Department of Microbiology (M.sc)

Program Outcomes (POs)	
PO1	Students will demonstrate a deep understanding of core concepts across various microbiological domains, including microbial systematics, molecular biology, immunology, clinical microbiology, and microbial technology.
PO2	Students will develop the ability to apply statistical, bioinformatics, and molecular tools for research, experiment design, and data analysis. They will gain hands-on experience in laboratory techniques, instrumentation, and microbial diagnostics.
PO3	Students will acquire practical skills in advanced microbiological techniques such as PCR, enzyme kinetics, microbial isolation, DNA sequencing, and bio-nanotechnology, preparing them for roles in research and industry.
PO4	Students will be equipped to solve complex biological problems by applying scientific reasoning, molecular tools, and a thorough understanding of microbial systems. This includes designing experiments, analyzing results, and drawing meaningful conclusions.
PO5	Students will gain practical knowledge of microbial applications in industries such as pharmaceuticals, fermentation, and bioremediation, with specific expertise in quality assurance, validation, and drug discovery processes.
PO6	Students will understand the role of microbes in environmental sustainability through bioremediation, biomass utilization, and wastewater treatment, contributing to eco-friendly solutions for industrial challenges.
PO7	Students will learn the importance of ethical practices, Good Laboratory Practices (GLP), Good Manufacturing Practices (GMP), biosafety, and adherence to international standards such as ISO and WHO in microbiological research and industry.
PO8	Students will be able to effectively communicate scientific findings, participate in collaborative research, and continually update their knowledge through self-directed learning, professional development, and adaptation to new technologies.

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Program Specific Objectives (PSOs)	
PSO-1	The objectives of PG Microbiology are to get students familiarized to versatile tools and techniques employed in Molecular Biology. They are introduced to the concepts of Clinical Biology.
PSO-2	The objective is also to inculcate research aptitude and carry out academic and applied research. They will gain an insight on Clinical Microbiology, Pharmaceutical Microbiology; Molecular biology, Microbial Virus Technology, Advances in Microbial Technology, Industrial waste water treatment and industrial production of vaccines.

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Course Outcome MSc-I (Microbiology) (CBCS 2019-20)		
Semester	**Course Title**	• **Course Outcome**
1	Microbial Systematics **MBCT 111**	• CO-1: Students will be able to apply mathematical tools for estimation of the total number of species and for measuring indices of diversity. • CO-2: Students will be able to identify, classify fungi into 6 classes based on morphological characterization. • CO-3: Students will be able to conceptualize, understand and use molecular methods for identifying unculturable bacteria • CO-4: Students will be able to execute the methods of extraction of total bacterial DNA. • CO-5: Students will be able to understand Neo-Darwinism and its importance in prokaryote evolution. • CO-6: Students will be able to learn the spontaneous mutation controvers, know the types and levels of mutations and molecular clocks.
1	Quantitative Biology **MBCT 112**	• CO-1: Students will be able to determine Mean, mode, median, percentile and standard deviation • CO-2: Students will understand the concepts of null hypothesis, alternate hypothesis, significance level, type I and type II errors. • CO-3: Students will learn to apply statistical tools for calculating degrees of freedom, two population means, t-tests and z test. • CO-4: Students will be able to learn non-parametric tests (Run test, Sign test, Wilcoxon's signed rank test, Mann-Whitney test).

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		• CO-5: Students will be able to examine measures of skewness; measures of kurtosis and able to calculate regression and correlation. • CO-6: Students will learn to implement and interpret F-test, ANOVA, Survey design, Factorial design (Plackett Burman method, DOE).
1	Biochemistry and Metabolism **MBCT 113**	• CO-1: Students will be able to describe protein chemistry, structural features of amino acids and classify amino acids • CO-2: Students will be able to demonstrate PCR and sequencing methods of DNA & RNA. • CO-3: Students will recite the organization of Cytoskeleton, Endoplasmic reticulum, Golgi complex and other organelles with their functions. • CO-4: Students will conceptualize principles of developmental biology, conserved nature of development, concepts of commitment and morphological gradient. • CO-5: Students will learn life cycle of Drosophila, *Arabidopsis* and *Xenopus* to understand the Molecular mechanisms • CO-6: Students will be able to determine the mechanisms of protein trafficking in cell compartment.
1	Biochemical Technique Practical **MBCP 114**	• CO-1: Students will learn the laboratory safety and hazards from chemicals, handling of chemicals and disposal of chemicals and cultures. • CO-2: Students will be able to prepare buffers • CO-3: Students will be able to plot and interpret different graphs

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		using Microsoft excel. • CO-4: Students will isolate alkaliphiles, and thermophiles • CO-5: Students will examine the stages of mitosis from the growing tips of onion root cells. • CO-6: Students will be able to separate sugars and amino acids by paper and thin layer chromatography and estimate them. • C)-7: Students will be able to perform SDS-PAGE
1	Fungal Systematics and extremophiles **MBET 115**	• CO-1: Students will learn and recite the classes of fungi • CO-2: Students will learn enrichment techniques to isolate extremophiles
1	Practical based on Fungal Systematics and extremophiles **MBEP 115**	• CO-1: Students will be able to isolate and identify yeast and molds. • CO-2: Students will be able to isolate acidophiles and halophiles.
2	Instrumentation and Molecular Biophysics **MBCT 121**	• CO-1: Students will understand the concepts of Instrumentation and Molecular Biophysics • CO-2: Students will be able to understand both fundamentals and applications of the instruments that are routinely used for the characterization of biomolecules. • CO-3: Students will understand the concept and applications of instruments
2	Molecular	• CO-1: Students will learn RNA processing &Molecular

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	Biology **MBCT 122**	Techniques • CO-2: Students will understand the process of Eukaryotic RNA Processing, Nuclear export of mRNA, types of regulatory, noncoding RNA and Pi RNA • CO-3: Students will be able to describe different tools for Genetic engineering • CO-4: Students will understand the concept of Genome projects, deciphering genetic code, construction of genomes • CO-5: Students will learn the Molecular diagnostics like protein arrays, microarrays, immunoassays and applications
2	Enzymology, Bioenergetics and Metabolism **MBCT123**	• CO-1: Students will learn about the enzyme reactions with respect purifications methods of purification chart, kinetics and coupled reactions. • CO-2: Students will be able to recite the Laws of thermodynamics, free energy, coupled reactions, high energy compounds and numerical problems. • CO-3: Students will understand classification, structure of lipids with regulation in their metabolism • CO-4: Students will know the synthesis of sugars, regulation of sugar metabolism, TCA cycle, glyoxalate cycle with their regulation mechanisms
2	Molecular biology, Enzymology and Instrumentation	• CO-1: Students will attain awareness about enzymology, molecular biology and instrumentation techniques • CO-2: Students will learn through experiments about concept of lac-operon; Glucose Repression; Diauxic growth

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	Techniques Practical **MBCP 124**	• CO-3: Students will be able to purify enzymes (Amylase/Invertase) by various methods and learn kinetics of enzymes • CO-4: Students will be acquainted with Aflatoxin, lipase/cellulase/chitinase extraction and estimation • CO-5: Students will study the methods of molecular techniques and gene annotation using bioinformatics tools • CO-6:Students will learn learn scientific communication modes like literature review, Experiment planning, experimentation and presenting the thesis. Use of reference management tools and data mining tools.
2	Bio-informatics and Bio-nanotechnology **MBTE 125**	• CO-1: Students will possess the knowledge of Bioinformatics • CO-2: Students will know steps in the process of gene or protein sequencing, annotations, comparative analysis. • CO-3: Students will understand Bio-nanotechnology • CO-4: Students will be able to discuss the methods of synthesis, characterization and application of nanoparticles • CO-5: Students will be acquainted with the concepts of Bionanotechnology and Bioinformatics
2	Practical based on Bio-informatics and Bio-nanotechnology **MBEP 125**	• CO-1: Students will be able to perform DNA isolation and purity checking. • CO-2: Students can perform PCR • CO-3: Students will learn to Draw phylogenetic tree using related sequences • CO-4: Students will be able to synthesize nanoparticles and characterize by UV-VIS spectroscopy

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2	Nitrogen Metabolism, respiration and Photosynthesis **MBET 127**	• CO1: Students will learn about the biochemistry of biological nitrogen fixation and regulation • CO2: Students will understand biosynthesis of amino acids, purines and pyrimidines • CO3: Students will be able to describe the biochemistry of anaerobic respiration, methanogenes and photosynthesis with various steps involved
2	Nitrogen Metabolism, respiration and Photosynthesis **MBEP 127**	• CO1: Students will be able to isolate microorganisms for production of IAA and siderophores • CO2: Students will perform enrichment techniques for nitrogen fixing; lignin degrading; xylan degrading microbes as well as methanogenes ;cyanobacteria and further • isolate and characterize the isolated microorganisms . • CO3: Students will be able to isolate and characterize the respective microorganisms from the enriched samples • CO4: Students will perform suitable method for Detection of chlorophyll-a activity of Cyanobacteria

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Course Outcome MSc-II(Microbiology) (CBCS 2019-20)

Semester	Course Title	Expected Course Specific Learning Outcome
3	Immunology **MBCT -231**	• CO-1: Students will understand the concepts of Immunology • CO-2: They will be able to understand the different effector mechanisms of host immune response • CO-3: This course will elucidate the concepts of signal transduction pathways to students
3	Molecular Biology **MBCT -232**	• CO-1: The concepts of Molecular Biology will be familiar to students • CO-2: Students will be able to understand the concept of Metabolomics. • CO-3: Detail knowledge about the concept and applications of transgenic plants and transgenic animals will be gained
3	Clinical Microbiology **MBCT -233**	• CO-1: The concepts of medical microbiology and medically important microorganisms will add on to students knowledge. • CO-2: Pupil will get to know about knowledge of morphology, cultural characteristics, biochemical tests, epidemiology, laboratory diagnosis etc of bacterial pathogens • CO-3: They will also understand the basics and applications of various chemotherapeutic agents and their mode of action
3	Practicals based on Immunology, Molecular Biology and Clinical Microbiology **MBCP -234**	• CO-1: Familiarity about techniques Immunology will be increased among students • CO-2: They will learn about Molecular Biology techniques • CO-3: Students will be acquainted with techniques in Clinical Microbiology

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3	Bioremediation and Bomass Utilization **MBET: 236**	• CO1:Students will develop an interest in the field of bioremediation • CO-2: They understand the concepts of biomass utilization • CO-3: The ideology behind concepts and use of microbial degradation will be clear to them
3	Practical based on Bioremediation and Biomass Utilization **MBEP: 236**	• CO-1: An interest will be developed in the field of bioremediation • CO-2: They will understand the concepts of biomass utilization • CO-3: Students will understand the concepts and use of microbial degradation
4	Pharmaceutical Microbiology **MBCT 241**	• CO-1: In addition to drug development students will also understand the concepts of drug discovery • CO-2: They will be able to know pharmacokinetics and pharmacodynamics. • CO-3: Besides this students will know the recent trends for MDR therapy also.
4	Microbial Technology **MBCT 242**	• CO-1: Students will learn about microbial technology and its applications • CO-2: They shall acquire knowledge about various process control methods in fermentation. • CO-3: Students will be acquainted with the applications. of microorganisms in different industries.
4	Dissertation **MBCP: 243**	• CO-1: Students will be able to choose a dissertation topic of research or application orientation • CO-2: They will get an experience for gathering literature survey and apply it into practical dissertation work .

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		• CO-3: They shall also be educated for use of statistical analysis and graphical presentations • CO-4: Besides this they will also be able to analyze qualitative and quantitative data with evidence based explanation gathered supports the initial hypothesis. • CO-5: This course will help students to craft an extensive and comprehensive piece of dissertation work with research or application orientation
4	Quality Assurance and Validation in Pharmaceutical Industry and Development of Anti- infectives **MBET 244**	• CO-1: Students. will have knowledge of Good Manufacturing Practices (GMP) and Good • CO-2: Laboratory Practices (GLP) in pharmaceutical industry. • CO-3: They will be accustomed with ISO, WHO and US certification and also Safety in microbiology laboratory. • CO-4:The knowledge of Therapeutic ratio, MIC and MBC Susceptibility Testing will be obtained by students
4	Practical based Quality Assurance and Validation in Pharmaceutical Industry and Development of Anti- infectives **MBEP 244**	• CO-1: Students will have knowledge of Quality Assurance in the Pharmaceutical Industry. • CO-2: Understanding about validation processes in the Pharmaceutical Industry will become easy. • CO-3: They will be acquainted with the knowledge of development of anti- infectives from plants
4	Industrial waste	• CO-1: Students w i l l g e t t o k n o w the concepts of Industrial

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	Water Treatment and Industrial Production of Vaccines **MBET 246**	Waste Water Treatment • CO-2: They will also learn about sludge treatment • CO-3: The concept of Industrial Production of Vaccines will also be clear to them
4	Practical based on Industrial waste Water Treatment and Industrial Production of Vaccines **MBEP 246**	• CO-1: The concepts of Industrial Waste Water Treatment will be familiar to students • CO-2: They will learn about sludge treatment • CO-3:Students get acquainted with the concepts of Industrial Production of Vaccines

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