.30 To understand developmental stages of higher organisms and cell division.

CO4: 1.31 Use of excel for processing of experimental data.

M. Sc. I (Microbiology) Semester II:

MB601: Instrumentation & Molecular Biophysics

CO1: 2.01 TC: Study of techniques will help in understanding basics.

CO2: 2.02 TC: Study of techniques will help in application of electromagnetic spectrum.

CO3: 2.04 TN: Studies of structure will lead to in-depth knowledge of carbohydrate and Lipids

CO4: 2.06 TN: Techniques of Characterization of nanoparticles will improve technical knowledge.

MB602: Virology

CO1: 2.07 TC- Structure and Replication of viruses. It will prove a good platform for understanding Basic Structure of Viruses and their life cycle

CO2: 2.08 TC- Cultivation and Detection methods for viruses. This module will focus on methods of cultivation of viruses, sampling and detection of viruses in samples. Infectivity assay for animal and bacterial viruses will be helpful to find out titre of viruses.

CO3: 2.09 TC- Nomenclature & Classification systems of viruses. This module will be helpful to classify viruses on the basis of different virus characteristics

CO4: 2.10 TN- Bacteriophages. This module will provide general idea about life cycle of phages including their gene regulation. From this one can develop phage therapies against different pathogens

CO5: 2.11 TN- Viral Therapeutics. This will be an applied module for developing drug against viruses by making any virus specific component as a target.

MB603: Microbial Metabolism

CO1: 2.18 TN- Nitrogen metabolism- This will be an applied module which will provide strategies used by bacteria to fix atmospheric nitrogen, their regulations and application of biological nitrogen fixing bacteria as a biofertilizers.

CO2: Students understand in this course basic metabolic processes of microbes such as enzymes and enzyme kinetics, bioenergetics, electron transport chain, nitrogen metabolism, photosynthesis which can be applied during their research project.

CO3: Students understand in this course basic metabolic processes of microbes such as enzymes and enzyme kinetics, bioenergetics, electron transport chain, nitrogen metabolism, photosynthesis which can be applied during their research project

MB611: Practical Course 1: Biophysics & Virology

CO1: 2.22 PC- Biophysical Instrumentation – I- Calibration and use of spectrophotometer to find molar extinction coefficient of biological molecules

CO2: 2.23 PC- Biophysical Instrumentation – II

CO3: 2.24 PC-Virology (Plant Viruses) to understand the strategies used by plant viruses for leaf infection and study infectivity assay for plant mosaic viruses

CO4: 2.25 PC-Virology (Animal & Bacterial Viruses)- applications in egg inoculation roots, animal virus titer can be determined using hemagglutination assay, Biological assays can be understood for enumeration of phages.

MB612: Practical Course 2: Enzymology & Microbial Metabolism

CO1: 2.27 PC- Purification & Assay of Enzymes. To understand various Protein purification methods and apply them to purify proteins

CO2: 2.28 PC- Isolation and Characterization of Anaerobic Bacteria. To understand the method of Isolation and characterization of Anaerobic Bacteria along with cultivation

CO3: 2.29 PC- Microbial Metabolism-I To understand the method of Isolation and characterization of (as nitrogen fixers) *Azospirillum* and detection of plant growth promoting compounds

CO4: 2.30 PC- Microbial Metabolism-II To understand the method of isolation and characterization of phosphate solubilizing bacteria as well as chitin, cellulose and pesticide degrading bacteria.

CO5: 2.31 PC- Extraction, detection and characterization of aflatoxins. To learn various methods to

identify toxins in food samples and To detect presence toxic compounds in food.

M. Sc. II (Microbiology) Semester III:

MB701: Immunology

CO1: 3.01 TC Cell surface molecules and receptors: Cell to cell networking will be studied in detail. Cytokine role as messengers in the cross-talking of cells. The cytokine mediated Janus Kinase mechanism will be studied with regulation strategies with the help of examples in research papers.

CO2: 3.02 TC Regulation of Immune response: Use of transgenic animals will be discussed with specific

animal model system. In this module, the actual implication of genetically modified animals will be studied with respect of mechanism of immunological tolerance, cytokine therapy in disease control and immune network theory of Jerne.

CO3: 3.03 TC Experimental Immunology: This module will deal with basic techniques of animal tissue culturing to study cellular transformation and quantitative/functional assay for cytokines. It will prove a good platform for understanding the basic concepts and trouble shoot in the animal tissue culture technique.

CO4: 3.04 TN Tumor Immunology: This module will focus on the molecular mechanism of cellular transformation leading to metastasis and how the tumors evolve to escape our immune system. This module will most importantly throw light upon Diagnosis of tumors along with the details of current biochemical and immunological tumor markers in the research field. It will also introduce the advancement in the cancer vaccine therapy and immunotherapy techniques.

CO5: 3.07 TN Immune system evolution: this module will explain the possible linkages in the Functional and structural evolution of immunoglobulin and other immune organs/cells in vertebrates and in-vertebrates.

MB702: Molecular Biology – I

CO1: 3.08 TC: Study of tools in molecular biology better understanding of subject.

CO2: 3.09 TC: Understanding regulation of operons.

CO3: 3.11 TC: Understanding structural arrangement of genome and its characteristics.

CO4: 3.13 TN: Study of tools in molecular biology better understanding of subject.

MB703: Industrial wastewater treatment

CO1: Various ways of treatment of Industrial waste and domestic waste water at Large scale

CO2: Student should able to detect the level pollution of water and carry out remedial measures for reduction of the same

CO3: Use of microbes in solid and liquid waste treatment.

CO4: Solid waste management at Industrial and domestic level.

CO5: Rules and regulation for disposition of waste solid and waste water.

MB711: Practical course based on Immunology, Pharmaceutical Microbiology and Environmental Microbiology

CO1: 3.20 PC Antigen-Antibody Interactions: hands-on training for the tests routinely performed in the pathological laboratories.

CO2: 3.21 PC Cell Culture Techniques: Demonstration of anchorage dependent and independent cell lines is thoroughly given to understand applied research being performed in repositories.

CO3: 3.22 PC Detection and isolation of anti-infectives from plant. It will have applications in finding bioactive compounds and antimicrobial agents from plants.

CO4: 3.23 PC Industrial waste water treatment: To understand of BOD, COD, TS, TSS AND TSS in pollution load of sample.

CO5: 3.24 PC On-site experimentation.

MB-712: Practical Course based on Molecular Biology (I and II) and Microbial Technology

CO1: 3.25 PC Molecular Biology – I Protocol to isolate and purify plasmid from bacterial cells is individually performed and troubleshoot understood.

CO2: 3.26 PC Molecular Biology – II transformation experiment using competent cells is also indigenously performed to understand its application in gene transfer studies widely.

- CO3: 3.27 PC Bioconversion: Applications in immobilisation of biotechnologically important enzyme.
- CO4: 3.28 PC Laboratory scale production: Biocompounds with various applications in industries will help in understanding their properties.
- CO5: 3.29 PC Biosorption: To understand ecofriendly nature of biosorption technique.

M. Sc. II (Microbiology) Semester IV:

MB801: Pharmaceutical and Medical Microbiology

- CO1: 4.01 TC: Understanding of Drug Discovery and Development of lead compounds with clinical trials and phases
- CO2: 4.02 TC- Development of Anti-infectives: it will provide rules of Susceptibility Testing recommended by CLSI
- CO3: 4.03 TC: Studies of Determinants of Microbial Pathogenicity with respect to cellular and molecular responses.
- CO4: 4.04 TN- Discovery of anti-infectives: This will be an applied module for developing drug against bacteria by making any bacterial component as a target for drug
- CO5: 4.07 TN: Application in Epidemiological and investigational approaches for emerging infectious diseases.

MB802: Molecular Biology II

- CO1: 4.08 TC Genomics: This module will focus upon introducing the newest techniques involved in Gene sequencing, DNA imprinting and Epigenetics. The techniques to locate SNPs in diseases and also means of using SNPs in medical therapies.
- CO2: 4.09 TC Gene technology: This will be an applied module which will include the application of Site directed mutagenesis in protein engineering, use of Expression vectors and gene cloning strategies in transgenic plants and animals.
- CO3: 4.10 TC Applications of recombinant DNA technology : Production of Secondary Metabolites: this module is inclusion of latest research in the area of Synthesis of commercial products: Amino acids, ascorbic acid, novel antibiotics, peptide antibodies, biopolymers: gum, rubber, polyhydroxyalkanoates. Unconventional microbial systems for production of high quality protein drugs.
- CO4: 4.11 TN Genetically modified plants and animals: This module will focus on the social and ethical issues of genetically modified organisms and its Applications in medicine for prevention, early detection and cure of diseases. The application of Gene augmentation, gene therapy in agriculture with examples
- CO5: 4.12 TN Bioremediation and biomass utilization: Very useful module in the present era as it deals with degradation of chemically hazardous compounds present in the nature as result of industrial and domestic pollution. Example: Degradation of xenobiotics, engineered degradative pathways and also Utilization of starch and cellulose for fructose, alcohol and silage production

MB803: Microbial Technology

- CO1: 4.18 TN: Applications of fungi in industries.
- CO2: Student learn different parameters of fermenter design and standardization of various fermentation processes for production of fermented product on large scale.
- CO3: Student should be able to design laboratory scale to pilot scale fermenter
- CO4: Basic concept of IPR and patent designing

MB811: Dissertation I

- CO1: Orientation to research methodology – mini research

MB 812: Dissertation II

- CO1: Orientation to research methodology – mini research