

Rayat Shikshan Sanstha's
Mahatma Phule Mahavidyalaya, Pimpri, Pune-17
Department of Microbiology
Course Outcomes
(PG)

M.Sc. I Microbiology NEP: 2020

**MB 511 MJ- Microbial
Systematics Compulsory Theory
Paper**

Course Outcomes (COs)	
After studying this course learners will be able to	
CO1	<ul style="list-style-type: none"> • define species concept in prokaryotes and eukaryotes • list measures and indices of diversity • define 'unculturable' bacteria and list culture independent molecular methods for identifying unculturable bacteria • list different molecular methods used in microbial taxonomy • know difference between 6 Classes of Fungi
CO 2	<ul style="list-style-type: none"> • explain 5-Kingdom and 3 domain classification system and facets of microbial diversity • understand molecular evolution • explain Socio-biology and Lamarckism, Darwinism, Neo Darwinism and understand Game theory , r and k selection
CO 3	<ul style="list-style-type: none"> • apply the use molecular clocks in taxonomy • summarize various theories of evolution

**MB 512 MJ: Biochemistry, Cell and Developmental
Biology Compulsory Theory Paper**

Course Outcomes (COs)	
After studying this course learners will be able to	
CO 1	Students learn about structural features of amino acids and proteins and their functions.
CO 2	Students get introduced with biochemistry and molecular biology technique.

CO 3	Students get introduced to developmental biology in that hox code, mechanism of gastrulation, pattern formation in body axis
CO 4	Students get introduced with ultrastructure and organization of eukaryotic cell, protein transport and cell cycle.

**MB 513 MJ -Basic Quantitative
Biology Compulsory Theory
Paper**

Course outcomes COs	
After studying the course learners will be able to	
CO 1	Understand importance of statistics in biology
CO 2	Understand basic terms used in statistics Formulate a hypothesis for the experiment as well as test it using appropriate methods.
CO 3	Methods for Systematically collection and arranging different type of data
CO 4	Calculate basic statistical parameters, plot graphs by using data
CO 5	Calculate and interpret the observations by using tests used inferential statistics
CO 6	Describe the method to collect samples in the most appropriate way to carry out desired experiments. Record the data obtained in the experiment in a suitable way.
CO 7	Design the experiments based on the different principles.
CO 8	Apply the measures of central tendency, dispersion to the data and calculate the probability of obtaining the expected results in the experiments.
CO 9	Analyze large data to get a meaningful inference from it.
CO10	Compare the different methods of measuring central tendency and evaluate the best suitable one for a particular data
CO11	Formulate a hypothesis for the experiment as well as test it using appropriate methods.

**MB 514 MJP: Biochemical Techniques Compulsory
Practical Paper**

Course outcomes COs	
After studying the course learners will be able to	
CO 1	To follow and appreciate protocols and practices in the laboratory as per the standards for successful practical completion
CO 2	Methods to prepare biological buffers
CO 3	Effective ways of presentation of biological data and its statistical using software
CO 4	Microbiological procedures required for isolation, characterization and identification of microbes.
CO 5	Methods for visualization of cell division
CO 6	Basic aspects of developmental biology
CO 7	Methods for extraction of microbial biomolecules and their estimation Computational aspect of protein structures

**MB 510 RM- Research
Methodology Compulsory
Theory Paper**

Course outcomes COs	
After studying the course learners will be able to	
CO 1	Understand research terminology
CO 2	Describe quantitative, qualitative and mixed methods approaches to research
CO 3	Identify the components of a literature review process
CO 4	Analyze and interpret the research
CO 5	Apply ethical principles of research in preparation of scientific documents

**MB 518 MJ -Experimental Design and Quantitative approach for
Biologists**

Group III Major Elective Theory

Course outcomes COs	
After studying the course learners will be able to	
Credit I:	
CO 1	Students will be able to gain knowledge about research methodology in detail.

CO 2	Students will be able to hypothesize the probabilistic statements and make predictions about the data under study.
CO 3	Students will be able to identify, select, and tabulate data under study.
CO 4	Students will be able to learn experimental designs and understand improved process and able to build confidence making informed decisions about the data
CO 5	Students will be able to learn the relationships between multiple input and output variables.
CO 6	Students will be able to learn epidemiology, able to use, comment and criticize various epidemiological methods.
Credit II	
CO 1	Students will be able to learn basics about numbers. .
CO 2	Students will be able to perform comparative study about different types of mathematical functions.
CO 3	Students will be able to correlate exponential function, bacterial growth and bacterial death
CO 4	Students will be able to learn mathematical basis of 12-D concept in autoclaving
CO 5	Students will be able to apply differentiation and integration in biology.
CO 6	Students will be able to apply mathematical and computational skills in real life.
CO 7	This course will enhance quality of student's mathematical, analytical and creative skills
CO 8	This course will enable the students and the faculty to become lifelong learners and practitioners of mathematics

**MB 518 MJP -Practicals Based on Experimental Design and Quantitative approach
for Biologists
Group III Major Elective Practical (Elective)**

Course outcomes COs	
After studying the course learners will be able to	
CO 1	To prepare the research proposal as per the standards
CO 2	To prepare the epidemiological study proposal, and carry out investigation as per the standards and analysis of the data
CO 3	Selection of appropriate design for an experiment and statistical analysis of the responses using software
CO 4	To use the mathematical calculations for preparation of solutions.
CO 5	To solve, interpret and give proper treatment to the mathematical problems based on biological applications
CO 6	Treatment of biological data and its statistical analysis with the aid of software.

Semester II

**MB 521 MJ -
Molecular Biology I
Compulsory Theory
Paper**

Course outcomes COs	
After studying the course learners will be able to	
CO 1	To remember the basic differences between the Eukaryotic and the Prokaryotic Genome organization-working
CO 2	To understand the regulation of Eukaryotic and Prokaryotic Gene expression with examples
CO 3	To apply recombinant DNA technology and genetic engineering in the field of molecular Biology
CO 4	To analyze and evaluate the molecular diagnostic techniques and its applications

MB 522 MJ - Enzymology, Bioenergetics and Metabolism
Compulsory Theory Paper

Course outcomes COs	
After studying the course learners will be able to	
CO 1	understand about enzyme kinetics, the mechanisms of enzyme catalysis, and the mechanisms of enzyme regulation in the cell.
CO 2	gain knowledge of purification methods of enzymes. They will define terms related to thermodynamics. They will draw structure of hormones.
CO 3	conceive the concept of energy, cite examples and assess its importance to living organisms.
CO 4	understand the Kinetics of enzyme reactions and gain knowledge of role of enzyme inhibitors
CO 5	write metabolic pathways with respect to carbohydrate and lipid metabolism. They will solve problems based on enzyme kinetics, purification and thermodynamics.
CO 6	study metabolic pathways for various nitrogenous compounds.
CO 7	collect information about types and functions of micronutrients
CO 8	Students will summarize types of cooperativity and models of allosteric enzymes.

MB 523 MJ -Laboratory Techniques and Instrumentation
Compulsory Theory Paper

Course outcomes COs	
After studying the course learners will be able to	
CO1	Study of techniques will help in understanding basics
CO2	Study of techniques will help in application of electromagnetic spectrum.
CO3	Studies of structure will lead to in depth knowledge of Biomolecules
CO 4	Techniques of Spectroscopy will improve technical knowledge which will help in Skill development.

MB 524 MJP- Practicals based on MB 521 MJ Molecular Biology I, MB 522 MJ Enzymology, Bioenergetics and Metabolism, and MB 523 MJ Laboratory Techniques and Instrumentation Compulsory Practical Paper

Course outcomes COs	
After studying the course learners will be able to	
CO1	To familiarize students with the molecular Biology techniques which includes study of DNA, RNA, proteins etc
CO2	To gain an understanding of the solution, the calculations and preparation for cellular extraction of biomolecules and Purification.
CO3	To experience a hands-on approach and the troubleshooting during processing of the biomolecules
CO 4	To have an insight in the usage of bioinformatics and data bases in gene annotation procedure

MB 526 MJ- Nitrogen Metabolisms, Respiration and Photosynthesis Group II Major Elective Theory

Course outcomes COs	
After studying the course learners will be able to	
CO1	Understand of biological nitrogen fixation and it's regulation.
CO2	Gain knowledge of enzymes involved in nitrogen metabolism.
CO3	Knowledge of anaerobic respiration with respect to chemolithotrophs
CO 4	Differentiate between oxygenic and unoxxygenic photosynthesis mechanism

MB 526 MJP -Practical based on Nitrogen Metabolism, Respiration and Photosynthesis Group II Major Elective Practical

Course outcomes COs	
After studying the course learners will be able to	
CO1	Methods used for isolation of microbes able to produce the metabolites such as indole acetic acid, siderophores and techniques for their detection.
CO2	Techniques used for isolation of microbial system that are able to fix the atmospheric nitrogen.
CO3	Characterization technique for polyphenols and tannins

CO 4	Microbial methods for isolation and characterization of microbes able to degrade biomolecules such as xylan/lignin
CO 5	Microbial methods required for isolation of sulfur reducing microbes / methanogens
CO 6	Microbial methods for photosynthetic microbes such as cyanobacteria and biochemical method to determine its chlorophyll content

M.Sc. II Microbiology

Name of the Department	Class	Course Code	Course Name	Course outcome
	M.Sc. II Sem III	MBCT 231	Immunology	<p>CO 1: Students will understand the concepts of Immunology.</p> <p>CO 2: They will be able to understand the different effector mechanisms of host immune response.</p> <p>CO 3: To acquaint students with the cell surface receptors present on various cells for signal transduction pathways and regulation of immune responses.</p> <p>CO 4: Applications of different immunological techniques in analysis and diagnosis of diseases and immunological disorders.</p> <p>CO 5: Extending the knowledge of how the immune system mounts an immune response against tumor and how tumors evade immunity.</p> <p>CO 6: Comparing strategies to combat tumors based on immunotherapy, including passive and active immunization.</p>
		MBCT 232	Molecular Biology	<p>CO 1: Students will be able to understand the concept of Metabolomics.</p> <p>CO 2: Detail knowledge about the concept and applications of transgenic plants and transgenic animals.</p> <p>CO 3: Understanding the terms</p>

				<p>illustrating the extract of terms involved in genomics.</p> <p>CO 4: Gaining knowledge concerning the methods developed to study genomic variations.</p> <p>CO 5: Theoretically Manifesting the importance of applications in rDNA technology by learning transgenic plants and animals.</p> <p>CO 6: Core clearance of pre-requisite concepts of proteomics.</p> <p>CO 7: Stretched the importance of learning GMOs and associated social and ethical issues.</p> <p>CO 7: Thorough overview of key concepts lies in transposons with reference of maize and drosophila.</p>
		MBCT 233	Clinical Microbiology	<p>CO 1: Interpretation of host parasite interaction.</p> <p>CO 2: Knowledge of morphology, cultural characteristics, biochemical tests, epidemiology, laboratory diagnosis etc of bacterial pathogens.</p> <p>CO 3: Understand the basics and applications of various chemotherapeutic agents and their mode of action.</p> <p>CO 4: To develop informatics and diagnostic skills, including the use and interpretation of laboratory tests in the diagnosis of infectious diseases</p> <p>CO 5: Acquaint with knowledge of handling and disposal of medical waste.</p> <p>CO 6: Illustrate prognosis, diagnosis, incidence and prevalence of local and global diseases using epidemiological models.</p>
		MBCP 234	Practicals based on Immunology, Molecular Biology and Clinical Microbiology	<p>CO 1: Students will be acquainted with techniques in Clinical Microbiology, Immunology and Molecular Biology.</p> <p>CO 2: Analysis of serum proteins and importance of it.</p> <p>CO 3: Applications of immunological techniques in qualitative and</p>

				<p>quantitative antigen/ antibody in diagnostics.</p> <p>CO 4: Evaluate efficiency of recombinant DNA technology by various screening techniques.</p> <p>CO 5: Exemplifying regular pathogens to understand their disease manifestation.</p>
		MBET 237	Microbial Virus Technology	<p>CO 1: Students will understand the basics of isolation and characterization of bacteriophages.</p> <p>CO 2: Pupil will understand the need of bacteriophages and phage therapy for antibiotic resistant pathogenic bacteria.</p> <p>CO 3: Comparing phage therapy over antibiotic therapy.</p> <p>CO 4: Studying the interaction between host and phage.</p>
		MBEP 237	Practicals based on Microbial Virus Technology	<p>CO 1: Students' knowledge will grow up with isolation, purification and preservation of bacteriophages</p> <p>CO 2: They will be acquainted with various concepts of bacteriophage growth kinetics</p> <p>CO 3: It will also help to learn about applications of bacteriophages.</p> <p>CO 4: Application of bacteriophages as therapeutic as well as bio control agents.</p>
	M.Sc II Sem IV	MBCT 241	Pharmaceutical Microbiology	<p>CO 1: In addition to drug development students will also understand the concepts of drug discovery.</p> <p>CO 2: They will be able to know pharmacokinetics and pharmacodynamics.</p> <p>CO 3: Besides this students will know the recent trends for MDR therapy also.</p> <p>CO 4: Summarizing the general concepts and definitions fall under the medicinal chemistry.</p> <p>CO 5: Comprehending the theoretical concept of classification, and drug mechanism.</p>

				<p>CO 6: Detailed overview of drug designing and development by</p> <p>CO 7: Assimilation of basic ideas behind clinical trials, definitions and methods to perform.</p> <p>CO 8: Extending the knowledge of drug metabolism in a circuitous way.</p> <p>CO 9: Extending the connotation of pharmacopeia in pharmaceutical industry.</p>
		MBCT 242	Microbial Technology	<p>CO 1: They shall acquire knowledge about various process control methods in fermentation.</p> <p>CO 2: Students will be acquainted with the applications of microorganisms in different industries.</p> <p>CO 3: Understanding the role of industrially important microorganisms in upstream and downstream process.</p> <p>CO 4: Extending the knowledge of production of industrially important products.</p>
		MBCP 243	Dissertation	<p>CO 1: Students will be able to choose a dissertation topic of research or application orientation</p> <p>CO 2: They will get an experience for gathering literature survey and apply it into practical dissertation work</p> <p>CO 3: They shall also be educated for use of statistical analysis and graphical presentations</p> <p>CO 4: Besides this they will also be able to analyze qualitative and quantitative data with evidence based explanation gathered supports the initial hypothesis.</p> <p>CO 5: This course will help students to craft an extensive and comprehensive piece of dissertation work with research or application orientation.</p>
		MBET 244	Quality Assurance and Validation in Pharmaceutical Industry and	<p>CO 1: Students. will have knowledge of Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP) in pharmaceutical industry.</p> <p>CO 2: They will be accustomed with</p>

			Development of Anti Infectives from plants	ISO, WHO and US certification and also Safety in microbiology laboratory. CO 3: The knowledge of Therapeutic ratio, MIC and MBC Susceptibility Testing will be obtained by students CO 4: Learning the significance of rules and regulations fall under pharmacopeia.
		MBEP 244	Practicals based on Quality Assurance and Validation in Pharmaceutical Industry and Development of Anti Infectives from plants	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.
		MBET 246	Industrial waste water treatment and Industrial production of vaccines	CO 1: Students will get to know the concepts of Industrial 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. CO 4: Understanding the composition of effluent. CO 5: handling and operating the parameters involved in effluent treatment and kinetics.
		MBEP 246	Practicals based on Industrial waste water treatment and Industrial production of vaccines	CO 1: They will learn about sludge treatment CO 2: Students get acquainted with the concepts of Industrial Production of Vaccines. CO 3: Critical analysis of industrial waste water.