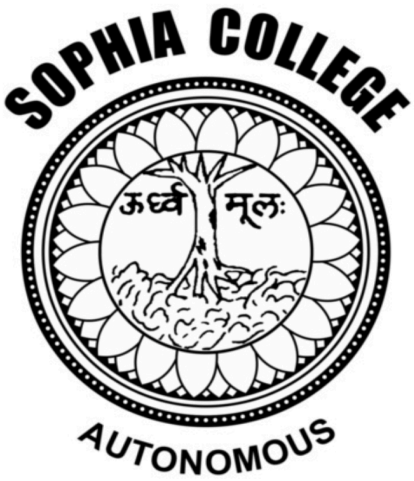

SOPHIA COLLEGE FOR WOMEN (AUTONOMOUS)

Affiliated to the University of Mumbai

Programme: Sciences

Microbiology (Major)

SYBSc MICROBIOLOGY

Syllabus for the Academic Year 2024-2025

based on the National Education Policy 2020

SOPHIA COLLEGE FOR WOMEN (AUTONOMOUS)

DEPARTMENT OF MICROBIOLOGY

COURSE DETAILS FOR MAJOR:

	SEMESTER 3			SEMESTER 4	
TITLE	**Major 3 Environmental Microbiology**	**Major 4 Basics of Biochemistry and Genetics**		**Major 5 Industrial Microbiology and Dairy Microbiology**	**Major 6 Epidemiology, Diagnostic Microbiology and Immunology**
TYPE OF COURSE	**DSC**	**DSC**		**DSC**	**DSC**
CREDITS	**4 (3 theory + 1 practical)**	**4 (3 theory + 1 practical)**		**4 (3 theory + 1 practical)**	**4 (3 theory + 1 practical)**

Preamble:
The department of Microbiology at Sophia College was founded in 1966. Microbiology is the study of life and tentative life forms that cannot be viewed by the unaided eye. The microscopic life encompasses bacteria, protozoa, algae, fungi, and viruses. These organisms impact many aspects of plant, animal and human life and progress.

The Undergraduate curriculum provides fundamental and applied aspects of Microbial life that impacts the rest of the biosphere.

The instructions methodology focuses on providing the fundamental basic information on Microbiology and progressing to the advances. Furthermore, there is emphasis on developing critical and analytical thinking and reasoning skills through problem solving in keeping with the

changing times. The courses provide training in Genetics, Biochemistry, Medical Microbiology, Immunology, Bioprocess technology, Food Science and Environmental Science. This interdisciplinary approach helps learners meet the requirements of higher education, research and industry.

PROGRAMME OBJECTIVES

PO1	To introduce the learners to Basic and Applied Microbiology.
PO2	To build a strong knowledge base in the learner as well as impart sound practical skills in the subject.
PO3	To provide opportunities for logical thinking, and critical reasoning, such that the learners can handle the demands of higher education, industry and research.
PO4	To impart soft skills in learners thereby enhancing employability.

PROGRAMME SPECIFIC OUTCOMES

PSO1	The learners will gain and apply knowledge of Genetics, Virology, Microbial Biochemistry, Medical Microbiology, Immunology, Cell Biology, Bioprocess technology, Environmental Microbiology, Food and Dairy Microbiology, etc to solve problems.
PSO2	The learners will acquire basic knowledge about scientific methodology, plan and execute experiments using good laboratory practices, and interpret the experimental results effectively.
PSO3	The students will undertake research projects, internships, visit industries, in order to become ready for higher studies, industry and research.
PSO4	The students will do value added courses in order to enhance their soft skills and employability.

SOPHIA COLLEGE FOR WOMEN (AUTONOMOUS)

Programme: SCIENCES **Microbiology Major 3**	**Semester –3**
Course Title: Environmental Microbiology	**Course Code: SMCB233MJ**

COURSE OBJECTIVES:

It aims to

1. provide students with the knowledge of pathogenic microorganisms and their products in air, launching of bioaerosols, their spread and deposition on surfaces
2. promote an understanding of the various methods of studying soil microorganisms.
3. facilitate understanding of various types of microorganisms present in water, techniques for assessing water quality, and strategies for purifying drinking water.
4. familiarize students with the complex interactions between plants and soil microorganisms in the rhizosphere.
5. provide students with the knowledge of the various methods for studying soil microorganisms, encompassing microscopic, cultural, physiological, immunological, and nucleic acid-based techniques.
6. facilitate students' understanding of the importance of microorganisms in the environment, their diverse roles and functions.
7. cultivate an understanding of the involvement of microorganisms in diverse processes related to wastewater treatment
8. facilitate the identification and knowledge of the characteristics of extremophiles found in various extreme environments.
9. equip students with analytical skills related to the molecular adaptations of extremophiles and their potential applications in biotechnology.

COURSE OUTCOMES:

At the end of the course, the learner will be able to

1. comprehend the details regarding airborne pathogenic microorganisms, their airborne transmission routes, including entry, spread, and deposition mechanisms on surfaces.
2. apply knowledge of diverse methodologies for analysing soil microorganisms including microscopic, cultural, physiological, immunological, and nucleic acid-based approaches.

3. analyze the types of microorganisms present in water sources and evaluate methods for assessing water quality.
4. propose appropriate purification techniques for the treatment of drinking water based on an understanding of microbial contaminants and their removal.
5. explain the processes for treatment of wastewater
6. interpret the intricate interactions between plants and soil microorganisms within the rhizosphere, elucidating their roles in nutrient cycling, plant growth promotion, and disease suppression.
7. explain the concept of ecosystem services and the role played by microorganisms in maintaining ecosystem balance.
8. identify and describe the characteristics of extremophiles found in different extreme environments, including temperature-based, pH-based, and high salt concentration environments.
9. discuss the molecular adaptations of extremophiles and explore their potential applications in various fields such as biotechnology and environmental science.

Theory Lectures per week (1 Lecture is 60 minutes)		**3**	
Total number of Hours in a Semester		**45**	
Credits		**3**	
Evaluation System	**Semester End Examination**	**2 hrs**	**50 marks**
	Internal Assessment	**-**	**50 marks**

UNIT 1 Air and Soil Microbiology (1 Credit)	1.1	Air Microbiology a. Number and kinds of organisms in air; droplet nuclei - aerosol, some important air borne pathogens and toxins b. Aeromicrobiological pathway c. Methods to study airborne microorganisms d. Air sanitation	15 hours
	1.2	Soil Microbiology a. Terrestrial environments, types of organisms and their activities (overview) b. Carbon, Nitrogen and Sulfur cycles. c. Plant - microbial interactions in rhizosphere- root nodulation, mycorrhiza and soil microorganisms as biocontrol agents d. Methods to study soil microorganisms- microscopic, cultural, physiological, immunological and nucleic acid based methods	
UNIT 2 Fresh and Wastewater Microbiology (1 Credit)	2.1	Freshwater Microbiology a. Niches and Microenvironment, freshwater habitats and microorganisms, oxygen relationships in freshwater environments b. Biological indicators of water pollution, bacteriological assessment of water quality and water borne diseases. c. Purification of drinking water	15 hours
	2.2	Wastewater Microbiology a. Types of wastewater b. Sewage treatment i. Primary, Secondary and Tertiary treatment ii. BOD, COD and TOC iii. Oxidation ponds and Septic tanks iv. Disposal of treated effluent and sludge	
UNIT 3 Extreme Environment (1 Credit)	3.1	Microorganisms and environment Ecosystem services and the role played by microorganisms in ecosystems.	15 hours
	3.2	Extremophiles	

		a. Characteristics and examples of the following extreme environments: Temperature based environments- Low and high temperature environments, pH based environments- Acidic and Alkaline environments, Environments with high salt concentration. b. Morphology, physiology and cultural characteristics of thermophiles, psychrophiles, acidophiles, alkaliphiles and halophiles. c. Molecular adaptations and applications of thermophiles, psychrophiles, acidophiles, alkaliphiles and halophiles.	

Programme: SCIENCES **Microbiology Major 3 Practical**	**Semester –3**
Course Title: Environmental Microbiology Practical	**Course Code: SMCB233MJP**

COURSE OUTCOMES:

The learner will be able to

1. carry out microbial analysis of air of various environments like laboratories, media preparation rooms, classrooms etc study the variation in the number and types of microbial flora and calculate the gravity sedimentation rate.
2. use the liquid impinger (air sampler) to collect the air sample of a laboratory or any other room and determine the count of the bacteria and yeast present in the same.
3. use appropriate media, for example, Starkey's medium for sulfate reducers, and mineral medium for nitrifiers for the enrichment of these groups in order to study their morphological and metabolic activities.
4. prepare Winogradsky's column in order to study microbiological diversity in specific environments like soil and water.
5. collect drinking water samples, perform presumptive, confirmed and completed tests and examine and interpret whether the samples are fecally contaminated or not.
6. determine the BOD of waste waters and analyze the results.
7. learn to enrich and isolate the thermophiles and halophiles, study their growth and morphological characteristics.

8. distinguish between a research and a review article, and search and identify a review article on an extremophile			
Lectures per week (1 Lecture is 120 minutes)		**1**	
Total number of Hours in a Semester		**30**	
Credits		**1**	
Evaluation System	**Semester End Examination**	**2 hrs**	**50 marks**
	Internal Assessment	**-**	

	1	Determination of air quality by gravity sedimentation method.	30 hours
	2	Enumeration of microorganisms in air by liquid impingement.	
	3	Enrichment and isolation of sulphate reducers.	
	4	Enrichment and isolation of Nitrosifiers and Nitrifiers.	
	5	Setting of Winogradsky's column and microbial analysis.	
	6	Microbiological analysis of drinking water.	
	7	Determination of BOD.	
	8	Enrichment and isolation of thermophilic bacteria.	
	9	Enrichment and isolation of halophilic bacteria.	
	10	Assignment/Activity- a. To understand the difference between a research paper and a review article b. To search and understand a review article on any extremophile. There will be compulsory questions on this activity in the quiz and the viva.	

SOPHIA COLLEGE FOR WOMEN (AUTONOMOUS)

Programme: SCIENCES **Microbiology Major 4**	**Semester – 3**
Course Title: Basics of Biochemistry and Genetics	**Course Code: SMCB234MJ**

COURSE OBJECTIVES:

It aims to

1. explore the structural diversity and complexity of various biologically relevant macromolecules
2. discuss the relationship between function and structure of macromolecules.
3. discuss the experiments performed to determine the genetic material
4. describe the prokaryotic and eukaryotic chromosomes, and their packaging
5. compare the chromosome with non-chromosomal elements
6. describe the molecular details of gene expression i.e transcription and translation and genetic code

COURSE OUTCOMES:

At the end of the course, learner will be able to

1. describe various types of biological macromolecules found in microorganisms.
2. describe the basic units of carbohydrates, proteins, lipids and nucleic acids
3. list the types of linkages between the building blocks of carbohydrates, proteins, lipids and nucleic acids.
4. compare the characteristics of primary, secondary, tertiary and quaternary structures of proteins
5. recall and explain the details of the experiments performed in search of the genetic material
6. describe the supercoiling in bacteria and nucleosome packaging in eukaryotes
7. compare and contrast the transcription process in bacteria and eukaryotes
8. explain the translation process and features of genetic code
9. apply the fundamentals of gene expression (transcription, translation) in understanding concepts in the fields of molecular biology, regulation of gene expression and virology in subsequent semesters

Theory Lectures per week (1 Lecture is 60 minutes)	**3**
Total number of Hours in a Semester	**45**
Credits	**3**

SOPHIA COLLEGE FOR WOMEN (AUTONOMOUS)

Programme: SCIENCES **Microbiology Major 4**		**Semester – 3**	
Evaluation System	**Semester End Examination**	**2 hrs**	**50 marks**
	Internal Assessment	**-**	**50 marks**

		Molecular building blocks of macromolecules (Occurrence, properties, Classification), structure and functions of :	
UNIT 1 Structure and functions of macromolecules (1 Credit)	1.1	Carbohydrate: a. Monosaccharides (hexoses , pentoses), Glycosidic bond b. Disaccharides (sucrose, lactose, maltose). c. Polysaccharides (Starch, Cellulose, Chitin) d. sugar derivatives (Glycoproteins; peptidoglycan, LPS)	15 hours
	1.2	Proteins : a. Amino acids- structure,classification b. Peptide bond formation. c. Different level of structural organization of proteins (primary, secondary, tertiary or quaternary)	
	1.3	Lipids: a. Fatty acids nomenclature, Acyl linkage b. Classification of lipids Storage lipids(Triacylglycerol) , structural lipids (Glycerophospholipid).	

	1.4	Nucleic acids: a. Purines and Pyrimidines, nucleosides and nucleotides, b. Ribonucleic and deoxyribonucleic acid, . Significance of phosphodiester linkage and hydrogen bond c. Chargaff's rules, 3D structure of DNA (Watson and Crick model), Forms of DNA (A,B and Z)	
UNIT 2 DNA and Chromosomes (1 Credit)	2.1	The Search for the genetic material a. Griffith's transformation experiment b. Avery's transformation Experiment c. Hershey and Chase's Bacteriophage experiment d. RNA as viral genetic material (briefly)	15 hours
	2.2	Gene and its function	
	2.3	Chromosomes a. Prokaryotic chromosomes, Supercoiling- negative and positive supercoiling and role of topoisomerases I and II b. Eukaryotic chromosomes- structure of chromatin, histones and nonhistones, nucleosome and nucleosome packaging, Euchromatin and heterochromatin, centromere, telomere and its sequences	
	2.4	Non chromosomal elements - Plasmids and Transposable elements	
	2.5	Properties of DNA - Absorption of UV light, Sedimentation behavior and Denaturation-Renaturation Properties of DNA	
UNIT 3 Gene expression and the Genetic Code (1 Credit)	3.1	Gene expression a. Central dogma - Overview b. Transcription- Introduction c. Transcription in bacteria - Initiation (promoter, consensus sequence, structure and function of RNA polymerase enzyme - holoenzyme and core enzyme, function of sigma factor), elongation,	15 hours

		termination - Rho-dependent and Rho-independent termination mechanisms d. Transcription in Eukaryotes - Eukaryotic RNA polymerases, promoters, production of mature mRNA in eukaryotes (processing) - 5' modification, 3' modification, splicing (briefly) comparison of transcription in prokaryotes and eukaryotes. e. Translation - Initiation, elongation and termination of translation	
	3.2	The Genetic code a. Deciphering the Genetic code b. Characteristics of the genetic code c. Exceptions to the Genetic code	

Programme: SCIENCES **Microbiology Major 4 Practical**	**Semester –3**
Course Title: Basics of Biochemistry and Genetics Practical	**Course Code: SMCB234MJP**
COURSE OUTCOMES: The learner will be able to 1. apply the qualitative tests to detect the presence of biomolecules in various samples 2. determine the concentration of reducing sugars, proteins, DNA and RNA using colorimetric methods like DNSA, Biuret, Diphenylamine and Orcinol methods respectively 3. extract DNA from onions and check its purity using Uv-visible spectrophotometer.	
Lectures per week (1 Lecture is 120 minutes)	**1**
Total number of Hours in a Semester	**30**

SOPHIA COLLEGE FOR WOMEN (AUTONOMOUS)

Credits		**1**	
Evaluation System	**Semester End Examination**	**2 hrs**	**50 marks**
	Internal Assessment	**-**	

	1	Qualitative detection of- carbohydrates by Benedict, Molisch test, amino acids by Ninhydrin test, proteins by biuret test	30 hours
	2	Estimation of reducing sugars by DNSA method	
	3	Estimation of proteins by Biuret method.	
	4	Estimation of DNA by Diphenylamine method.	
	5	Estimation of RNA by Orcinol method.	
	6	Isolation of genomic DNA from onion and its confirmation using UV-visible spectrophotometer.	

ASSESSMENT DETAILS:

I. Internal Assessment (IA): 50 marks
II. Semester End Examination (SEE): 50 marks

REFERENCES:

SMCB233MJ Environmental Microbiology

1. Kołwzan B., Adamiak W., Grabas K. & Pawełczyk A. (2006) Introduction to Environmental Microbiology, *Oficyna Wydawnicza Politechniki Wrocławskiej.*
2. Madigan, M. T., Bender, K. S., Buckley, D. H., Sattley, W. M., & Stahl, D. A. (2019). Brock Biology of Microorganisms, 15th edn. *Pearson.*
3. Maier R. M., Pepper I. L. & Gerba C. P., (2010) Environmental Microbiology 2nd edn, *Academic Press, California.*

4. Pelczar Jr M. J., Chan E. C. S. & Krieg N. R. (2010) Microbiology: Application Based Approach, 1 st edn, *New Delhi, Tata McGraw Hill.*
5. Salle A. H., (2007) Fundamental Principles of Bacteriology 7 th edn, *McGraw-Hill Book Company.*
6. Willey J.M., Sherwood L.M., & Woolverton C.J. (2008) Prescott, Harley and Klein's Microbiology 7 th edn, *New York, McGraw Hill International Edition.*

SMCB234MJ Basics of Biochemistry and Genetics

1. Brooker, Robert J. (2012). Genetics: Analysis & Principles, 4th edn, *McGraw-Hill.*
2. Klug, William S., Cummings, Michael R., Spencer, Charlotte A., & Palladino, Michael A. (2015). Concepts of Genetics, 11th edn, *Pearson Education India.*
3. Madigan, Michael T., Martinko, John M., Stahl, David A., & Clark, David P. (2012). Brock Biology of Microorganisms, 13th edn, *Benjamin Cummings*.
4. Madigan, Michael T., Bender, Kelly S., Buckley, Daniel H., Sattley, W. Matthew., & Stahl, David A. (2018). Brock Biology of Microorganisms, 15th edn, *Pearson.*
5. Nelson D., Cox M., & Hoskins A., (2021). Lehninger Principles of Biochemistry 8th edn.*MacMillan Publishing Company.*
6. Pierce, Benjamin A. (2012). Genetics: A Conceptual Approach, 4th edn, *W. H. Freeman and Company.*
7. Russell, Peter J. (1998). Genetics, 5th edn, *Benjamin Cummings.*
8. Russell, Peter J. (2010). iGenetics: A Molecular Approach, 3rd edn, *Benjamin Cummings.*
9. Snustad, Peter D., & Simmons, Michael J. (2012). Principles of Genetics, 6th edn, *John Wiley & Sons, Inc.*
10. Willey, Joanne M., Sherwood, Linda M., & Woolverton, Christopher J. (2008). Prescott, Harley, and Klein's Microbiology, 7th edn, *McGraw-Hill Higher Education.*

SOPHIA COLLEGE FOR WOMEN (AUTONOMOUS)

Programme: SCIENCES Microbiology Major 5	Semester –4
Course Title: Industrial, Dairy and Food Microbiology	**Course Code: SMCB245MJ**

COURSE OBJECTIVES:

It aims to

1. provide an overview of the industrial microbiology
2. understand the types of screening
3. describe the classical design of a fermenter and its various components
4. understand the role of each of the media components and the process of inoculum preparation
5. describe and discuss the different types of fermentations and processes
6. understand the biotechnological importance of microorganisms for production of food, milk and dairy products
7. know about the microbial spoilage of food, milk and dairy products
8. learn about the methods used for microbiological analysis of food, milk and dairy products
9. understand the methods of prevention of microbial spoilage of food, milk and dairy products

COURSE OUTCOMES:

At the end of the course, learner will be able to

1. outline the process of industrial microbiology
2. classify primary and secondary screening methods
3. explain the design of a fermenter and identify the functions of its parts
4. explain the significance of each of the media components of a fermentation
5. distinguish between different types of fermentations
6. apply this knowledge in understanding other concepts of bioprocess technology in future semesters
7. explain the importance of microorganisms in the production of dairy products
8. describe the methods used to prevent the spoilage of food, milk and milk products
9. select appropriate methods for microbiological analysis of food, milk and milk products.

Theory Lectures per week (1 Lecture is 60 minutes)	**3**
Total number of Hours in a Semester	**45**
Credits	**3**

SOPHIA COLLEGE FOR WOMEN (AUTONOMOUS)

Evaluation System	**Semester End Examination**	**2 hrs**	**50 marks**
	Internal Assessment	**-**	**50 marks**

UNIT 1 Industrial Microbiology (1 Credit)	1.1	Overview of an industrial process (upstream and downstream processing), Industrially important microbial products along with the associated microorganisms	15 hours
	1.2	Screening a. Desirable characteristics of industrial strain b. Principles and methods of primary and secondary screening	
	1.3	Fermenter design: Basic parts of a mechanically agitated fermenter/ classic design	
	1.4	Media for industrial fermentations a. Introduction b. Media components: - Carbon source, nitrogen source, amino acids and vitamins, minerals, water, buffers, antifoam agents, precursors, inhibitors and inducers	
	1.5	Inoculum preparation	
	1.6	Types of fermentations a. Submerged b. Aerobic c. Anaerobic d. Solid state fermentations e. Surface fermentations	
	1.7	Types of fermentation processes (mode of operation) a. Batch b. Continuous c. Fed-batch fermentation process	

UNIT 2 Dairy Microbiology (1 Credit)	2.1	Milk- Definition, Composition of milk and Sources of contamination of milk, human pathogens associated with milk, effects of microbial contamination on milk quality and Control of microorganisms in milk, Pasteurization of milk-LTLT, HTST and UHT	15 hours
	2.2	Production and spoilage of i. Butter ii. Cheese- Types of cheese, production of Cheddar and Cottage cheese iii. Yogurt- Types, production of plain yogurt	
	2.3	Assessment of quality of milk a. Rapid platform test and organoleptic tests b. Microbiological analysis of milk.:- SPC, Coliform count, Laboratory Pasteurisation Count, Psychrophiles and Thermophilic count.	
UNIT 3 Food Microbiology (1 Credit)	3.1	Microbial growth in foods a. Intrinsic and extrinsic factors influencing growth of microorganisms in food.	15 hours
	3.2	a. General principles of spoilage b. Spoilage of foods i. Fruits and vegetables ii. Eggs iii. Meat and poultry iv. Canned food	
	3.3	General principles of food preservation (principle of each method and process used with example of foods) a. High temperature b. Low temperature c. Drying d. Radiations e. Food additives and preservatives (salt, sugar and organic acids only)	
	3.4	Food Safety a. Introduction to principles of HACCP b. Food borne diseases and intoxications (differences)	
	3.5	Methods of detection of microorganisms in food: a. Sampling of food and homogenisation methods	

		b. Overview of - i. Cultural methods -SPC, Spiral plate counter and MPN ii. Microscopic methods- DMC, Direct Epifluorescent Filter technique and microscopic colony counts iii. Physical methods (Principle and examples) Impedance, Microcalorimetry and Flow cytometry iv. Chemical methods (Principle and examples) - Limulus amoebocyte lysate (LAL) test, ATP measurement, Detection of Thermostable nuclease, Use of Fluoro and Chromogenic substrates and Radiometry v. Bioassay methods- Use of whole animals, animal models requiring surgical procedures and cell culture systems	

Programme: SCIENCES **Microbiology Major 5 Practical**	**Semester–4**
Course Title: Industrial, Dairy and Food Microbiology Practical	**Course Code:** **SMCB245MJP**
COURSE OUTCOMES: The learner will be able to 1. screen soil samples for microorganisms capable of producing antibiotics using Crowded plate and Wilkins agar methods. 2. perform MBRT, RRT, DMC, microbiological analysis of raw and pasteurized milk and examine the quality of the samples 3. correlate the concepts learnt during the lectures with the industrial visit 4. use starch agar, Gorodkowa's agar, and milk agar for isolation and detection of amylolytic, lipolytic, and proteolytic microorganisms respectively. 5. carry out the MIC of salt and sugar for microorganisms and apply the results obtained for preservation of food.	
Lectures per week (1 Lecture is 120 minutes)	**1**

SOPHIA COLLEGE FOR WOMEN (AUTONOMOUS)

Total number of Hours in a Semester		**30**	
Credits		**1**	
Evaluation System	**Semester End Examination**	**2 hrs**	**50**
	Internal Assessment	**-**	

	1	Isolation of antibiotic producers from soil using Crowded plate technique and Wilkins overlay method.	30 hours
	2	Rapid platform tests for determining the quality of raw and pasteurized milk samples: a. Methylene blue dye reduction test. b. Resazurin reduction test. c. Direct microscopic count.	
	3	Microbiological analysis of raw and pasteurized milk	
	4	Visit to any industry/Gowardhan Dairy.	
	5	Isolation and study of food spoilage causing microorganisms - amylolytic, lipolytic and proteolytic	
	6	Determination of minimum inhibitory concentration of salt	
	7	Determination of minimum inhibitory concentration of sugar (for yeast)	

Programme: SCIENCES **Microbiology Major 6**	**Semester –4**

SOPHIA COLLEGE FOR WOMEN (AUTONOMOUS)

Course Title: Epidemiology, Diagnostic Microbiology and Immunology	Course Code: SMCB246MJ

COURSE OBJECTIVES:

It aims to

1. understand the fundamental concepts and terminology used in epidemiology, including sporadic, endemic, hyperendemic, epidemic, and pandemic diseases.
2. analyze and interpret epidemiological data using measures such as morbidity rate, mortality rate, and prevalence rate.
3. identify and describe the different stages of an infectious disease and the methods used for surveillance and mapping of infectious diseases.
4. understand the principles and practices of clinical microbiology laboratory procedures.
5. identify and isolate pathogens from various clinical specimens using appropriate culture techniques.
6. apply laboratory methods for the identification and characterization of microorganisms.
7. investigate the historical progression of immunology, highlighting significant milestones and their impact on shaping our understanding of the immune system.
8. analyze the historical context surrounding immunological developments, including the role of diseases like smallpox, the use of royal poisons, and the emergence of early vaccines.
9. examine the pioneering contributions of Louis Pasteur in advancing immunological knowledge, particularly through his groundbreaking work on the Vibrio vaccine and its implications for immunology.
10. explore the components and functions of the innate immune system, including the anatomical and physiological barriers, mechanisms of phagocytosis, and the inflammatory response.
11. study the process of hematopoiesis, including the origins and functions of hematopoietic stem cells, the dynamics of hematopoiesis within the bone marrow, and the regulatory mechanisms involved.
12. examine the diverse array of cells comprising the immune system, focusing on their distinct roles, interactions, and contributions to immune function.
13. investigate the structure, function, and interplay of primary and secondary lymphoid organs, elucidating their significance in orchestrating immune responses and maintaining immune homeostasis.

COURSE OUTCOMES:

At the end of the course, learner will be able to

1. define and explain key epidemiological terms and concepts, and apply them to real-world scenarios.
2. to calculate and interpret epidemiological measures, such as morbidity rate, mortality rate, and prevalence rate, to assess the burden of infectious diseases.
3. to describe the course of an infectious disease, and discuss the methods used for surveillance and mapping of infectious diseases, including remote sensing and geographic information systems.
4. to demonstrate proficiency in the collection, handling, and transport of clinical specimens.
5. to select and use appropriate growth media and culture techniques for the isolation of pathogens from clinical specimens.
6. to identify microorganisms using microscopy, growth-dependent identification methods, rapid identification methods, and molecular methods.
7. demonstrate a comprehensive understanding of key immunological milestones, enabling them to contextualize contemporary immunological concepts within a historical framework.
8. analyze and evaluate the historical context of immunological developments, fostering critical thinking skills and an appreciation for the complexities of scientific progress.
9. assess the significance of Louis Pasteur's contributions to immunology, recognizing the enduring impact of his discoveries on vaccine development and disease prevention.
10. identify and explain the various components and functions of the innate immune system, illustrating their roles in host defense and immune surveillance.
11. demonstrate proficiency in understanding hematopoietic processes, including the regulation of hematopoiesis and its implications for immune cell development and homeostasis.
12. demonstrate a comprehensive understanding of the various cell types within the immune system, including leukocytes (neutrophils, macrophages, dendritic cells) and lymphocytes (T cells, B cells, natural killer cells), and their respective functions in immune surveillance, activation, and memory.
13. evaluate the importance of primary and secondary lymphoid organs in immune function, illustrating their roles in immune cell development, antigen presentation, lymphocyte activation, and the coordination of adaptive immune responses.

Theory Lectures per week (1 Lecture is 60 minutes)	**3**
Total number of Hours in a Semester	**45**

SOPHIA COLLEGE FOR WOMEN (AUTONOMOUS)

Credits		**3**	
Evaluation System	**Semester End Examination**	**2 hrs**	**50 marks**
	Internal Assessment	**-**	**50 marks**

UNIT 1 Epidemiology (1 Credit)	1.1	Epidemiological Terminology: Epidemiology, sporadic disease, endemic disease, hyper endemic disease, epidemic disease, index case, pandemic disease, outbreak	15 hours
	1.2	Epidemiologists tools of measuring disease frequency a. Morbidity rate b. Mortality rate c. Prevalence rate	
	1.3	Course of an infectious disease	
	1.4	Surveillance of an infectious disease; list methods.	
	1.5	Mapping infectious diseases: Remote sensing and Geographic information system	
	1.6	Types of epidemics in a population: Common source and propagated epidemics	
	1.7	The spread of infection: a. Reservoirs of infection i. Human reservoirs ii. Animal reservoirs iii. Non-living reservoirs b. Transmission of disease: i. Contact transmission ii. Vehicle transmission, iii. Vectors	
	1.8	Nosocomial Infections	
	1.9	Control of epidemics: a. Immunization, b. Role of public health system	

	1.10	Emerging and Re-emerging Infectious Diseases: a. Factors favoring its development b. Examples: Dengue and Chikungunya, Covid 19	
	1.11	Biosafety - Biosafety levels of pathogens with examples and care needed to handle them, Biosafety cabinets	
UNIT 2 Diagnostic Microbiology (1 Credit)	2.1	Overview of the Clinical Microbiology Laboratory.	15 hours
	2.2	a. Isolation of Pathogens from clinical specimens. 1. Growth media and Culture 2. Collection of specimens, handling and transport 3. Types of specimens and their culture: Blood, urine, feces, sputum, cerebrospinal fluid, pus, genital and culture of anaerobes. b. Identification of microorganisms from specimens: 1. Microscopy 2. Growth-Dependent Identification Methods c. Rapid Methods of Identification: 1. Mechanized/ automated systems 2. Manual biochemical systems 3. Immunological systems d. Bacteriophage Typing e. Molecular Methods and Analysis of Metabolic Products: 1. Nucleic Acid –Based Detection Methods 2. Sanger Sequencing 3. Next-Generation Sequencing (NGS) 4. Gas liquid Chromatography 5. Plasmid Fingerprinting	

UNIT 3 Introduction to Immunology (1 Credit)	3.1	Exploring Immunology Through History. a. Overview of Immunological Milestones b. Historical Context: Smallpox, Royal Poisons, and Early Vaccines c. Louis Pasteur: Pioneering Immunological Breakthroughs with the Vibrio Vaccine and Beyond.	15 hours
	3.2	Innate Immune System a. Anatomic barrier b. Physiological barrier c. Phagocytosis d. Inflammatory Response	
	3.3	Hematopoiesis a. Hematopoietic Stem Cells: Origins and Functions b. Hematopoiesis in the Bone Marrow c. Regulation of Hematopoietic Processes	
	3.4	Cells of the Immune system. a. Leukocytes: Neutrophils, Macrophages, Dendritic Cells b. Lymphocytes: T Cells, B Cells, Natural Killer Cells.	
	3.5	Organs of the Immune system a. Primary lymphoid organs- Bone marrow and thymus. b. Secondary lymphoid organs- Thymus, Spleen, Tonsils and Gut associated lymphoid tissue.	

SOPHIA COLLEGE FOR WOMEN (AUTONOMOUS)

Programme: SCIENCES **Microbiology Major 6 Practical**	**Semester–4**
Course Title: Epidemiology, Diagnostic Microbiology and Immunology Practical	**Course Code:** **SMCB246MJP**

COURSE OUTCOMES:

The learner will be able to

1. use the biosafety cabinet
2. use MacConkey's agar, Salmonella Shigella agar, XLD agar, Salt Mannitol agar, and CLED agar in order to selectively isolate a group of microorganisms.
3. perform the Indole test, Methyl Red test, Voges Proskauer test, Citrate utilization test, sugar fermentation test, lysine decarboxylase test, Phenylalanine deaminase test, Urease test, TSI agar, and catalase test in order to identify a microorganism.
4. apply the selective media and biochemical tests in subsequent semesters to identify pathogens from clinical and natural samples

Lectures per week (1 Lecture is 120 minutes)		**1**	
Total number of Hours in a Semester		**30**	
Credits		**1**	
Evaluation System	**Semester End Examination**	**2 hrs**	**50**
	Internal Assessment	**-**	

	1	To learn the use of a biosafety cabinet.	30 hours
	2	Use of selective and Differential Solid Media: a. MacConkey’s agar b. Salmonella Shigella agar c. Xylose Lysine Deoxycholate agar	

		d. Salt Mannitol agar e. Cystine Lactose Electrolyte Deficient agar	
	3	Use of Biochemical media/tests for identification of pathogens: a. Indole test b. Methyl red test c. Voges Proskauer test d. Citrate utilization test e. Carbohydrate/Sugar fermentation f. Lysine decarboxylase test g. TSI agar h. Phenylalanine deaminase test i. Urease test j. Catalase test	

ASSESSMENT DETAILS:

I. Internal Assessment (IA): 50 marks
II. Semester End Examination (SEE): 50 marks

REFERENCES:

SMCB245MJ Industrial, Dairy and Food Microbiology

1. Casida. L.E. (2007) Industrial Microbiology, *New Age international publisher.*
2. Casida L. E. (2016) Industrial Microbiology, Reprint, *New Delhi, New Age International (P) Ltd. Publishers.*
3. De S. (2001) Outlines Of Dairy Technology, 1st edn, *New Delhi, Oxford University Press.*
4. Frazier W.C. & Westhoff D.C., (2013) Food Microbiology, 5th edn, *McGraw Higher Ed.*
5. Jay James M. (1996) Modern Food Microbiology 5th edn, *New York, Springer Publishing.*
6. Madigan T., Michael J. M., Martinko K. S., Bender D. H, Buckley & Stahl D.A. (2006) Brock Biology of Microorganisms 11th edn. *Boston, Pearson Prentice Hall.*
7. Martin, N. H., & Steele, J. L. (Eds.). (2019). Dairy Microbiology, *John Wiley & Sons.*
8. Modi H. A. (2009) Fermentation Technology Vol 2, *Jaipur, Pointer Publications.*
9. Patel A. H. (2007) Industrial Microbiology 1st edn, *New Delhi, Macmillan Publishers.*
10. Prescott & Dunn. (1982) Industrial Microbiology, 4th edn, *London, Macmillan Publishers.*

11. Singh B. D. (2012) Biotechnology Expanding Horizons 4th edn, *Ludhiana, Kalyani Publishers.*
12. Stanbury, Peter F., Whitaker, Allan., & Hall, Stephen J. (1995) Principles of Fermentation Technology, 2nd edn, *Butterworth-Heinemann, Elsevier.*
13. Stanbury, Peter F., Whitaker, Allan., & Hall, Stephen J. (2017) Principles of Fermentation Technology, 3rd edn, *Butterworth-Heinemann, Elsevier.*
14. Willey J.M., Sherwood L.M., & Woolverton C.J. (2008) Prescott, Harley and Klein's Microbiology 7th edn, *New York, McGraw Hill International Edition.*

SMCB246MJ Epidemiology, Diagnostic Microbiology and Immunology

1. Khan, Fahim Halim. (2009). The elements of Immunology. *Pearson Education.*
2. Laboratory biosafety manual, 3rd edn., World Health Organization, 2004.
3. Laboratory biosafety manual, 4th edn., World Health Organization, 2020.
4. Madigan, M., Martinko, J. Bender, K., Buckley, D., & Stahl, D. (2015) Brock Biology of Microorganisms 14th edn. *Pearson.*
5. Madigan, Michael T., Bender, Kelly S., Buckley, Daniel H., Sattley, W. Matthew., & Stahl, David A. (2018). Brock Biology of Microorganisms, 15th edn, *Pearson.*
6. Mouffak, S., Shubbar, Q., Saleh, E., & El-Awady, R. (2021). Recent advances in management of COVID-19: A review. *Biomedicine & Pharmacotherapy,* 143, 112107. https://doi.org/10.1016/j.biopha.2021.112107.
7. Parasher, A. (2020). COVID-19: Current understanding of its Pathophysiology, Clinical presentation and Treatment. *Postgraduate Medical Journal,* 97(1147), 312-320. https://doi.org/10.1136/postgradmedj-2020-138577.
8. Punt, Jenni., Stanford, Sharon., Jones, Patricia., & Owen, Judith A. (2018). Kuby Immunology, 8th edn, *W. H. Freeman.*
9. Talaro, Kathleen. P. (2008). Foundations in Microbiology, 7th edn, *McGraw Hill.*
10. Tortora, G.J., Funke, B.R., & Case, C.L. (2010) Microbiology: An Introduction, 10th edn, *Benjamin Cummings.*
11. Tortora, G.J., Funke, B.R., & Case, C.L. (2016). Microbiology: An Introduction, 11th edn, *Pearson.*
12. Willey, J.M., Sherwood, L.M., & Woolverton, C.J. (2008). Prescott, Harley and Klein's Microbiology, 7th edn. New York*, McGraw Hill International Edition.*
13. Willey, Joanne., Sandman, Kathleen., & Wood, Dorothy. (2023). Prescott's Microbiology, 12th edn, *McGraw Hill.*
14. www.d.umn.edu - Microbiology Lab practices and Safety Rules Randall E. Hicks.
15. https://www.cdc.gov/training/quicklearns/biosafety