

P. R. Thakur Government College

Department of Microbiology Course Outcome

Semester I (H)			
Course Code	Paper Title	Unit No.	Course Outcome
MCBACOR01T	Introduction to Microbiology and Microbial Diversity (Theory)	Unit 1 History of Development and scope of Microbiology	<ol style="list-style-type: none"> 1. To have a basic overview of the developmental history of Microbiology and the contributions made by different renowned scientists. 2. Understand the scopes and their opportunities of Microbiology in different fields.
		Unit 2 Microscopy: Basic principles & application	Define basic terms and understand principles of microscopy, recognize, illustrate and label various structural components of microscope and relate structure with function.
		Unit 3 Diversity of Microbial World A. Systems of classification. B. General characteristics of different groups:	<ol style="list-style-type: none"> 1. To understand the basic classification system and general characteristics of prokaryotic and eukaryotic microbes. 2. Able to place a specific microorganism in the Universal Phylogenetic tree. 3. To understand the details of microscopic fungal, algal and protozoan characters, body structures and life cycles.
MCBACOR01P	Introduction to Microbiology and Microbial Diversity (Practical)		<ol style="list-style-type: none"> 1. To have a basic overview of good laboratory practices of Microbiology. 2. To understand the basic working principle of different instruments used in Microbiology. 3. Able to learn the staining technique of fungi. 4. To enumerate and determine microbes and their cellular morphology. 5. Able to prepare culture media for cultivation of fungi.

Semester I (H)			
Course Code	Paper Title	Unit No.	Course Outcome
MCBACOR02T	BACTERIOLOGY (Theory)	Unit 1 Cell organization	To have an insightful understanding about the morphology and structure of Prokaryotic (bacterial and archaeal) cells.
		Unit 2 Bacteriological techniques	State nutritional requirements, different types of culture media and growth of bacteria.
		Unit 3 Staining methods	Learn different (both simple and differential) types of staining techniques of bacterial and fungal cells.
		Unit 4 Microbial Growth and Effect of Environment on Microbial Growth	<ol style="list-style-type: none"> 1. To understand the effect of environment on microbial growth. 2. To understand the nutritional requirements, different types of culture media and growth of bacteria.
		Unit 5 Important archaeal and eubacterial groups	<ol style="list-style-type: none"> 1. Able to learn the general characteristics, phylogenetic overview and important features of archaeal and bacterial groups. 2. Compare the different groups of archaea and bacteria.
MCBACOR02P	BACTERIOLOGY (Practical)		<ol style="list-style-type: none"> 1. To Cultivate bacteria under laboratory conditions and learn the staining techniques. 2. To understand the basic working principle of different instruments used in Microbiology. 3. Able to isolate pure culture of bacteria. 4. To enumerate and determine microbes.

Semester II (H)			
Course Code	Paper Title	Unit No.	Course Outcome
MCBACOR03T	BIOCHEMISTRY (Theory)	Unit 1 Bioenergetics	To understand the basic of thermodynamics and energy molecules
		Unit 2 Carbohydrates	1. To understand the basic structures and characteristics of carbohydrates. 2. Able to compare different type sugars and their properties.
		Unit 3 Lipids	Know about the basic structures and characteristics of lipids.
		Unit 4 Proteins	To understand the structural and functional details of proteins.
		Unit 5 Enzymes	1. To have the knowledge of structure and nomenclature of enzymes. 2. Gain profound knowledge about the mechanisms of action of enzymes and the effect of various factors on enzyme activity.
MCBACOR03P	BIOCHEMISTRY (Practical)		1. To identify different biomolecules by qualitative and quantitative analyses. 2. To understand the enzyme kinetics. 3. To study the effect of the effects of temperature, pH and heavy metals on enzyme activities.

Semester II (H)			
Course Code	Paper Title	Unit No.	Course Outcome
MCBACOR04T	ENVIRONMENTAL MICROBIOLOGY (Theory)	Unit 1 Microorganisms and their Habitats	1. To understand the environmental aspects of microbial sustainability. 2. To have the knowledge about the distribution pattern of certain species of microorganisms in various different places of human body as well as the environment. Know about the microbial association with plants and animals
		Unit 2 Microbial Interactions	1. Know about the microbial association with plants and animals. 2. Able to know and compare different type interactions between micro-organisms and macro-organisms also among the microorganisms.
		Unit 3 Biogeochemical Cycling	Learn about the principles of microbial ecology, illustrate, compare and contrast the biogeochemical cycles and their significance.
		Unit 4 Waste Management	To understand the different type and level of modern and advanced techniques of waste management.
		Unit 5 Microbial Bioremediation	Gain profound knowledge about the beneficial role of microbes and their usage for the remedial purposes of the environment.
		Unit 6 Water Potability	To have the idea of the quality control techniques for drinking water
MCBACOR04P	ENVIRONMENTAL MICROBIOLOGY (Practical)		1. Able to isolate microbes and detect microbial enzymes from different soil sources. 2. Able to isolate microbes from rhizosphere and phyllosphere. 3. To understand the microbiological quality of water from different sources.

Semester III (H)			
Course Code	Paper Title	Unit No.	Course Outcome
MCBACOR05T	MICROBIAL PHYSIOLOGY AND METABOLISM (Theory)	Unit 1 Nutrient uptake and Transport	Learn about the basics of microbial nutrient uptake and transport and their significance.
		Unit 2 Chemoheterotrophic Metabolism - Aerobic Respiration	To understand and analyse the types of aerobic respiration in microbes.
		Unit 3 Chemoheterotrophic Metabolism- Anaerobic respiration and fermentation	1. To understand and analyze the types of anaerobic respiration in microbes.
		Unit 4 Chemolithotrophic and Phototrophic Metabolism	1. Analyse and explain the basic of catabolism and anabolism of microorganism, specifically, chemolithotrophic and phototrophic microorganism.
		Unit 5 Nitrogen Metabolism - an overview	To have an overview about the nitrogen metabolism the environment.
MCBACOR05P	MICROBIAL PHYSIOLOGY AND METABOLISM (Practical)		1. Able to estimate the effects of pH, temperature, carbon and nitrogen sources on a specific model bacteria, E.coli 2. Able to demonstrate alcoholic fermentation in the laboratory using normal substrates.

Semester III (H)			
Course Code	Paper Title	Unit No.	Course Outcome
MCBACOR06T	CELL BIOLOGY (Theory)	Unit 1 Structure and organization of Eukaryotic Cell	To understand the structural and functional aspects of different components of eukaryotic cells.
		Unit 2 Nucleus	To understand the details of nuclear organization.
		Unit 3 Basics of Protein Sorting and Transport	Gain advanced knowledge of the basic mechanisms of protein sorting and transport in living cells.
		Unit 4 Introduction to Cell Signaling	1. To have a basic overview on the components involved, molecular mechanism and importance of cell signaling both in microbial and eukaryotic system.
		Unit 5 Cell Cycle	1. To have a basic idea on cell cycle regulation, cancer biology and stem cell biology. 2. Able to know about apoptosis and necrosis.
MCBACOR06P	CELL BIOLOGY (Practical)		1. To study the structure of cell organelles. 2. Able to identify the different phases of eukaryotic cell division and compare and contrast mitosis and meiosis. 3. Able to perform the cytochemical staining technique of DNA.

Semester III (H)			
Course Code	Paper Title	Unit No.	Course Outcome
MCBACOR07T	MOLECULAR BIOLOGY (Theory)	Unit 1 Structures of DNA and RNA / Genetic Material	1. To understand the basic structure and organization of nucleic acids. 2. To learn about the structures of DNA and RNA, compare different forms of DNA.
		Unit 2 Replication of DNA (Prokaryotes and Eukaryotes)	1. To understand eukaryotic and prokaryotic replication mechanisms with the enzymes involved. 2. Able to compare eukaryotic and prokaryotic replication.
		Unit 3 Transcription	1. To understand eukaryotic and prokaryotic transcription mechanisms with the enzymes involved. 2. Able to compare eukaryotic and prokaryotic transcription.
		Unit 4 Basic concept of Post-Transcriptional Processing	1. To understand the basic ideas of post-transcriptional processing. 2. Learn about various molecules (with their significance) involved in post-transcriptional processing.
		Unit 5 Translation	1. To have the knowledge of eukaryotic and prokaryotic translation. 2. Able to compare and contrast between eukaryotic and prokaryotic translation.
		Unit 6 Regulation of gene Expression	To have the knowledge about molecular mechanism of regulation of gene expression in prokaryotic and eukaryotic.
MCBACOR07P	MOLECULAR BIOLOGY (Practical)		1. Able to measure DNA and RNA through quantitative analysis. 2. Able to isolate, visualize, purify the genomic DNA. 3. To purify the isolated DNA and visualize both DNA and protein through different gel types

Semester III (H)			
Course Code	Paper Title	Unit No.	Course Outcome
MCBSSEC01M	FOOD FERMENTATION TECHNIQUES	Unit 1 Fermented Foods	To understand different types fermented foods and their benefits.
		Unit 2 Milk Based Fermented Foods	Gain profound knowledge about the preparation of inoculums, types of microorganisms involved and production process of milk based fermented foods.
		Unit 3 Grain Based Fermented Foods	To understand the preparation of inoculums, types of microorganisms involved and production process of grain based fermented foods.
		Unit 4 Vegetable Based Fermented Foods	To know about the preparation of inoculums, types of microorganisms involved and production process of vegetable based fermented foods.
		Unit 5 Fermented Meat and Fish	To understand the involvement of microorganisms in meat and fish based fermented foods.
		Unit 6 Probiotic Foods	To have a knowledge about different beneficial health aspects of probiotics.

Semester IV (H)			
Course Code	Paper Title	Unit No.	Course Outcome
MCBACOR08T	MICROBIAL GENETICS (Theory)	Unit 1 Genome Organization, Mutation & DNA repair	1. To study the genomic organization of different organisms as well as brief idea of mutation and different kinds of agents causing mutation (mutagens). 2. To understand the effects of molecular mutagens on microbial cells and mechanisms of DNA repair.
		Unit 2 Plasmids	1. To learn about the type and characteristics of plasmid. 2. Able to know about regulation of copy number, curing of plasmids.
		Unit 3 Mechanisms of Genetic Exchange	Know about extrachromosomal inheritance of microbial cells and the advantages to inherit those molecules.
		Unit 4 Transposable elements	To understand the transposable genetic elements of microbial cells and the mechanism of transposition.
MCBACOR08P	MICROBIAL GENETICS (Practical)		1. To understand the preparation of master and replica plates. 2. To understand the effect of the exposure of UV (as a mutagen) on bacterial cells through the survival curve as well as standard methods. 3. To know the process to isolate and visualize different plasmids. 4. To have the ideas about bacterial genetic exchange through different methods.

Semester IV (H)			
Course Code	Paper Title	Unit No.	Course Outcome
MCBACOR09T	VIROLOGY (Theory)	Unit 1 Nature and Properties of Viruses	1. To understand the basic properties, diversity, architecture, classification and nomenclature of viruses.
		Unit 2 Bacteriophages & phage genetics	1. To understand the basic ideas and life cycle regulation of bacteriophages. 2. Able to know about mechanism of viral entry and multiple mode of multiplication in host cells.
		Unit 3 Viral Transmission, Salient features of viral nucleic acids and Replication	To understand the viral transmission and genomic variations as well as multiplication and replication strategies of viruses.
		Unit 4 Viruses and Cancer	To understand the basic ideas oncogenic virus and their pathophysiology.
		Unit 5 Prevention & control of viral diseases	1. To understand the basics of treatment against viral diseases.
MCBACOR09P	VIROLOGY (Practical)		1. Able to isolate and enumerate bacteriophages.

Semester IV (H)			
Course Code	Paper Title	Unit No.	Course Outcome
MCBACOR010T	FOOD & DAIRY MICROBIOLOGY (Theory)	Unit 1 Foods as a substrate for microorganisms	1. To understand the significance and activities of microorganisms in food. 2. To understand the role of intrinsic and extrinsic factors on growth and survival of microorganisms and attain information on microbial food spoilage..
		Unit 2 Microbial spoilage of various foods	1. To understand the principles, spoilage of vegetables, fruits, meat, eggs, milk and butter, bread, canned Foods.
		Unit 3 Principles and methods of food preservation	1. To understand principles, physical and chemical methods of food preservation.
		Unit 4 Fermented foods	Able to analyze various types of starter cultures, fermented milk products, probiotics, SCP and edible mushrooms.
		Unit 5 Food borne diseases	To have the knowledge of food intoxications and food infections.
		Unit 6 Food sanitation and control	1. To have the basic ideas related to control microbiological quality of foods and the quality systems. 2. To have the knowledge about food sanitary quality and sanitizers.
MCBACOR010P	FOOD & DAIRY MICROBIOLOGY (Practical)		1. Able to perform MBRT of milk samples and their standard plate count. 2. Able to check the efficiency of pasteurization of milk by Alkaline phosphatase test. 3. Isolate food borne bacteria from food products. 4. Isolate spoilage microorganisms from spoiled vegetables, fruits and bread.

Semester IV (H)			
Course Code	Paper Title	Unit No.	Course Outcome
MCBSSEC02M	MICROBIOLOGICAL ANALYSIS OF AIR AND WATER	Unit 1 Aeromicrobiology	1. Understand the concept of Bioaerosols, fate of Bioaerosols and different inactivation mechanisms of Bioaerosols. 2. To understand different types of airborne microbes and their impacts on the environment and human health.
		Unit 2 Air Sample Collection and Analysis	To study different methods for the collection and analyses of microbes from air.
		Unit 3 Control Measures	To have a knowledge to control airborne microbes through different physical methods.
		Unit 4 Water Microbiology	To know about the water borne pathogens and water borne diseases.
		Unit 5 Microbiological Analysis of Water	To understand the different methods for the collection and analyses of microbes from water.
		Unit 6 Control Measures	To have a knowledge to control waterborne microbes through different physical methods.

Semester V (H)			
Course Code	Paper Title	Unit No.	Course Outcome
MCBACOR011T	INDUSTRIAL MICROBIOLOGY (Theory)	Unit 1 Introduction to industrial microbiology	To understand the history and developments in industrial microbiology.
		Unit 2 Isolation of industrially important microbial strains and fermentation media	1. To understand the various physical and chemical requirements to isolate and maintain industrially important microbes. 2. Know the concepts of inoculum development and media sterilization for fermentation process.
		Unit 3 Types of fermentation processes, bio-reactors and measurement of fermentation parameters	1. Understand the basics of fermentation technology, screening techniques, microbial culture preservation techniques. 2. Learn about the typical structure of fermenter and its parts, types of fermentation processes and synchronous growth.
		Unit 4 Down-stream processing	To understand the different downstream techniques in industries.
		Unit 5 Microbial production of industrial products	To have the knowledge of the methods implemented in the industry to get specific fermentation products e.g., ethanol, citric acid, vit.B12, penicillin, amylase, wine.
		Unit 6 Enzyme immobilization	To have the idea of enzyme immobilization and its recovery in industries.
MCBACOR011P	INDUSTRIAL MICROBIOLOGY (Practical)		1. Able to perform Microbial fermentations for the production and estimation of ethanol, citric acid, amylase. 2. To experience the industrial fermentation and other downstream processing operations by visit to any industry.

Semester V (H)			
Course Code	Paper Title	Unit No.	Course Outcome
MCBACOR012T	IMMUNOLOGY (Theory)	Unit 1 Introduction	To understand the basic concepts of immunology, properties of immune system and types of immunity.
		Unit 2 Immune Cells and Organs	To understand the types, structures and functions of immune cells and organs in human body.
		Unit 3 Antigen	1. Learn the definition and characterizations of antigen and immunogen. 2. Distinguish and characterize antibody isotypes, development, and functions.
		Unit 4 Antibodies	To understand the different characters and aspects of antibody.
		Unit 5 Major Histocompatibility Complex	Gain the brief idea of major histocompatibility complex as well as antigen processing and presentation.
		Unit 6 Complement System	1. To have the basic ideas related to components of the complement system. 2. To have the knowledge about three main pathways and biological consequences of complement activation.
		Unit 7 Generation of Immune Response	1. To understand the basic ideas about generation of immune response. 2. Compare and contrast the innate versus adaptive immune systems and humoral versus cell-mediated immune responses.
		Unit 8 Immunological Disorders and Tumor Immunity	1. To have the knowledge about immunological disorders like Autoimmunity and Hypersensitivity 2. To understand about different immunodeficiencies and cancer immunology and therapy
		Unit 9 Immunological Techniques	Gain a profound knowledge on different modern immunological techniques like ELISA, ELISPOT, western blotting, precipitation, agglutination, flow cytometry.
MCBACOR012P	IMMUNOLOGY (Practical)		1. Able to detect human blood groups. 2. Able to perform Single Radial Immuno Diffusion, Immunoelectrophoresis. 3. Able to perform Immunodiffusion by Ouchterlony method. 4. Able to demonstrate DOT ELISA.

Semester V (H)			
Course Code	Paper Title	Unit No.	Course Outcome
MCBADSE01T	ADVANCES IN MICROBIOLOGY (Theory)	Unit 1 Evolution of Bacterial Genomes	To understand the basic concept of bacterial genome evolution, horizontal gene transfer and evolution of bacterial.
		Unit 2 Metagenomics	1. To learn about the Development of metagenomics. 2. To understand the bacterial diversity using metagenomic approach. 3. Gain basic knowledge of viral metagenome, metatranscriptomics, metaproteomics and metabolomics.
		Unit 3 Molecular Basis of Host-Microbe Interactions	1. To know about the virulence factors of pathogens. 2. To understand growth regulators and disease development of pathogens. 3. To gain intense knowledge on biofilms.
		Unit 4 Systems and Synthetic Biology	1. To understand about networking in biological systems. 2. To have a brief idea about of synthetic biology with respect to bacteria and viruses.
MCBADSE01P	ADVANCES IN MICROBIOLOGY (Practical)		1. Able to extract and purify genomic DNA from E.coli by phenol chloroform method. 2. Able to perform PCR amplification by using suitable DNA. 3. Able to isolate of antibiotic resistant bacteria from soil and study of multiple antibiotic resistance, using antibiotics.

Semester V (H)			
Course Code	Paper Title	Unit No.	Course Outcome
MCBADSE03T	INHERITANCE BIOLOGY (Theory)	Unit 1 Introduction to Genetics	To understand the basic concepts of heredity and genetics.
		Unit 2 Mendelian Principles	1. To understand the different aspects of mendel's laws and its deviation. 2. To understand the complex concepts of multiple allele and different types of genetic interactions, incomplete dominance, co-dominance, Epistasis, penetrance, expressivity.
		Unit 3 Linkage and Crossing over	1. To understand linkage and recombination of genes, 2. To know cytological basis of crossing over. 3. To understand the molecular mechanism of crossing over.
		Unit 4 Extra- Chromosomal Inheritance	1. To have the knowledge of extra nuclear inheritance in bacteria and organelle heredity.
		Unit 5 Characteristics of Chromosomes	1. To know the structural organization of chromosomes. 2. To have the knowledge about packaging of DNA molecules. 3. To know about the euchromatin and heterochromatin, chromosome banding.
		Unit 6 Recombination	To have the knowledge about Homologous and non-homologous recombination.
		Unit 7 Human genetics	1. To gain knowledge about pedigree analysis, lod score for linkage testing, karyotypes, 2. To know the variations in chromosome structure and variation in chromosomal number and structural abnormalities.
MCBADSE03P	INHERITANCE BIOLOGY (Practical)		1. To understand the use of statistics to solve different genetical issues. 2. To analyze pedigree and conclude the relation of a disease with gene. 3. To study of polytene chromosomes using temporary mounts of salivary glands of Chiromonas / Drosophila larvae.

Semester VI (H)			
Course Code	Paper Title	Unit No.	Course Outcome
MCBACOR013T	MEDICAL MICROBIOLOGY (Theory)	Unit 1 Normal microflora of the human body and host pathogen interaction	1. To have the knowledge of human anatomy and diverse array of microorganisms present under normal condition in different parts of human body. 2. To understand the normal human microflora and their importance.
		Unit 2 Sample collection, transport and diagnosis	To understand the various processes of microbiological sample collection and transportation for diagnostic purposes.
		Unit 3 Bacterial diseases	1. To understand diseases of various organ systems and their causative agents. 2. To know about symptoms, mode of transmission, prophylaxis and control of some specific bacterial diseases.
		Unit 4 Viral diseases	1. To understand diseases of various organ systems and their causative agents. 2. To know about symptoms, mode of transmission, prophylaxis and control of some specific viral diseases..
		Unit 5 Protozoan diseases	1. To understand diseases of various organ systems and their causative agents. 2. To know about symptoms, mode of transmission, prophylaxis and control of some specific protozoal diseases.
		Unit 6 Fungal diseases	1. To understand diseases of various organ systems and their causative agents. 2. To know about symptoms, mode of transmission, prophylaxis and control of some specific fungal diseases.
		Unit 7 Antimicrobial agents: General characteristics & mode of action	To have the preliminary ideas about different types of antimicrobial agents and their mode of action.
MCBACOR013P	MEDICAL MICROBIOLOGY (Practical)		1. To identify different bacteria by various physical and chemical methods. 2. To study the different techniques to detect antibiotic sensitivity.

Semester VI (H)			
Course Code	Paper Title	Unit No.	Course Outcome
MCBACOR014T	RECOMBINANT DNA TECHNOLOGY (Theory)	Unit 1 Introduction to Genetic Engineering	To understand the milestones of genetic engineering and biotechnology.
		Unit 2 Molecular Cloning- Tools and Strategies	To understand the different basic tools and strategies used in recombinant DNA technologies.
		Unit 3 Methods in Molecular Cloning	1. To understand the basic ideas, methods and analyses of techniques for gene cloning.
		Unit 4 DNA Amplification and DNA sequencing	To have the knowledge of nucleic acid sequencing methods and amplification techniques like, PCR, RT-PCR and Real Time PCR.
		Unit 5 Construction and Screening of Genomic & cDNA libraries	To have the knowledge of genomic library construction of organisms.
		Unit 6 Applications of Recombinant DNA Technology	To introduce basic ideas about applications of RDT in different fields.
MCBACOR014P	RECOMBINANT DNA TECHNOLOGY (Practical)		<ol style="list-style-type: none"> 1. Able to prepare competent cells for transformation. 2. Able to perform bacterial transformation and calculate transformation efficiency. 3. Able to digest DNA using restriction enzymes and analysis by agarose gel electrophoresis. 4. Able to perform ligation of DNA fragments and cloning of DNA insert and Blue white screening of recombinants.

Semester VI (H)			
Course Code	Paper Title	Unit No.	Course Outcome
MCBADSE04T	MICROBES IN SUSTAINABLE AGRICULTURE AND DEVELOPMENT (Theory)	Unit 1 Soil Microbiology	1. To understand the various beneficial effects of soil microorganisms on soil health. 2. To know about microbial diversity of soil.
		Unit 2 Microbial Activity in Soil and Green House Gases	1. To understand the different activities of microorganisms in soil. 2. To understand the microbial production and control in soil.
		Unit 3 Microbial Control of Soil Borne Plant Pathogens	Learn the use of soil microorganisms to fight against plant pathogens and sustainable development.
		Unit 4 Biofertilization, Phytostimulation, Bioinsecticides	To have the knowledge of plant growth promoting bacteria, biofertilizers and phosphate solubilizers.
		Unit 5 Secondary Agriculture Biotechnology	To know the – general concepts and advantages of biomanure, biogas, biofuels.
		Unit 6 Genetically Modified crops	To have the knowledge about genetically modified agricultural products and their advantages, social and environmental aspects.
MCBADSE04P	MICROBES IN SUSTAINABLE AGRICULTURE AND DEVELOPMENT (Practical)		1. To isolate and characterise phosphate solubilizing bacteria and Nitrogen fixing bacteria from soil. 2. To study the microflora of rhizospheric soils and isolate Rhizobium from root nodules. 3. To perform soil dehydrogenase assay.

Semester VI (H)			
Course Code	Paper Title	Unit No.	Course Outcome
MCBADSE06T	INSTRUMENTATION AND BIOTECHNIQUES (Theory)	Unit 1 Microscopy	To understand the working principles and usage of different types of microscopes.
		Unit 2 Chromatography	To understand the working principles and usage of different types of chromatography
		Unit 3 Electrophoresis	To understand the working principles and usage of different types of electrophoresis.
		Unit 4 Spectrophotometry	To understand the working principles and usage of different types of Spectrophotometry
		Unit 5 Centrifugation	To understand the working principles and usage of different types of Centrifuge.
MCBADSE06P	INSTRUMENTATION AND BIOTECHNIQUES (Practical)		<ol style="list-style-type: none"> 1. Able to perform number of techniques to separate biomolecules from mixtures. 2. To determine λ_{max} for an unknown sample and pedigree and able to calculate the extinction coefficient.