Department of Microbiology

Programme Outcome:

Upon graduating with honours in Microbiology, the students will be able to acquire, retain and apply specialized concepts and knowledge on the microbial world that will generate scientific approach in them. This will, in turn, enhance their capacity for higher studies in Microbiology in M. Sc., Ph. D. Programmes.

After the completion of graduation in Microbiology honours, the students will acquire practical knowledge on the isolation, culture, identification, classification, preservation and maintenance of microorganisms of different biological samples of different sources that will help them to step into the academic and applied fields of Microbiology.

Students of Microbiology will gather extensive knowledge in laboratory safety and in routine and specialized microbiological skills applicable to clinical diagnosis and research including accurately reporting observations and analyses.

The microbiological programmes will help the students to develop knowledge and skills in basic principles of bacteriology, virology, mycology, immunology, molecular biology, biotechnology, parasitology, industrial microbiology and so on, that will help them in pursuing higher studies and becoming employed in their desired fields.

The graduated students will acquire the activity to effectively function as a team to accomplish a common goal of contemporary importance in the field of Microbiology.

They will be able to interpret scientific concepts, experimental results and analytical arguments,clearly and concisely, both verbally and in writing, that will be required in their future life.

They will develop benchwork skills and become convenient in operating modern instruments and in microbiological techniques that will ease their future academic and research life.

The graduated students will develop interdisciplinary or multidisciplinary scientific aptitude to increase their ability in collaborative work which is essential to solve intricate and unrevealed scientific areas.

Attending seminars, interactive sessions, symposiums, workshops and scientific presentations make them aware of contemporary thrust areas in the field of Microbiology that will give them proper direction to choose their desired career option.

They will become competent and methodical after the completion of this course that will make them eligible for higher education and jobs in various sectors and also develop their entrepreneurship abilities.

Programme Specific Outcome:

Develop a strong foundation on the basic principles of theoretical and practical microbiology.

Develop concepts on the fundamental principles of functioning life in the light of microorganisms.

Understand the evolution of microbes with respect to their genomes including the pathogens and develop insights to study unculturable microbes.

Develop practices for safe handling of microbes and other biomolecules as well as their quantitative and qualitative enumeration.

Understand the distribution of microbes in the various environmental micro-niche as well as their roles in different sectors of human dwellings including food and dairy, agriculture, medicine and other industries

Nurture and inculcate skills to apply microbes and microbial products in various aspects of our everyday life.

Get an exposure in the frontiers areas of biological research involving microbes, biomolecules and sophisticated instrumentations to handle them.

Acquire knowledge about applications of genetic engineering to maneuver microbes and apply them for the benefit of mankind.

Acquire knowledge about the different types of microbe borne diseases in both plants and animals and the defense mechanisms present to resist these challenges.

Course Outcome:

Semester 1		
Course	**Course Outcome**	
CC1 Introduction To Microbiology and Microbial Diversity Theory	CO1	Understanding the history of development of Microbiology as a discipline and the concept of basic microbiology.
	CO2	Gaining knowledge about the diversity of microorganisms and their detailed structures and functions.
	CO3	Understanding the various scopes of microbiology.
CC1 Introduction To Microbiology and	CO1P	Learning about good microbiology practice. Preparation, sterilization of bacterial culture media

Microbial Diversity Practical		Gaining knowledge about the structure of algae, fungi and protozoa.
CC2 Bacteriology	CO1	This course throws the light on the various features of bacterial morphology, cultivation and maintenance techniques of bacteria. This also introduces the diversity of the bacterial and archaeal world.
	CO2	Understanding of bacterial nutrition and growth patterns, use of various different nutrients for reproduction and growth of bacteria.
	CO3	Course introduces use of different trivial and modern techniques to understand taxonomic position in bacterial systematics.
	CO4	Understanding the visualisation technique of microorganisms by magnification of small entities by applying various microscopic techniques Also introduces the modern molecular biological methods in determining bacterial systematic position.
CC2 Bacteriology Practical	CO1 P	Development of technique for cultivation and visualisation of bacteria. Introduction of various staining techniques to apply them on particular requirements.
	CO3 P	Introduction of techniques for purification of single bacterial type from a mixture by commonly followed methods.
Semester 2		
CC3 Biochemistry Theory	CO1	Understanding the basic concepts of thermodynamics with special focus on biothermodynamics and free energy in living cells, its generation and expenditure and develop concepts to solve problems in free energy
	CO2	Understanding the structure, stereochemistry and basis of reactivity of carbohydrates (monosaccharides, disaccharides and polysaccharides), developing insights to understand differences amongst different types of sugars.
	CO3	Learning the major classes of commonly encountered lipids in living cells along with their structure, degree of unsaturation and function as effector molecules of various cellular responses
	CO4	Learning the structure and chemical nature of amino acids as building blocks of proteins, understanding the different components of protein structure and folding and the forces involved therein, obtaining a basic idea about non-ribosomal peptides, their structure and function.
	CO5	Understanding the basis of enzyme classification, developing concepts on mechanism and kinetics of enzyme action in presence and absence of inhibitors and carrying out physicochemical characterisation of a given enzyme.

	CO6	Learning the basics of classification and characteristics of vitamins
CC3 Biochemistry Practical	CO1P	Develop basic concepts to solve numerical problems on acid, bases, buffers, free energy Develop basic concepts to be able to identify a biomolecule on the basis of biochemical tests and learn quantitative estimation of proteins Learn how to carry out physicochemical characterisation of enzymes and determine catalytic parameters. Learn basic concepts of protein modeling.
CC4 Cell Biology Theory	CO1	Understanding the cellular organization, detailed structure of cell wall, cell membrane, mitochondria, chloroplast and their functions.
	CO2	Understanding the detailed structure of nucleus and their role in gene expression.
	CO3	Gaining knowledge about protein sorting and quality control and transport.
	CO4	Understanding the molecular mechanism of cell signaling.
	CO5	Understanding the eukaryotic cell cycle, cell death and cell renewal systems.
CC4 Cell Biology Practical	CO1P	Learning microscopic structure analysis of plant cell, animal cell, cancer cell, stages of cell cycle.
Semester 3		
CC5 Virology	CO1	This course introduces different aspects of viruses like morphology, classification and taxonomic positions of various bacterial and eukaryotic viruses.
	CO2	Understandings of viral cultivation, techniques to assay viral growth and reproduction.
	CO3	Understanding various methods in identifying and characterizing viruses. Application of different viral growth controlling agents.

	CO4	This course throws light on the aspect of viral morphological features, roles of these particular features in infection and transmission of the viruses. Features of viral nucleic acids in viral reproduction are also introduced.
	CO5	Highlights the relation between virus and cancer: roles of particular viral properties in developing oncogenic potential.
CC5 Virology Practical	CO1 P	Understanding the ultrastructural features of viruses by electron micrographs. Identifying the properties involved in viral transmission and infection.
	CO3 P	Learning the technique to isolate and study bacteriophage from a suitable source using probable host bacteria.
CC6 Microbial Physiology & Metabolism	CO1	Understanding microbial growth patterns and growth variations in response to different environmental parameters, their mode of nutrition and energy acquisition.
	CO2	Conceptualize the process of nutrient uptake including important processes like group translocation and iron uptake in microorganisms.
	CO3	Comprehend heterotrophic metabolism with in depth knowledge of aerobic respiration, anaerobic respiration and fermentation.
	CO4	Basic idea on autotrophy-- focusing mainly on microbial aspects . Conceptualize microbial photosynthesis. Ability to differentiate between chemolithotrophy and photolithotrophy and a brief idea on different chemolithotrophic pathways.
	CO5	Understanding important biological processes of nitrogen assimilation and nitrogen dissimilation and the crucial role played by microbes to generate nitrogen balance.
CC7 Molecular Biology	CO1	Knowing the history of elucidation of DNA structure and understanding different structural forms of DNA, topology and renaturation kinetics with development of a conceptual idea on eukaryotic, prokaryotic and organellar genome organization
	CO2	Understanding the fundamental mechanism of DNA replication in eukaryotes and prokaryotes along with different co-replicative and post-replicative damage repair pathways
	CO3	Understanding the fundamental mechanism of transcription in prokaryotes and eukaryotes
	CO4	Understanding the mechanisms of different post transcriptional modification in eukaryotes along with an introduction to the RNA interference mechanisms

	CO5	Understanding the fundamental mechanisms of translation in prokaryotes and eukaryotes
	CO6	Developing key concepts to understand the principle mechanisms of regulation of gene expression in eukaryotes and prokaryotes
CC7 Practical	CO1P	Develop concepts to differentiate between different types and conformations of nucleic acids through micrographs and models. Develop concepts to understand and differentiate between alternative modes of replication. Quantitative estimation of nucleic acids through spectrophotometric/colorimetric methods Learn the techniques of horizontal and vertical gel electrophoresis for visualization of nucleic acids and proteins.
SECA2	CO1	Getting basic concepts on biofertilizer and the role of microorganisms in biofertilizer preparation. Gaining knowledge on isolation, identification and field application of symbiotic nitrogen fixing microorganisms.
	CO2	Gaining knowledge on isolation, identification and field application of non symbiotic nitrogen fixing microorganisms.
	CO3	Gaining knowledge on isolation, identification and field application of phosphate solubilizing microbes
	CO4	A brief idea on Mycorrhizae and their application as Biofertilizers.
	CO5	An insight into the role of microorganisms in controlling different types of pests.
CC8 Microbial Genetics	CO1	Understanding genome organization in microbes and its complexities.
	CO2	Understanding the molecular basis of mutations and knowing about different types of mutations so that their effects can be analyzed in genes and different predictions can be made about the genotypes.
	CO3	A discrete idea on different types of plasmids, principle of their transmission and maintenance inside host cells. Significance of plasmids in medicine and environment.
	CO4	Describe the process of transformation, conjugation and transduction.
	CO5	Map genes by calculating recombination frequency and co transduction of markers.

	CO6	Mention characteristics and components of transposable elements.Explain genetic phenomena, like gene rearrangement, mediated by transposons in bacteria.
CC9 Environmental Microbiology	CO1	Basic concepts of Microbiome: Microbes in terrestrial, aquatic, atmospheric and biological environments. A brief idea on the nature and habitats of extremophilic microorganisms.
	CO2	Understanding the types and effects of microbial interaction with other microbes, plants and animals
	CO3	understanding the mechanisms of various geochemical pathways carried out by soil microorganisms
	CO4	An insight into the role of microorganisms in different waste treatment processes. A brief idea of various stages of wastewater treatment, trickling filter, Activated sludge, Anaerobic treatment of wastewater and sludge.
	CO5	An idea of all harmful xenobiotics and hazardous wastes and to study the role of different microorganisms in controlling the environmental pollutants.
	CO6	Gaining knowledge on different microbiological tests performed to ensure the quality of drinking water.
CC10 Recombinant DNA Technology	CO1	List of different enzymes used in molecular cloning. Select suitable vectors used for cloning different sizes of gene fragments.
	CO2	Describe various methods to successfully deliver DNA to target cells and analyze quality of extracted biomolecules by utilizing important techniques like blotting, microarray and SDS-PAGE.
	CO3	Describe, compare and differentiate PCR, RT-PCR and Real- time PCR.
	CO4	Designing of primers and amplification of DNA fragments in thermocyclers
	CO5	State the principle of traditional and automated sequencing techniques.
	CO6	Describe steps involved in genomic and cDNA library preparation and screening of the gene of interest from the library.

	CO7	Discuss the application of Recombinant DNA technology in therapy, in creating transgenic products, vaccines and protein engineering.
	CO8	Preparation of Competent cells and transforming cells by using pUC plasmids.
SECB1 Food Fermentation Techniques	CO1	Development of the concept of fermentation and fermented foods along with introduction to physicochemical changes during fermentation.
	CO2	Understanding the use of various microbes in fermentation to yield many fermented food and beverages.
	CO3	Throwing light on biochemical and microbiological standards and features of various starting materials like milk, cereals, vegetables etc.
	CO4	Understanding the use of meat, fish, as starting materials and analysing the biochemical changes occurring in the fermentation process.
	CO5	Introduction to quality of probiotics and probiotic potential of some specific fermented foods.
Semester 5		
CC11 Food & Dairy Microbiology	CO1	Describe various intrinsic and extrinsic factors having an impact on food microbiology.
	CO2	State principles of food spoilage and different microbes associated with different categories of foods.
	CO3	Know and apply different food preservation methods for increasing shelf life of food and to prevent quality deterioration of food during storage.
	CO4	Comprehend the benefits of probiotics and the principle behind the preparation of different fermented foods and dairy products with an understanding of their beneficial aspects.
	CO5	Brief idea about packaged food technologies, food processing and food sanitary indices to minimize food intoxication and spoilage.
	CO6	Differentiate between food infection and intoxication. Isolate spoilage microorganisms from food using different selective media.

	CO7	Mention causative organisms and symptoms associated with important food borne diseases and strategies to control and minimize their occurrence.
CC12 Industrial Microbiology	CO1	Knowledge about the brief history and developments in industrial microbiology
	CO2	Understand the suitability of microbes in industrial processes. Knowledge of isolation of industrially important microbial strains from natural sources, strain improvement for better product formation. Selection and formulation of fermentation media for optimum microbial growth
	CO3	Basic concepts of types of fermentations and different bioreactors depending on the state of the fermentation processes. Knowledge on different physicochemical parameters need to be optimized during the fermentation process.
	CO4	Knowledge on post fermentation recovery and purification of the desired product using different techniques.
	CO5	Economic aspects of fermentation processes product optimization, and Applications of the following: Citric acid, ethanol, penicillin, glutamic acid, Vitamin B12 Enzymes (amylase, protease, lipase) Wine, beer
	CO6	Basic concept on the different methods of enzyme immobilization, their pros and cons and their industrial application.
DSEA2 Advances in Microbiology Theory	CO1	Understanding the principle differences in evolution of bacterial genome in comparison to evolution of an eukaryotic genome. Learning the salient features of sequenced microbial genome, pan genome, genome pool, horizontal gene transfer and their relation with pathogenicity.
	CO2	Develop a concept on metagenomics, metatranscriptomics, metaproteomics, and metabolomics.
	CO3	Understanding the knowledge of host-microbe interactions and their significance in environment, health.
	CO4	Learning the basic concept of networking in biological systems and quorum sensing in bacteria.

DSEA2 Advances in Microbiology Practical	CO1P	Learning the extraction method of DNA from soil and probable impediments in extracting the metagenomic DNA and PCR amplification of soil metagenomic DNA for prokaryotic and eukaryotic species detection.
DSEB1 Inheritance Biology Theory	CO1	Conceptualize the term model organisms and understanding the attributes on the basis of which model organisms were chosen for biological research
	CO2	Learning the principles of Mendelian and Non-mendelian inheritance including the different forms of extra-nuclear inheritance and developing concepts on linkage and crossing over
	CO3	Understanding the structural organization of prokaryotic and eukaryotic chromosomes, learning the key concepts of chromosome banding and developing knowledge on structural and numerical abnormalities and associated disorders.
	CO4	Learning the basic concepts of homologous and non-homologous recombination including transposition
	CO5	Learning the basic principles of human genetic analysis and probing genetic diseases
	CO6	Understanding the key concepts of Quantitative Genetic Analysis
DSEB1 Practical	CO1P	Learning how to study Barr body and polytene chromosomes under microscope along with the basic principles of karyotyping through photograph based demonstration
	CO2P	Learning problem solving in chi-square analysis and human pedigree analysis
Semester 6		
CC13 Immunology Theory	CO1	Learning the history of development of the discipline of Immunology along with landmark works in the fields of cellular and humoral immunity by pioneer scientists

	CO2	Learning about the cells and organs involved in generation of immune response in the body
	CO3	Developing concepts to understand basic characteristics of antigenicity and the two alternative antigen processing pathways
	CO4	Understanding the basic structure of antibody and mechanisms for generation of antibody diversity and self, non-self-discrimination.
	CO5	Understanding the different complement mediated pathways for neutralization of antigens
	CO6	Understanding the differences between primary and secondary immune response, mechanisms of killing by cytotoxic T lymphocytes and NK cells and gaining fundamental concepts on immune tolerance
	CO7	Understanding the basic principles of hypersensitivity and autoimmune disorder and gaining preliminary knowledge on the causes and types of tumor as well as cancer therapy
	CO8	Learning the fundamental principles of different immunological techniques including agglutination/precipitation based different quantitative and qualitative antigen-antibody interactions.
CC13 Practical	CO1P	Learning the techniques of enumeration of different hematological parameters including identification of blood groups. Learning different precipitation based techniques of Antigen-antibody interaction
CC14 Medical Microbiology Theory	CO1	Gaining knowledge of normal microflora of the human body and their importances and understanding the host pathogen interactions in development of various types of infections.
	CO2	Learning of principles of different diagnostic tests, collection, transport and culturing of clinical samples.
	CO3	Gaining knowledge of bacterial diseases of various organ systems and their causative agents.
	CO4	Gaining knowledge of viral diseases of various organ systems and their causative agents.
	CO5	Gaining knowledge of fungal diseases of various organ systems and their causative agents.

	CO6	Gaining knowledge of protozoan diseases of various organ systems and their causative agents.
	CO7	Understanding the concept of antimicrobial agents, their general characteristics and mode of actions.
CC14 Medical Microbiology Practical	CO1P	Gaining knowledge of identification of basic laboratory bacterial strains based on their morphology, biochemical and cultural characteristics, normal bacterial flora in skin by swab method and understanding the antimicrobial activity of any antibiotics by minimal inhibitory concentration and disk diffusion method.
DSEA3 Plant Pathology	CO1	Knowledge regarding plant pathology, economic losses and social impact of plant diseases.
	CO2	A brief idea on different stages in development of a disease
	CO3	Study on epidemiology of plant diseases
	CO4	Understanding the virulence factors of different types of plant pathogens and plant defense mechanisms against those pathogens.
	CO5	Concept on the principles & different practices involved in the management of plant diseases.
	CO6	Detailed study of some important plant diseases caused by bacteria, fungi and virus having economical importance
DSEB3 Instrumentation & Biotechniques	CO1	Understanding theoretical concepts of various biologically applicable instruments and techniques like microscopy,chromatography, electrophoresis, sedimentation and spectrophotometry.
	CO2	Introduction to relation and application of the techniques to understand biological phenomena like visualisation of microbes, purification of biological macromolecules, identification, characterisation of macromolecules.
	CO3	Introduction of the analyses and understanding the data obtained from application of the techniques in real situations working with biological samples.
	CO4	Comparison of application of different techniques to understand properties of biological samples and deciphering the characters of those.

DSEB3 Instrumentation & Biotechniques Practical	CO1 P	Understanding the use of instruments and techniques involving microscopy, electrophoresis in identification of biological macromolecules.
	CO2 P	Introduction of use of techniques like chromatography, sedimentation. Spectrophotometry in analysing standard biomolecules.
	CO3 P	Understanding various analytical methods to apply the biotechniques in characterisation of various biomolocules.