



(Autonomous) Sion (West), Mumbai – 400022

Faculty: Science

Program: B.Sc.

Subject: MICROBIOLOGY

Academic Year: 2024– 2025

AS PER NATIONAL EDUCATION POLICY 2020

Choice Based Credit System (CBCS)

S.Y.B.Sc. (Major)

**Revised Credit Based Semester and Grading Syllabus approved by
Board of Studies in Microbiology brought into effect from June 2024**

Approved in academic council meeting on 7th August 2024

PROGRAM OUTCOME (PO)

At the end of an Undergraduate Program, a student would have obtained the following:

- **PO1. Solving Complex Problem:**

Applying the knowledge of various courses learned under a program with an ability to break down complex problems into simple components, by designing processes required for problem solving.

- **PO2. Critical Thinking:**

Organizing thoughts to identify assumptions, verifying the accuracy and validity of assumptions, making informed decisions that guide actions (at Institutional, Personal and Intellectual level), developing the ability to think with different perspectives and ideas.

- **PO3. Reasoning ability and rational thinking:**

Developing rational thinking on the basis of acquired contextual knowledge, assessing societal, public health and safety, cultural, legal, gender, ethnic and environmental issues, and performing with decisive responsibility.

- **PO4. Research skill:**

Utilizing the contextual knowledge in an interdisciplinary framework. Integrating research-based knowledge and research methods involving problem definition, analysis and interpretation of data, synthesis of the information to provide valid conclusions. Exercising analytical skill, research ability, creativity, for employability and collaborating with industries.

- **PO5. Effective Communication skill:**

Facilitating to speak, read, write and listen effectively through both formal language and in one's own mother tongue, in order to make meaning of the world around. Enabling to comprehend and write effective reports and documentation, make successful presentations, give and receive clear instructions.

- **PO6. Proficiency with ICT:**

Equipping to create, select, apply appropriate tools and techniques, resources through electronic media for the purpose of gathering, analyzing data and drawing inference with an understanding of its merits and demerits.

- **PO7. Social Interactive Skills and team work:**

Eliciting networking with people, mediate disagreement and help reach conclusions in group settings. Functioning effectively as an individual, and as a member in diverse groups, and in multidisciplinary settings exhibiting adaptability, leadership quality and team-building

- **PO8. Ethical values:**

Recognizing and respecting different value systems including one's own, to understand the moral dimensions of one's decisions, intention to help the society and feeling good about it, commitment to professional duties and responsibilities.

- **PO9. Self-directed Learning:**

Acquiring the ability to explore and gain knowledge in independent ways, keep evolving lifelong in the broad context of socio-technological changes.

- **PO10. Sensitization towards Environment and Sustainability:**

Understanding the need for sustainable development and concern for environmental issues, realizing the importance of cohabitation, co-evolution in our achievements of sustainable development goal

- **PO11. Gender Sensitization:**

Demonstrating knowledge and understanding of gender equity-issues and gender justice.

- **PO12. Civic Values and Global Citizenship:**

Expressing empathetic social concern while helping others when their rights are violated, no matter where in the world they live, to act with an informed awareness on issues, to participate in civic life by volunteering for social justice.

PROGRAMME SPECIFIC OUTCOMES (PSO) (FOR MICROBIOLOGY)

- PSO1: Students will be introduced to the subject of Microbiology which is not taught at the junior college
- PSO2: Eloquence in specific phraseology pertaining to the subject of microbiology.
- PSO3: Familiarize with the theories and techniques of the various areas in microbiology.
- PSO4: Obtain expertise in essential practical techniques required in microbiological analysis and prepare for advance studies.
- PSO5: Discuss the applications of microorganisms in the various fields of microbiology.

Course code	MAJOR PAPER I	
	SEMESTER III	
SIUMIMJ211	Nucleic acid chemistry , Nanotechnology and Analytical techniques	3 Credits (45 lectures)
Unit-I	Nucleic acid chemistry	15 lectures
Unit-II	Nanobiotechnology, biofilms & biosensors with applications	15 lectures
Unit-III	Analytical techniques – I	15 lectures
	PRACTICALS	1 Credit

Course code	MAJOR PAPER II	
	SEMESTER III	
SIUMIMJ212	Water Microbiology , Epidemiology & Immunology	3 Credits (45 lectures)
Unit-I	Potable water & Sewage Microbiology	15 lectures
Unit-II	Epidemiology & Diagnostic Microbiology	15 lectures
Unit-III	Introduction to Immunology	15 lectures
	PRACTICALS	1 Credit

Course code	MAJOR PAPER I	
	SEMESTER IV	
SIUMIMJ221	Metabolism and Basic Analytical Techniques	3 Credits (45 lectures)
Unit-I	Introduction To Metabolism and Bioenergetics	15 lectures
Unit-II	Enzyme Kinetics	15 lectures
Unit-III	Analytical techniques II	15 lectures
	PRACTICALS	1 Credit

Course code	MAJOR PAPER II	
	SEMESTER IV	
SIUMIMJ222	Dairy Microbiology, Food Microbiology and Taxonomy	3 Credits (45 lectures)
Unit-I	Dairy Microbiology	15 lectures
Unit-II	Food Microbiology	15 lectures
Unit-III	Microbial Taxonomy	15 lectures
	PRACTICALS	1 Credit

S.Y.B.Sc. MICROBIOLOGY SYLLABUS

SEMESTER III MAJOR PAPER I

Course: Nucleic acid chemistry, Nanotechnology and Analytical techniques

Course code: SIUMIMJ211

Course Outcomes (CO)

At the end of the course the students will be able to:

1. Understanding the nucleic acid molecules & central dogma, genetic code as the basis of life, DNA mutations and studying their effects on the genetic code and defining the different genetic elements
2. Discriminate between the techniques of nanoparticles, biofilm and biosensor and comparatively evaluate their applications.
3. Understanding the principle and working of spectroscopic and electrophoretic techniques and their applications.

Course code SIUMIMJ211	MAJOR PAPER I Nucleic acid chemistry, Nanotechnology and Analytical techniques	3 CREDITS
UNIT	TOPIC	LECTURES
Unit I	Nucleic acid chemistry and Genetic elements 1.1 Nucleic acid chemistry- Denaturation of double helical DNA and RNA Nucleic acid from different species can form Hybrids, Nucleotides and nucleic acids undergo non enzymatic transformations, DNA methylation 1.2 Other Functions of nucleotides 1.3 Central dogma of life, Genetic code 1.4 Plasmids and types of Plasmids 1.5 Transposons (Structure and Types)	15L

<p>Unit II</p>	<p>Nanobiotechnology, Biofilms and biosensors with applications</p> <p>2.1 Nanobiotechnology:</p> <ul style="list-style-type: none"> • Introduction of Nanobiotechnology, • Types of nanomaterials, nanoparticles, nanocapsules, nanotubes, liposomes, nanogels, Dendrimers, Gold nanoparticles(Definitions) • UV characterization of nanoparticles Application in drug and gene delivery <p>2.2 Biofilms and biosensors</p> <ul style="list-style-type: none"> • Biofilms: Introduction of biofilms, Types of biofilms, Mechanism of formation of biofilms and applications of biofilms. • Biosensors: Introduction, design, working and applications of biosensors 	<p>15L</p>
<p>Unit III</p>	<p>Analytical Techniques I</p> <p>3.1 Spectroscopic Techniques- Visible, UV and IR spectrophotometry Principles, instrumentation and applications</p> <p>3.2 pH meter: principle, instrumentation and Application</p> <p>3.3 Electrophoresis - General principles, Factors affecting electrophoresis, apparatus, support media- agarose gels, polyacrylamide gels & applications</p>	<p>15L</p>

S.Y.B.Sc. MICROBIOLOGY SYLLABUS

SEMESTER III MAJOR PAPER II

Course: Water Microbiology, Epidemiology & Immunology

Course code: SIUMIMJ212

Course Outcomes (CO)

At the end of the course the students will be able to:

1. Review of freshwater and sewage microbiology and understanding the methods of potability testing and sewage treatment.
2. Study the epidemiological methods of disease and evaluate different diagnostic techniques in diagnostic microbiology.
3. Distinguish between different types of immunity and review their role in disease Control.

Course code SIUMIMJ212	MAJOR PAPER II Water Microbiology, Epidemiology & Immunology	3 CREDITS
UNIT	TOPIC	LECTURES
Unit I	Water Microbiology-Fresh Water and Sewage Microbiology 1.1 Fresh water environments and micro-organisms found in Springs, rivers and streams, Lakes,marshes and bogs 1.2 Potable water: Definition, water purification, water quality standards and pathogens transmittedthrough water 1.3 Microbiological analysis of water: Indicator organisms and their detection in water-Total Coliforms, Faecal Coliforms and <i>E. coli</i> , Faecal <i>Streptococci</i> , <i>Clostridium perfringens</i> 1.4 Modern Waste Water treatment: Primary,Secondary & Tertiary treatment 1.5 The nature of wastewater and Monitoring of waste water treatment process (BOD,COD) 1.6 Removal of Pathogens by Sewage treatment	15L

	<p>Processes</p> <p>1.7 Oxidation Ponds and Septic tanks</p> <p>1.8 Sludge Processing</p> <p>1.9 Disposal of treated waste water and biosolids.</p>	
Unit II	<p>Epidemiology and Diagnostic Microbiology</p> <p>2.1 Epidemiological terminology: Epidemiology, sporadic diseases, endemic diseases, Hyperendemic Diseases, Epidemic Diseases, Index Case, Pandemic Disease, Outbreak</p> <p>2.2 The Spread of Infection:</p> <p>a) Reservoirs of infection-Human reservoir, Animal reservoir, non-living reservoir.</p> <p>Transmission of Disease- Contact transmission, Vehicle Transmission and vectors</p> <p>2.3 Nosocomial infection: (1L)</p> <p>Microorganisms in hospitals, compromised host, Transmission and control of Nosocomial infection</p> <p>2.4 Isolation of Pathogens from clinical specimens:</p> <p>a) Growth media and Culture</p> <p>b) Collection of specimens, handling and transport</p> <p>c) Types of specimens and their culture ---Blood, Urine, Faeces, sputum, Cerebrospinal fluid, pus, genital and culture of Anaerobes.</p> <p>2.5 Identification of microorganisms from specimens:</p> <p>a) Microscopy</p> <p>Growth-Dependent Identification Methods</p> <p>2.6 Rapid Methods of Identification: Molecular Methods and Analysis of Metabolic Products:</p> <p>a) Nucleic Acid –Based Detection Methods</p> <p>b) Gas liquid Chromatography</p> <p>Plasmid Fingerprinting</p>	15L

Unit III	<p>Introduction to Immunology</p> <p>3.1 Basic concepts in immunology Hematopoiesis, Blood cell types, Components of immune system – Cells and organs of the immune system</p> <p>3.2 Humoral and Cell mediated immune response</p> <p>3.3 Phagocytosis and Acute and chronic inflammation</p>	15L
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S.Y.B.Sc. MICROBIOLOGY SYLLABUS

SEMESTER III

Course code	PRACTICALS	1 Credit
SIUMIMJP211	MAJOR PAPER I	1 Credit
	TOPIC	
	<ol style="list-style-type: none"> 1. Estimation of total sugars by Anthrone method Estimation of reducing sugar by DNSA method 2. Estimation of protein Biuret method (indirect and direct) 3. Estimation of DNA by DPA method 4. Estimation of RNA by Orcinol Method 5. Preparation of Nanoparticles and their characterization using UV Spectrophotometer 6. Introduction to colorimeter and study of λ_{\max} 7. Data representation and interpretation 8. U.V. spectrophotometer (Demo) 9. DNA estimation by UV Spectrophotometer technique 10. Working of a pH meter 	

Course code	PRACTICALS	1 Credit
SIUMIMJP212	MAJOR PAPER II	1 Credit
	TOPIC	
	<ol style="list-style-type: none"> 1. Determination of total solids in wastewater 2. Determination of BOD and COD of wastewater 3. Visit to a sewage treatment plant or water purification plant 4. Use of Selective and Differential Solid Media: Mac Conkeys agar, SS agar, XLD agar, TCBS agar, SIBA, Salt Mannitol agar, CLED agar, Cetrimide agar 5. Blood staining by the Field's method 6. Preparation of serum and plasma 	

**SYBSc Microbiology Syllabus
Semester - 4**

MAJOR PAPER I

Course: Metabolism and Basic Analytical Techniques

Course code: SIUMIMJ221

Course Outcomes (CO)

At the end of the course the students will be able to:

1. Understanding the principles of bioenergetics with respect to cellular metabolism.
2. Understanding the enzyme kinetics and summarizing the various factors affecting enzyme kinetics.
3. Understanding the principle and working of chromatographic and centrifugation techniques and their applications.

COURSE CODE	MAJOR PAPER I	3 CREDITS
SIUMIMJ221	Metabolism and Basic Analytical Techniques	45 LECTURES 3 CREDITS
UNIT	TOPIC	LECTURES
Unit I	Introduction To Metabolism and Bioenergetics 1.1 Bioenergetics and thermodynamics: Energy transformations, thermodynamic quantities, standard –free energy, difference between ΔG & ΔG_o 1.2 Structure of ATP, phosphoryl group transfer and ATP, Types of energy – rich compounds, multi-roles of ATP, inorganic phosphoryl group donor 1.3 Biochemical and chemical reactions, Biological oxidation-reduction reaction	
Unit II	Enzyme Kinetics 2.1 Introduction of Enzymes: <ul style="list-style-type: none"> • General properties of enzymes • Concept of activation energy • Rate law for a simple catalyzed reaction • Michaelis-Menten equation and it's derivation 	15L

	<ul style="list-style-type: none"> • Lineweaver Burk plot • Classification of enzymes <p>2.1 Overview of Coenzyme:</p> <ul style="list-style-type: none"> • Coenzymes: Different types and reactions catalyzed by coenzymes NAD⁺: structure, occurrence and biochemical function <p>2.3 Enzyme Kinetics:</p> <ul style="list-style-type: none"> • Saturation kinetics • Effect of temperature and pH • Effect of Inhibitors- Reversible and irreversible, competitive, Noncompetitive and uncompetitive inhibitors • Multisubstrate reactions- Ordered, Random and pingpong reactions. • Allosteric effects in enzyme catalysed reactions- Koshland-Nemethy and Filmer model and Monod, Wyman and Changeux model 	
Unit III	<p>Analytical techniques</p> <p>3.1 Paper and thin layer Chromatography: Introduction to chromatography, types of chromatography Paper chromatography: Principle, circular, ascending and descending Paper Chromatography, Thin layer chromatography :principle, preparation of TLC plates, procedure forTLC, preparative TLC, 2D TLC, HPTLC</p> <p>3.2 Column chromatography : Introduction and principleSize Exclusion chromatography , Ion Exchange chromatography, Affinity chromatography, High Performance Liquid chromatography Gas chromatography</p> <p>3.3 Centrifugation Introduction : basic principles of sedimentation, Types, Preparative centrifugation and its applications, Analytical centrifugation and its applications</p>	15

MAJOR PAPER II

Course: Dairy Microbiology, Food Microbiology and Taxonomy

Course code: SIUMIMJ222

Course Outcomes (CO)

At the end of the course the students will be able to:

1. Define the basics of dairy microbiology and applying the role of microbes to develop dairy products.
2. Understand the role of microbes in food microbiology with respect to food production, spoilage and preservation.
3. Classify microorganisms based on taxonomic principles and evaluate the different methods of microbial taxonomy.

COURSE CODE	MAJOR PAPER II	3 CREDITS 45 LECTURES
SIUMIMJ222	Dairy Microbiology, Food Microbiology and Taxonomy	
UNIT	TOPIC	LECTURES
Unit I	Dairy Microbiology 1.1 Milk- Definition, composition, Spoilage of milk: Sources of contamination of milk. Color defects, Flavour defects, Ropiness of milk Stormy fermentation of milk 1.2 Pasteurization of milk <ul style="list-style-type: none">• LTLT, HTST, UHT Method• Efficiency testing of Pasteurization (Phosphatase Test)• Milk products- production of a Yoghurt, Butter, Cheese-Cheddar and Cottage cheese, Dried milk. 1.3 Quality control of milk:- <ul style="list-style-type: none">• Rapid platform test:- MBRT, Resazurin• Microbiological analysis of milk:- SPC, Coliformcount, Psychrophiles, Thermophilic count.	15L

<p>Unit II</p>	<p>Food Microbiology</p> <p>2.1 Introduction: Significance, food as a substrate and sources, Intrinsic and extrinsic factors</p> <p>2.2 General Principles of spoilage: Spoilage of fresh foods: fruits and vegetables, eggs, meat, poultry and seafood.</p> <p>2.3 General principles of food preservation (principle of each method and example of foods only): High temperature (Including TDT, TDP, D, F and Z value), Low temperature (Freezing), Asepsis, Drying, Radiations, Chemical preservatives</p> <p>2.4 Food control agencies:- HACCP, FDA, FSSAI</p> <p>2.5 Methods of detection of microorganisms in food: overview of cultural, microscopic, physical, chemical and bioassay methods</p>	<p>15L</p>
<p>Unit III</p>	<p>Microbial Taxonomy</p> <p>3.1 Introduction to microbial taxonomy</p> <p>3.2 Systems of classification (Cavalier Smith 6 kingdom) Bergey's manual</p> <p>3.3 The three domain concept based on phylogeny- Nomenclature, Taxonomic ranks, Numerical Taxonomy</p> <p>3.4 Methods of analysis used in classification: Phenotypic analysis (Morphological characteristics Physiological and metabolic characteristics, Biochemical characteristics, Ecological characteristics, Fatty acid analysis).</p> <p>3.5 Microarray Nucleic acid sequencing types, Phylogenetic tree: concept</p>	<p>15</p>

**SYBSc Microbiology Syllabus
Semester 4**

COURSE CODE	PRACTICALS	1 Credits
SIUMIMJP221	MAJOR PAPER I	1 Credit
	<ol style="list-style-type: none"> 1. Problems on bioenergetics to calculate the K_{eq}; Gibbs energy, enthalpy, etc 2. Effect of pH, Temp, substrate and enzyme concentration on activity of invertase. 3. Determination of K_m and V_{max} of an enzyme 4. Separation and identification of amino acids by ascending paper chromatography 5. Density gradient centrifugation and sizing of yeast cells 	

COURSE CODE	PRACTICALS	1 Credits
SIUMIMJP222	MAJOR PAPER II	1 Credit
	<ol style="list-style-type: none"> 1. Visit to Food/Dairy industry 2. RPT of Milk– RRT, MBRT, DMC 3. Isolation of food spoilage agent: 4. Fruit/Vegetable- Physical and Microscopic and Pectinolytic agent 5. Meat - Proteolytic, lipolytic, saccharolytic 6. Identification of bacteria using Bergey's Manual 	