Restructured Syllabus (CBCS Pattern as per NEP 2020)

To be implemented from Academic Year: 2024-25

Faculty	**Science**
Program	**B.Sc and M.Sc**
Class	**F.Y.B.Sc and M.Sc 1**

Semester		Course Code	Type of Course	Course Title	Theory/ Practical	Credits	No. of clock hours per week
F.Y.B.Sc Sem 1 and Sem 2		MB 101TH, MB 101PR MB 151TH, MB 151PR	CBCS	Introduction to Microbiology Laboratory Techniques in Microbiology Basic Microbiology Laboratory Techniques in Microbiology	Th PR Th PR	2 2 2 2	3 4 3 3
M.Sc. I Sem I	Core theory and Practicals	MB 501 MJ - TH	CBCS	Microbial Systematics	TH	4	4
		MB 502 MJ - TH	CBCS	Biochemistry, Cell, and Developmental Biology	TH	4	4
		MB 503 MJ - TH	CBCS	Basic Quantitative Biology	TH	2	2
		MB 504 MJ - PR	CBCS	Practical's based on MB 501MJ -TH Microbial	PR	4	8

				Systematics, MB 502 MJ - TH Biochemistry, Cell and Developmental Biology, and MB 503 MJ - TH Basic Quantitative Biology			
	Research Methodology Theory	MB 531 RM-TH	CBCS	Research Methodology	TH	2	2
	Research Methodology Practical	MB 531 RM- PR	CBCS	Research Methodology	PR	2	4
	Optional Papers Elective/ Departmental Course **Any one group**	**Group I**					
		MB 510 MJ – TH	**CBCS**	**Microbial Extremophiles**	**TH**	**2**	**2**
		MB 510 MJ - PR	**CBCS**	**Practical's Based on MB 510 MJ - TH** **Microbial Extremophiles**	**PR**	**2**	**4**
		OR					
		Group II					
		MB 511 MJ-TH	CBCS	Microbial communication, Membrane transport and signal transduction	TH	2	2
		MB 511 MJ-PR	CBCS	Practicals Based on MB 511 MJ TH Microbial communication, Membrane transport and signal transduction	PR	2	4

		OR					
		Group III					
		MB 512 MJ-TH	CBCS	Advanced Quantitative Biology	TH	2	2
		MB 512 MJ-PR	CBCS	Practicals Based on MB 512 MJ-TH Advanced Quantitative Biology	PR	2	4

		OR					
		Group IV					
		MB 513 MJ-TH	CBCS	Experimental Design and Quantitative approach for Biologists	TH	2	2
		MB 513 MJ PR	CBCS	Practicals Based on MB 513 MJ-TH Experimental Design and Quantitative approach for Biologists	PR	2	4
M.Sc. I Sem II	Core theory and Practicals	MB 551 MJ-TH	CBCS	Molecular Biology-I	TH	4	4
		MB 552 MJ –TH	CBCS	Enzymology, Bioenergetics and Metabolism	TH	4	4
		MB 553 MJ -TH	CBCS	Laboratory Techniques and Instrumentation	TH	2	2
		MB 554 MJ –PR	CBCS	Practicals based on MB 551 MJ-TH Molecular biology I, MB 552 MJ -TH Enzymology, Bioenergetics and Metabolism, MB 553 MJ -TH Laboratory techniques and	PR	4	8

				Instrumentation			
	Internship/ On Job Training	MB 581 OJT	CBCS	Internship/ On Job Training	PR	4	Total 120 hours
	Choice Based Optional Papers Elective/ Departmental Course **Any one group**	Group I					
		MB 560 MJ -TH	CBCS	Molecular biology tools and applications	TH	2	2
		MB 560 MJ -PR:	CBCS	Practical based on MB 560 MJ-TH Molecular Biology tools and applications	PR	2	4
		OR					
		Group II					
		MB 561 MJ-TH	**CBCS**	**Nitrogen Metabolism, Respiration and Photosynthesis**	**TH**	**2**	**2**
		MB 561 MJ -PR	**CBCS**	**Practical based on MB 561 MJ-TH Nitrogen Metabolism, Respiration and Photosynthesis**	**PR**	**2**	**4**
		OR					
		Group III					
		MB 562 MJ –TH	CBCS	Molecular Biophysics	TH	2	2
		MB 562 MJ- PR	CBCS	Practical based on MB 562 MJ -TH Molecular Biophysics	PR	2	4
		OR					
		Group IV					
		MB 563 MJ -TH	CBCS	Bioinformatics	TH	2	2
		MB 563 MJ -PR	CBCS	Practical based on MB 563 MJ-TH Bioinformatics	PR	2	4

Course Objectives:

F.Y.B.Sc

- To enrich students' knowledge and train them in the pure microbial sciences
- To introduce the concepts of application and research in Microbiology
- To inculcate a sense of scientific responsibility, social and environmental awareness.
- To help students build up a progressive and successful career.

M.Sc

- To enrich students‘ knowledge and train them in the pure microbial sciences
- To introduce the concepts of mathematics in biology
- To inculcate research aptitude
- To inculcate sense of scientific responsibilities and social and environment awareness
- To help students build-up a progressive and successful career in Microbiology

Course Outcomes:

F.Y.B.Sc. Theory

	Course Outcomes (COs) **On completion of the course, the students will be able to:**
CO1	Describe the origin of microbial life on earth by outlining the experiment relating to the formation of organic matter in a laboratory set-up.
CO2	Explain the evolution of the microbiology field and the scientific discoveries relating to each field.
CO3	Outline the relatedness of the different upcoming areas of biological sciences to the field of microbiology.
CO4	Classify different species according to the different classification systems.
CO5	Review the differences between the basic types of cells found in all biological systems.
CO6	Write about the morphological and differential characteristics of different groups of microorganisms.

F.Y.B.Sc. Practicals

Course Outcomes (COs) **On completion of the course, the students will be able to:**	
CO1	Describe the good lab practices and biosafety measures to be adopted while working ina microbiology lab and identify different instruments commonly used for microbiological experiments.
CO2	Give examples of different nutrient media popularly used in culturing microorganisms and compare different methods of sterilizing them.
CO3	Demonstrate different cultivation methods for different microbial groups.
CO4	Explain morphological characteristics of different microbial life forms by microscopic observation.
CO5	Measure the dimensions of different biological cells.
CO6	Design experiments to study the effect of sanitation methods on microflora

M.Sc. Theory

MB 501 MJ - TH: Microbial Systematics

Total: 4 Credits Workload:-15hrs/credit
(Total Workload:-4 credits x 15 hrs =60 hrs in semester)

Course Outcomes (COs)	
After studying this course learners will be able to	
CO1	Define species concept in prokaryotes and eukaryotes.List measures and indices of diversity. Define –unculturable b a c t e r i a and list culture independent molecular methods. Identify unculturable bacteria. List different molecular methods used in microbial taxonomy.
CO2	Explain 5-Kingdom and 3 domain classification system and facets of microbial diversity. Understand molecular evolution. Explain Socio-biology and Lamarckism, Darwinism, Neo Darwinism & understand Game theory, r and k selection.
CO3	Apply the knowledge of molecular clocks in taxonomy. Summarize various theories of evolution.

MB 502 MJ-TH : Biochemistry, Cell and Developmental Biology

Total: 4 Credits Workload: -15 hrs/ credit
(Total Workload:-4 credits x 15 hrs= 60 hrs in semester)

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 ultra structure and organization of eukaryotic cell, protein transport and cell cycle.

MB 503 MJ –TH: Basic Quantitative Biology

Total: 2 Credits Workload:-15 hrs/credit
(Total Workload:-2 credits x15 hrs = 30 hrs in semester)

Course outcomes COs	
After studying the course learners will be able to	
CO1	Understand importance of statistics in biology.
CO2.	Understand basic terms used in statistics. Formulate a hypothesis for the experiment as well as test it using appropriate methods.
CO3	Know the methods for systematic collection and arranging different types of data.
CO4	Calculate basic statistical parameters and plot graphs by using data.
CO5	Calculate and interpret the observations by using tests used in inferential statistics.

MB 510 MJ- TH: Microbial Extremophiles

Group I Major Elective Theory

Total: 2 Credits Workload:-15hrs./credit
(Total Workload:-2 credits x 15 hrs. = 30 hrs.in semester)

Course outcomes COs	
After studying the course learners will be able to	
CO 1	Understand extremophiles - microorganisms surviving under harsh conditions.
CO 2	Know the applications of extremophiles at industrial level.
CO 3	Understand the mechanisms of surviving of extremophiles under harsh conditions.
CO 4	Know different classes of extremophiles.

MB 511 MJ -TH: Microbial communication, Membrane transport and signal transductionGroup II Major Elective Theory

Total:2 Credits Workload :-15hrs./credit
(Total Workload:-2 credits x 15 hrs. = 30 hrs.in semester)

Course outcomes COs	
After studying the course learners will be able to	
CO 1	Understand the quorum sensing phenomenon with molecular mechanisms in Myxobacteria.
CO 2	Develop insights of quorum sensing in Gram negative and Gram positive bacteria.

CO 3	Acquainted with formation and dispersal of biofilm and extrapolate applications of biofilm in pathogenic and nonpathogenic bacteria.
CO 4	Gain in depth knowledge of membrane dynamics, architecture and composition and solute and ion mediated transport mechanisms.
CO5	Get knowledge about the signal transduction mechanism and chemotaxis in Microorganisms.

MB 512 MJ -TH Advanced Quantitative Biology

Group III Major Elective Theory

Total:2 Credits Workload :-15 hrs /credit
(Total Workload:-2 credits x 15 hrs = 30 hrs in semester)

Course outcomes COs	
After studying the course learners will be able to	
CO 1	To appreciate the variation among the independent and dependent variables.
CO 2	Use the method of treatment of numerical biological data from different populations to evaluate the variation among them.
CO 3	Understand and analyze the relationship between outcome and several predicts or variables in biology.
CO 4	Appreciate the difference among analysis of qualitative and quantitative data.
CO 5	Know the techniques to analyze the data based upon categorical variables in biology.
CO 6	Understand the Methodology to determine the relation among qualitative variables in biology.

MB 513 MJ-TH: Experimental Design and Quantitative approach for BiologistsGroup IV Major Elective Theory

Total: 2 Credits Workload:-15hrs/credit
(Total Workload:-2 credits x 15 hrs=30 hrs in semester)

Course outcomes COs	
After studying the course learners will be able to	
Credit I:	
CO 1	Gain knowledge about research methodology in detail.
CO 2	Hypothesize the probabilistic statements and make predictions about the data under study.
CO 3	Able to identify, select, and tabulate data under study.
CO 4	Able to learn experimental designs and understand improved process and able to build confidence making informed decisions about the data.
CO 5	Understand the relationships between multiple input and output variables.
CO 6	Understand the term epidemiology, will also be able to use, comment and criticize various epidemiological methods.
Credit II	

CO 1	Understand the basics about numbers..
CO 2	Perform comparative study about different types of mathematical functions.
CO 3	Correlate exponential function and bacterial growth.
CO 4	Correlate exponential function and bacterial death.
CO 5	Understand the mathematical basis of 12-D concept in autoclaving.
CO 6	Apply differentiation and integration in biology.
CO 7	Apply mathematical and computational skills in real life.

M.Sc. Practicals

MB 504 MJ -PR: Biochemical Techniques (Compulsory Practical Paper)

Course outcomes COs	
After studying the course learners will be able to	
CO1	Follow and appreciate protocols and practices in the laboratory as per the standards for successful practical completion.
CO2.	Understand various methods to prepare biological buffers.
CO3	Know the effective ways of presentation of biological data and its statistics using software.
CO4	Use microbiological procedures required for isolation, characterization and identification of microbes.
CO5	Understand methods for visualization of cell division.
CO6	Understand the basic aspects of developmental biology. Use methods for extraction of microbial bio molecules and their estimation and understand the computational aspect of protein structures.

MB 531 RM-TH Research MethodologyCompulsory 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 510 MJ -PR: Practicals based on MB 510 MJ Microbial ExtremophilesGroup I Major Elective Practical

Course outcomes COs	
After studying the course learners will be able to	
CO 1	Understand the technical details pertaining to samples required for isolation of extremophilic microbes.
CO 2	Know the methods to isolate and identify extremophilic microbes from different sources such as thermophiles / psychrophiles / acidophiles.
CO3	Know the methods to isolate and identify extremophilic microbes from different sources such as halophiles / alkaliphiles / oligophiles.
CO4	To build identification key for extremophilic microbes.
CO5	Identify extremophilic microbes using such keys.

MB 511 MJ -PR: Practicals Based on MB 511 MJ Microbial communication, Membranetransport and signal transduction

Group II Major Elective Practicals

Total:2 Credits Workload :-15hrs./credit
(Total Workload:-2 credits x 30 hrs. = 60 hrs.in semester)

Course outcomes COs	
After studying the course learners will be able to	
CO 1	Gain insights into the biofilm formation and determination of quorum sensing signals in bacteria.
CO 2	Understand chemotaxis response by various methods
CO 3	Know the mechanism of osmosis and diffusion with effect of various physical and chemical factors.
CO 4	Comprehend the details of cell disruption methods and effect of transport b swab testing.

MB 512 MJ -PR : Practicals Based on MB 512 MJ Advanced Quantitative BiologyGroup III Major Elective Practical

Total:2 Credits Workload :-30hrs/credit
(Total Workload:-2 credits x 30 hrs =60 hrs in semester)

Course outcomes COs
After studying the course learners will be able to

CO 1	Appreciate the way the biological variables are distributed in nature.
CO 2	Understand the methodology of experimentation in biology and generation of the data.
CO 3	Know the methods of processing the biological data and make inferences.
CO 4	Use different softwares to process the numerical data and its interpretation.

MB 513 MJ -PR : Practicals Based on MB 553 MJ Experimental Design and Quantitativeapproach for Biologists

Group IV Major Elective Practical

Total:2 Credits Workload:-30 hrs /credit
(Total Workload:-2 credits x 30 hrs=60 hrs in semester)

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

M. Sc. Microbiology Part I Semester II

M.Sc Theory

MB 551 MJ-TH – Molecular Biology-I

Compulsory Theory Paper

Total: 4 Credits Workload: -15 hours /credit

(Total Workload: - 4 credits x 15 hours = 60 hours in semester)

Course outcomes COs	
After studying the course learners will be able to	
CO 1	Understand the basic differences between the Eukaryotic and the Prokaryotic Genome organization-working.

CO 2	Understand the regulation of Eukaryotic and Prokaryotic Gene expression with examples.
CO 3	Apply recombinant DNA technology and genetic engineering in the field of molecular Biology.
CO 4	Analyze and evaluate the molecular diagnostic techniques and its applications

MB 552 MJ –TH : Enzymology, Bioenergetics and Metabolism

Compulsory Theory Paper

Total: 4 Credits Workload: -15 hours. /Credit

(Total Workload: -4 credits x 15 hrs. = 60 hours in semester)

Course outcomes COs	
After studying the course learners will be able to	
CO1	Gain the knowledge of purification methods of enzymes. They will be able to define the terms related to thermodynamics. They will be able to draw structure of hormones.
CO2	Understand the Kinetics of enzyme reactions and gain knowledge of role of enzyme inhibitors.
CO3	Write metabolic pathways with respect to carbohydrate and lipid metabolism. They will be able to solve problems based on enzyme kinetics, purification and thermodynamics.
CO4	Construct a purification chart. Students will be able to compare anabolic reactions and catabolic reactions of carbohydrate metabolism. They will also be able to understand the synthesis of lipids and degradation of lipids.
CO5	Get information about types and functions of micronutrients.
CO6	Summarize types of cooperativity and models of allosteric enzymes

MB 553 MJ -TH -Laboratory Techniques and Instrumentation

Compulsory Theory Paper

Total: 2 Credits Workload: -15 hours /credit

(Total Workload: -2 credits x 15 hours = 30 hours in semester)

Course outcomes COs	
After studying the course learners will be able to	
CO 1	Understand basic techniques and instrumentation in laboratory.
CO 2	Learn application of electromagnetic spectrum.
CO 3	Gain detailed knowledge of Biomolecules.
CO 4	Gain technical knowledge of spectroscopy.

MB 560 MJ -TH: Molecular biology tools and applications Group I Major Elective Theory

Total: 2 Credits Workload: -15 hours. /Credit

(Total Workload: -2 credits x 15 hrs. = 30 hours in semester)

Course outcomes COs	
After studying the course learners will be able to	
CO1	Explain principle and procedures of various molecular techniques.
CO2	Explain the concept of microarray.
CO3	Describe various hybridization techniques.

CO4	Explain the concept of recombinant DNA technology.
CO5	Describe the use of Biopolymers.

MB 561 MJ-TH Nitrogen Metabolism, Respiration and Photosynthesis Group II Major Elective Theory

Total: 2 Credits Workload: -15 hours. /Credit

(Total Workload: -2 credits x 15 hrs. = 30 hours in semester)

Course outcomes COs	
After studying the course learners will be able to	
CO 1	To understand biological nitrogen fixation and it's regulation.
CO 2	Gain knowledge of enzymes involved in nitrogen metabolism.
CO 3	Understand anaerobic respiration with respect to chemolithotrphs
CO 4	Differentiate between oxygenic and anoxygenic photosynthesis mechanism

MB 562 MJ –TH : Molecular Biophysics

Total: 2 Credits Workload: -15 hours. /Credit

(Total Workload: -2 credits x 15 hrs. = 30 hours in semester)

Course outcomes COs	
After studying the course learners will be able to	
CO1	Understand proper handling of various instruments.
CO2	Know the importance of the use of X-ray crystallography in purification of proteins.
CO3	Understand application of Radioisotopes in Biology.
CO4	To know the usefulness/Utility of Confocal Microscopy.

MB 563 MJ -TH: Bioinformatics

Group IV Major Elective Theory

Total:2 Credits Workload:-15 hrs/credit

(Total Workload :-2 credits x 15 hrs= 30 hrs in semester)

Course outcomes COs	
After studying the course learners will be able to	
CO 1	Understand the importance of bioinformatics.
CO 2	Use methods of sequencing and various databases for microorganisms.
CO 3	Learn how to submit the sequences to databases.

CO 4	Understand the use of tools and software in bioinformatics.

M.Sc Practicals

MB 554 MJ –PR : Practicals based on MB 551 MJ-TH, MB 552 MJ -TH, MB 553 MJ -TH
Compulsory Practical Paper

Total:4 Credits Workload: -30 hrs/credit

(Total Workload:-4 credits x 30 hrs= 120 hrs in semester)

Course outcomes COs	
After studying the course learners will be able to	
CO 1	Understand various Molecular Biology techniques which includes study of DNA, RNA, proteins etc.
CO 2	Know the preparation of standard solutions, calculations and preparations for cellular extraction of biomolecules and their purification.
CO 3	Experience a hands-on approach and the troubleshooting during processing of the biomolecules.
CO 4	Have an insight in the usage of bioinformatics and data bases in gene annotation procedure.

MB 560 MJ -PR: Practical based on MB 525 MJ-TH Molecular Biology tools and application
Group I Major Elective Practical

Total: 2 Credits Workload: -30 hours. /Credit

(Total Workload: -2 credits x30 hrs=60 hrs in semester)

Course outcomes COs	
After studying the course learners will be able to	
CO1	Explain principle and procedures of various molecular techniques.
CO2	Explain the concept of microarray.
CO3	Describe various hybridization techniques.
CO4	Explain the concept of recombinant DNA technology.
CO5	Describe the use of Biopolymers.

MB 561 MJ -PR -Practical based on Nitrogen Metabolism, Respiration and Photosynthesis

Group II Major Elective Practical

Total: 2 Credits Workload:-30 hours /credit

(Total Workload:-2 credits x 30hrs=60 hours in semester)

Course outcomes COs	
After studying the course learners will be able to	
CO 1	Isolate Plant growth promoting microorganisms.
CO 2	Know the extraction and estimation of polyphenols, tannins.
CO 3	Isolate and characterize Cyanobacteria.
CO 4	Isolate and characterize lignin/xylan degraders

MB 562 MJ- PR : Molecular Biophysics Group III Major Elective Practical based on MB 562 MJ - TH

Total: 2 Credits Workload: -30 hours. /Credit

(Total Workload: -2 credits x30 hrs=60 hrs in semester)

Course outcomes COs	
After studying the course learners will be able to	
CO1	Understand the Experimentation and interpretation of data using Radioisotopes.
CO2	To solve virtual lab problem-based exercises
CO3	To know the Utility of various instruments.
CO4	Learn the use of instruments in biophysical techniques.

MB 563 MJ -PR: Bioinformatics

Group IV Major Elective Practical based on MB 563 MJ-TH

Total:2 Credits Workload:-30 hrs/credit

(Total Workload :-2 credits x 30 hrs= 60 hrs in semester)

Course Outcomes (COs)	
After studying this course learners will be able to	
CO1	Understand the gene sequencing process.
CO2	Explain the process of amplification and purification of 16S rRNA.
CO3	Carry out Sequence matching and BLAST Analysis.
CO4	To draw phylogenetic tree.