

M. Sc., Microbiology Program and Course Outcome.

Program Specific Outcomes

After successful completion of program, students will be able to:

1. Practice safety measures in microbiology by using appropriate protective, biosafety and emergency procedures.
2. Learn microbiological skills and techniques through understanding principle, performing practical and research projects.
3. Describe diversity of microorganisms, bacterial cell structure and function, microbial growth and metabolism, and the ways to control their growth by physical and chemical means.
4. Explain the basic genetic systems of bacteria, bacteriophage and plasmids
5. Contribute to the development of innovative and creative scientific knowledge, technology development and creators of entrepreneurs and self-sustainable individuals.
6. Describe microbial processes that can be used for the development of biochemical and immunological tools to improve the quality of human life.
7. Study the cell biology, biochemistry, growth as well as application of environmentally and industrially important microbes with a specific emphasis on improving environmental sustainability and human health.
8. Understand the concepts of role of microorganisms in bio-geochemical processes like leaching of metals and bioremediation methods.
9. Become efficient microbiologist in food beverages industry, pathology laboratories, microbial testing of any product to certify quality control and assurance.
10. Explain the role of microorganisms in food production and preservation, and their ability to cause food-borne infections.
11. Understand the concept of disease development, spread, control and eradication from society.
12. Document and report on experimental protocols, results and conclusions.

I Semester

Paper Title - MB HC-1.1: Fundamentals of Microbiology

Student Learning Course Outcomes

After successful completion of this course, students will be able to: -

1. Learn about the different fields in microbiology and gain knowledge about the different types of microorganisms and their significance.
2. Learn about theory and practical skills in microscopy and their handling techniques and staining procedures.
3. Learn about prokaryotic and eukaryotic cell structures, nutritional requirement of microorganisms and techniques for microbial growth measurement.

4. Know about various culture media and their applications, cultivation and culture preservation for routine microbiological skill handling.
5. Know the various physical and chemical methods for control of microorganisms along with different methods of disinfection and sterilization.
6. Understand different systems for microbial classification and nomenclature for the study of microbial biodiversity.

Paper Title- MB HC-1.2: Biochemistry and Biostatistics

Student Learning Course Outcomes

After successful completion of this course, students will be able to: -

1. Gain fundamental knowledge on structure, functions and metabolism of biomolecules.
2. Understand the properties of carbohydrates, proteins, lipids, DNA, RNA, glycoproteins, glycolipids and their importance.
3. Compare the types of noncovalent chemical bonds important to bring the stability of biomolecules.
4. Understand the basic concepts of enzyme biochemistry, its kinetics and regulation
5. Articulate and differentiate working principles, instrumentation and applications of various techniques used to analyze properties and structures of biomolecules.
6. Apply the principles of statistics for designing microbiological experiment, statistical analysis, and interpretation of results and get acquainted with basic approach of research methodology.

Paper Title- MB HC -1.3: Microbial physiology and bioinformatics

Student Learning Course Outcomes

After successful completion of this course, students will be able to:

1. Demonstrate significant knowledge and understanding of microbial physiology, metabolism and ecology.
2. Learn about bioenergetics and carbohydrate metabolism
3. Gain knowledge about photosynthesis mechanisms in microorganisms, metabolism of lipids and nitrogenous compounds.
4. Understand secondary metabolism of fungi and bacteria.
5. Gain working knowledge of bioinformatics tools and methods.
6. Critically analyze and interpret results of their study.

Paper Title- MB SC -1.7 (A): Mycology

Student Learning Course Outcomes

After successful completion of this course, students will be able to: -

1. Gain knowledge about distribution of fungi in nature and positive negative impacts of fungi in nature
2. Know the structural and functional diversity of fungi and their mutual relations.
3. Apply the knowledge in fungal taxonomy, bioremediation and bioprospecting of secondary metabolites and industrially important fungal enzymes.
4. State the economic importance of different fungi.
5. Understand mycotoxins and their importance
6. Know about cultivation of mushroom for entrepreneurship.

Paper Title- MB SC -1.7 (B): Principles of Genetics

Student Learning Course Outcomes

After successful completion of this course, students will be able to:

1. History and scope of Genetics
2. To study the laws and concepts of Mendelian inheritance.
3. Understanding the mechanism of sex determination in different organisms.
4. Application of statistical concepts used in health medical science, plants and animal system
5. Describing the chromosomal basis of inheritance and linkage, explaining the environmental influences on gene expression,
6. Describing population structure in terms of genetic variation, evaluating mechanisms that change gene frequencies in populations and applying statistical methods to describe population structure.

II Semester

Paper Title- MB HC -2.1: Microbial Genetics and Molecular Biology

Student Learning Course Outcomes

After successful completion of this course, students will be able to:

1. Explain central dogma of molecular biology (replication, transcription, and translation)
2. Describe the structure and synthesis of DNA and RNA, organization of prokaryotic and eukaryotic genomes.
3. Explain various levels of gene regulation in both prokaryotic and eukaryotic organisms.
4. Explain the concept of mutagenesis, mutation and mutants and their significance in microbial evolution.
5. Explain concepts in DNA repair mechanisms, and recombination as a molecular biology tool, describe transcriptional process and RNA editing.
6. Understand and articulate applications of molecular biology in the modern world.

Paper Title- MB HC -2.2: Medical Microbiology

Student Learning Course Outcomes

After successful completion of this course, students will be able to:

1. Acquire a good understanding of infection process, common diseases caused by bacteria, fungi, viruses and parasites and their stages of infection.
2. Describe various methods that can be adopted to control spread of infection in community, understand various hospital, air and water borne diseases.
3. Understanding about host pathogen interaction, normal micro flora in the human body and sample collection and its analysis.
4. Understand the role of zoonotic infections and emerging infectious diseases.
5. Gain knowledge of various pathogenic strategies, antimicrobial resistance mechanisms and prophylaxis.
6. Gain knowledge about vaccination, screening of various diseases.

Paper Title- MB SC -2.5 (A): Plant Microbe interaction

Student Learning Course Outcomes

After successful completion of this course, students will be able to:

1. Describe the positive and negative interaction between microbes and plants.
2. Understand molecular mechanisms of disease resistance in plants and apply the knowledge to solve problems associated with disease management.
3. Demonstrate detailed understanding of how immune receptors function in the defense of plants against invading microbes.
4. Perform basic experiment that is aimed at studying plant-microbe interactions.

5. Will gain insight into genetics of host-pathogen interactions, resistance mechanism in plants understand physical, chemical & biological methods of disease control
6. Attain knowledge about designing of molecular diagnosis of plant disease and development of transgenic plants with applications and constraints.

Paper Title- MB SC -2.5 (B): Microbial Enzymology

Student Learning Course Outcomes

After successful completion of this course, students will be able to:

1. Gain fundamental knowledge about enzymes and their functions.
2. Demonstrate the enzyme extraction and purification methods.
3. Understanding about the importance of industrially important fermentation products.
4. Elucidate the bioenergetics and microbial metabolic pathways.
5. Demonstrate the properties, and significance of microbial enzymes.
6. Understand the enzyme kinetics, enzyme regulation and applications of isolated enzymes in industry.

Paper Title- MB Open Elective -2.7 (A): Water Microbiology

Student Learning Course Outcomes

After successful completion of this course, students will be able to:

1. Understand the natural microflora in the raw water and outline standard criteria of drinking water
2. Describe the different biological and chemical treatments that should be carried out for drinking water as well as for waste water.
3. Know the different water-related diseases.
4. Gain the knowledge about the risks and hazardous resulting in biofilms.
5. Gain knowledge about the microbiological tests that should be done for drinking water.
6. Understand and learn about various bioreactors and its usage, effluent recycle.

Paper Title- MB Open Elective -2.7 (B): Agriculture Microbiology

Student Learning Course Outcomes

After successful completion of this course, students will be able to:

1. Explain various aspects of agriculture microbiology.
2. Understand the properties of different types of soil and interaction of microbes with plants, insects and microbes itself.
3. Understand importance of biological nitrogen fixation and its mechanism
4. Understand various plant microbe interactions especially rhizosphere, and phyllosphere.
5. Mass production and applications of different biofertilizers like *Rhizobium*, *Azotobacter*, *Azospirillum*, *Frankia* etc..
6. Understand the role of microorganisms in promoting plant growth and their protection from pathogens.

III Semester

Paper Title-MB HC -3.1: Agriculture Microbiology

Student Learning Course Outcomes

After successful completion of this course, students will be able to:

1. Competently explain various aspects of agriculture microbiology and to become familiar with current research in soil and agriculture microbiology.
2. Understand the positive and negative interactions of microbes with plants.
3. Efficient in understanding the different symptoms, epidemiology and management of various plant and seed borne diseases.
4. Understand various plant microbes interactions especially rhizosphere and phyllosphere microorganisms.
5. Understand the role of microorganisms in promoting plant growth and their protection from pathogens.
6. Learning the application of microorganisms as biofertilizers and their mass production techniques.
7. Understand strategy of plant defense mechanism.

Paper Title-MB HC -3.2: Immunology

Student Learning Course Outcomes

After successful completion of this course, students will be able to:

1. Describe the structure and organization of various components of the immune system and their function.
2. Explain about the importance of innate immunity and acquired immunity.
3. Describe the genetic basis for the expression of immune cell receptors and generation of immunological diversity, complement system.
4. Make them understand the salient features of antigen antibody reaction and its uses in diagnostics and various other studies.
5. Learn about immunization and their preparation and its importance.
6. Understand the operation and the mechanisms which underlie the immune response.
7. Well versed with immunity to infectious microbes, hypersensitivity, autoimmune disease, and transplantation immunology.

Paper Title-MB SC -3.5 (A): Immunotechnology

Student Learning Course Outcomes

After successful completion of this course, students will be able to:

1. The basic and general concept of immunotechnology.

2. Basic Understanding of various immunological process like innate and adaptive immunity, cells and organs of immune system, antigen and antibody interaction, immunogenicity and antigenicity, epitopes and antibody structure.
3. Describe the organization of Ig genes, class switching in constant regions of genes and expression and regulation of Ig genes.
4. How B-cell and T-cell are activated and differentiate.
5. Study immune response during allergic reaction, cancer, AIDS and other immunodeficiency diseases.
6. Development of vaccines and molecular diagnostic kits to detect various diseases.

Paper Title-MB SC -3.5 (B): Fermentation technology

Student Learning Course Outcomes

After successful completion of this course, students will be able to:

1. Understand the fermentation processes involved for various products and investigate the applications of various techniques for fermentation products
2. Design a simple containment system of fermenter to be monitored and controlled in fermentation process.
3. Isolate, identify and develop the microbial inoculum for industrial processing.
4. Improve and screen better strains for fermentation.
5. Understand the microbial growth and their role in producing commercial metabolites.
6. Study different types of fermentation media and fermenters used for production of different metabolites.

Paper Title-MB Open Elective -3.7 (A): Diagnostic microbiology

Student Learning Course Outcomes

After successful completion of this course, students will be able to:

1. Explain the isolation of pathogens from clinical samples, develop skills of techniques and procedures commonly used in the clinical microbiology laboratory.
2. Use appropriate safety protocol and laboratory techniques for processing specimens and acquire knowledge of culture techniques appropriate for the primary culture sites.
3. Recognize the expected “normal” flora for each culture site.
4. Understand the importance of Clinical Microbiology laboratory organism isolation and identification in diagnosing and monitoring diseases.
5. Associate selected infectious diseases with appropriate culture requirements and causative agents.
6. Understand the recommended process for identifying unknown pathogens.

Paper Title-MB Open elective -3.7 (B): Industrial Microbiology

Student Learning Course Outcomes

After successful completion of this course, students will be able to:

1. Understand the scope of industrial microbiology
2. Gain knowledge of isolation, maintenance and handling of industrially important microbial cultures in the laboratory.
3. Develop an understanding of fermentation, fermenter design, inoculums, media, their formulation and techniques of sterilization.
4. Gain knowledge about upstream and downstream processes in a fermentation process.
5. Learn the concepts of processes, instruments, management and quality being used in industries to produce the products using microorganisms.
6. Gain knowledge about production and applications antibiotics, vitamins, amino acids, alcoholic beverages, enzymes and organic acids.

IV Semester

Paper Title-MB HC -4.1: Food and Industrial Microbiology

Student Learning Course Outcomes

After successful completion of this course, students will be able to:

1. Gain knowledge of isolation, maintenance and handling of industrially important microbial cultures in laboratory.
2. Gather information regarding microbes causing food intoxications and food-borne infections.
3. Use standard methods and procedures for the microbiological analysis of milk and different food products.
4. Know about the production and evaluation of the quality of starter cultures and fermented food products.
5. Study the characteristics of food-borne and spoilage microorganisms and preventive measures.
6. Acquire knowledge about various industrially relevant microbial products and their production process.
7. Apply the knowledge about the food preservation, food fermentation, food safety, quality control and validation.

Paper Title-MB HC -4.2: Microbial Biotechnology

Student Learning Course Outcomes

After successful completion of this course, students will be able to:

1. Understand the tools, techniques, advantages and disadvantages of genetic engineering.
2. Understand and describe DNA, fingerprinting and its application in forensic science.
3. Understand the methods of production of health related compounds.
4. Understand the applications of biotechnology in agriculture, medicine and environment.
5. Understand the importance of microbial enzymes, their applications, production process and relate biotransformation principles to biotransformation of steroids
6. Understand the production and importance of genetically modified foods.
7. Comprehend the importance of GMO in producing heterologous proteins and the technology used.

Semester IV Paper Title-MB-4.3: Environmental Microbiology

Student Learning Course Outcomes

After successful completion of this course, students will be able to:

1. Overview the till date developments in the field of environmental microbiology with special emphasis on the role of microbes in mitigating environment pollution.
2. Develop the concepts of microbial community structure and role of microorganisms in biogeochemical cycles.
3. Understand the adaptations and biotechnological applications of microbes of extreme environment.
4. Describe the role of soil microbes in nutrient transformation, plant microbe interactions.
5. Describe the role of microbes in solid and liquid waste management, gaining knowledge of various methods employed in sewage treatment and solid waste treatment.
6. Understand the role of microflora in degradation of xenobiotic compounds like petroleum, paper, wood etc., to reduce the load of pollutants in environment as well as emphasis on biofouling and bioleaching to control pollution.

Semester IV Paper Title-MB-4.7: Project work

Student Learning Course Outcomes

After successful completion of this course, students will be able to:

1. Formulate a scientific question.
2. Develop the ability to apply the tools and techniques of microbiology in conducting independent research.
3. List the objectives and state the hypothesis of the research project.
4. Outline the methodology that will be followed to achieve the listed objectives.
5. Employ the finalized methodology to solve the problem which has been undertaken.
6. Analyze the data which has been generated by carrying out several experiments.
7. Create document and report on experimental protocols, results, and conclusions.
8. Present and explain their research findings to the audience effectively.