SOPHIA COLLEGE FOR WOMEN (EMPOWERED AUTONOMOUS)

Affiliated to the University of Mumbai

Programme: Science

Microbiology

F.Y.B.Sc. MICROBIOLOGY (DSC)

Syllabus for the Academic Year 2025-2026 based on the National Education Policy 2020

SOPHIA COLLEGE FOR WOMEN (EMPOWERED AUTONOMOUS)

DEPARTMENT OF MICROBIOLOGY

COURSE DETAILS FOR MAJOR:

	SEMESTER 1		SEMESTER 2
TITLE	Fundamentals of Microbiology		Microbial Growth and Its Control
TYPE OF COURSE	**DSC**		**DSC**
CREDITS	**4** **(2 theory + 2 practical)**		4 **(2 theory + 2 practical)**

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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

PO 1	To introduce the learners to Basic and Applied Microbiology.
PO 2	To build a strong knowledge base in the learner as well as impart sound practical skills in the subject.
PO 3	To provide opportunities for logical thinking, and critical reasoning, such that the learners can handle the demands of higher education, industry and research.
PO 4	To impart soft skills in learners thereby enhancing employability.

PROGRAMME SPECIFIC OUTCOMES

PSO 1	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.
PSO 2	The learners will acquire basic knowledge about scientific methodology, plan and execute experiments using good laboratory practices, and interpret the experimental results effectively.
PSO 3	The students will undertake research projects, internships, visit industries, in order to become ready for higher studies, industry and research.
PSO 4	The students will do value added courses in order to enhance their soft skills and employability.

SOPHIA COLLEGE FOR WOMEN (EMPOWERED AUTONOMOUS)

Programme: **Sciences** **Microbiology Major**	**Semester – 1**
Course Title: Fundamentals of Microbiology	**Course Code:** SMCB111

COURSE OBJECTIVES:

1. To provide a glimpse of the historical developments and pioneers in the field of microbiology.
2. To promote the understanding of fundamental aspects of microbial cell structure and function.
3. To provide realization of the crucial role of a light microscope and use oil immersion objectives for observing microorganisms.
4. To review the concept of magnification, resolving power and numerical aperture.
5. To explain the principle underlying differential staining procedures and list the staining procedures used for studying bacterial cell structure.
6. To give an overview of diverse nutritional modes of microorganisms.
7. To highlight different kinds of media and techniques used for culturing microbes.

COURSE OUTCOMES:

The learner will be able to

1. enlist the major events in the history of microbiology, including the major contributors to the early development of microscopy, aseptic techniques and advances in medical microbiology .
2. review the structural characteristics of prokaryotic cells.
3. explain how the magnified images are formed, and how properties of light affect image resolution & visibility.
4. explain the principle of simple and differential staining, and list special staining methods for demonstrating specific structures.
5. classify microorganisms into different nutritional modes based on the carbon, energy and electron source used for growth.
6. explain the purpose of enriched, selective, enrichment and differential media.
7. describe the principle and applications of inoculation techniques used for cultivating a variety of microorganisms.

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Theory Lectures per week (1 Lecture is 60 minutes)		**2**	
Total number of Hours in a Semester		**30**	
Credits		**2**	
Evaluation System	**Semester End Examination**	**1 Hour**	**30 marks**
	Internal Assessment	**--**	**20 marks**

UNIT 1 History of Microbiology and Prokaryotic Cell Structure (1 Credit)	1.1	Microbiology:Then and Now a. History of Microbiology, Conflict over spontaneous generation b. Milestone Discoveries c. Golden Age of Microbiology d. Recent Advances in Microbiology e. Scope of Microbiology	**15 Hours**
	1.2	Prokaryotic cell structure a. Morphology and Arrangement b. Cell wall c. Plasma membrane d. Nuclear material: Chromosome and plasmid e. Ribosomes f. Structures external to the cell wall:Capsule, Slime layer, Flagella g. Endospores h. Organic and inorganic inclusion bodies	

UNIT 2 Microscopy , Staining and Culturing techniques (1 credit)	2.1	Microscopy: a. History and Basic concepts of microscopy b. Structure and functions of different parts of a microscope c. Simple and compound light microscope (ray diagram of image formation) d. Microscope objective- Numerical aperture,resolving power e. Use of oil immersion objective	**15 Hours**
	2.2	Staining a. Stains: Types of stains (Acidic, Basic, Compound) b. Fixatives, Mordants and Decolorizers. c. Simple and Differential staining (Gram and Acid Fast) d. Special staining:Cell wall, Capsule, Lipid granules, Spores, Metachromatic granules & Flagella (Only name of the method, stains used, appearance of cells/structure)	
	2.3	Culturing Microorganisms a. Nutritional requirements – Macro and Micronutrients, growth factors. b. Nutritional types of microorganisms c. Culture media: Types with examples d. Methods of Inoculation e. Pure culture techniques f. Cultivation of anaerobes	

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PRACTICAL Course Title: Fundamentals Of Microbiology	Course Code: SMCB111P

COURSE OUTCOMES:

The learner will be able to

1. operate a compound light microscope, adjust the light as well as use different objectives.
2. observe the morphology of microorganisms after staining with simple and differential staining techniques using the compound light microscope and document the results.
3. demonstrate the presence of intracellular and extracellular structures that are characteristics of specific bacteria using special staining techniques.
4. prepare wet mounts of pond water, hay infusion, etc., and observe the microorganisms present.
5. tabulate 10 common microorganisms, including their names, morphology, arrangement, Gram nature, and diagrams, demonstrating their understanding of microbial diversity and characteristics.
6. disinfect surfaces and dispose of the laboratory waste safely, demonstrating their understanding of laboratory safety.
7. demonstrate the ability to sterilize glassware and microbiological media using various methods and perform aseptic transfers of media.
8. select an appropriate growth medium or method for experimental work.
9. apply the knowledge of inoculation methods for isolating a variety of bacteria
10. study colonies characteristics of isolates on solid medium.

Lectures per week (1 Lecture is 120 minutes)		**2**	
Total number of Hours in a Semester		**60**	
Credits		**2**	
Evaluation System	**Semester End Examination**	**3 Hours**	**50 marks**
	Internal Assessment	**--**	

Fundamentals of Microbiology Practical	1	Use and care of a microscope	60 hours
	2	Monochrome staining	
	3	Negative Staining	
	4	Differential staining: Gram staining	
	5	Cell wall staining	
	6	Demonstration of capsule	
	7	Endospore staining	
	8	Lipid staining	
	9	Metachromatic granules staining	
	10	Flagella staining (Demonstration)	
	11	Wet mount of natural samples and study of motility.	
	12	Assignment: Tabulation of names, morphology, arrangement and Gram nature with diagrams of 10 common microorganisms including Gram variable microorganisms.	
	13	Introduction to Laboratory equipment	
	14	Disinfection & safe disposal of waste	
	15	Sterilization of glassware and microbiological media	
	16	Aseptic transfer of media	
	17	Preparation of Culture Media: a. Liquid medium (Nutrient Broth) b. Solid Media (Nutrient agar & Sabouraud's agar) c. Preparation of slant, butts & plates	
	18	Methods of Inoculation and Study of Growth Characteristics: a. Liquid Medium b. Solid Media (Spoting, stabbing, streaking, streak isolation, swabbing)	
	19	Isolation of pigment producers and study of colony characteristics.	

ASSESSMENT DETAILS:

1. Internal Assessment (IA): Any one activity / assignment / test of 20 marks
2. Semester End Examination (SEE): Theory exam of 30 marks – One hour duration
3. Semester End Examination (SEE): Practical exam of 50 marks – Three hours duration

REFERENCES:

SMCB111 Fundamentals of Microbiology

1. Madigan, M. T., Bender, K. S., Buckley, D. H., & Sattley, W. M. (2021). *Brock biology of microorganisms* (16th global ed.). Pearson.
2. Pelczar, M. J., Jr., Chan, E. C. S., & Krieg, N. R. (1986). *Microbiology* (5th ed.). Tata McGraw-Hill.
3. Tortora, G. J., Funke, B. R., & Case, C. L. (2020). *Microbiology: An introduction* (13th global ed.). Pearson.
4. Willey, J. M., Sandman, K., & Wood, D. (2019). *Prescott's microbiology* (11th ed.). McGraw-Hill Education.

SOPHIA COLLEGE FOR WOMEN (EMPOWERED AUTONOMOUS)

Programme: Sciences **Microbiology Major**	**Semester – 2**
Course Title: Microbial Growth and Its Control	**Course Code:** SMCB122

COURSE OBJECTIVES:

1. To impart the knowledge of fundamental aspects of microbial growth
2. To give an overview of the growth pattern of bacterial culture in a closed system
3. To provide a glimpse of environmental parameters that affect microbial growth.
4. To introduce various ways of estimating increase in microbial population
5. To provide understanding of the key concepts related to control of microorganisms
6. To list the methods of microbial control
7. To explain the principle, advantages and applications of physical methods (High temperature, Radiations) for controlling microbial population.
8. To give an overview of different types of bacteria proof filters used in microbiology laboratory
9. To highlight the mode of action, uses, limitations of the common chemical disinfectants and sterilizing gases.

COURSE OUTCOMES:

The learner will be able to

1. derive and use the mathematical expression of bacterial growth for calculating increase in microbial population .
2. describe the features of different phases of bacterial growth.
3. discuss the advantages and limitations of direct and indirect methods of enumerating microorganisms.
4. select appropriate enumeration methods for estimating growth in various scenarios.
5. define and differentiate among the major terms for microbial control, citing examples of each.
6. describe use of dry heat and moist heat methods and their chief applications for sterilization and disinfection.
7. explain the use of filtration for sterilization of liquids.
8. differentiate between ionizing and nonionizing radiations used for the purpose of destroying microbial contaminants.
9. summarize the modes of action and practical uses of alcohols, phenolics, quaternary ammonium compounds, halogens and heavy metal solutions as disinfectants/ antiseptics.

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Theory Lectures per week (1 Lecture is 60 minutes)		**2**	
Total number of Hours in a Semester		**30**	
Credits		**2**	
Evaluation System	**Semester End Examination**	**1 Hour**	**30 marks**
	Internal Assessment	**--**	**20 marks**

UNIT 1 Microbial Growth (1 Credit)	1.1	a. Definition of growth, Mathematical Expression and Growth curve b. Influence of environmental factors on growth	15 hours
	1.2	-Measurement of growth a. Direct microscopic count and Haemocytometer. b. Viable count – Spread plate and Pour plate technique c. Measurements of cell constituents. d. Turbidity measurements – Nephelometer and spectrophotometer	
UNIT 2 Control of Microorganisms (1 Credit)	2.1	a. Concept of sterility,Need for control, Definitions of Antimicrobial agents Methods of microbial control: b. Physical: a. Moist heat, Dry heat b. Radiation c. Filtration d. Low temperature e. Desiccation and Osmotic pressure	15 hours

	2.2	c. Chemical : a. Phenolics b. Alcohols c. Heavy metals d. Halogens e. Quaternary ammonium compounds f. Chlorhexidine g. Sterilizing gases- ETO, Formaldehyde	

SOPHIA COLLEGE FOR WOMEN (EMPOWERED AUTONOMOUS)

PRACTICAL COURSE **Course Title: Microbial Growth and Its Control**	**Course Code: SMCB122P**

COURSE OUTCOMES:

The learner will be able to

1. enumerate bacteria by Breed's Count, using Haemocytometer and Brown's opacity tubes.
2. enumerate the number of viable bacteria using the surface speed and power plate technique.
3. plot the bacterial growth curve and identify the phases of the bacterial growth curve after culturing microorganisms under standard conditions.
4. suggest the optimum growth pH and temperature of microorganisms based on experimental findings under laboratory conditions.
5. demonstrate the use of membrane filters for bacteria-proof filtration.
6. demonstrate the effect of alcohols, phenolics, quaternary ammonium compounds, halogens, heavy metal solutions and disinfectants/ antiseptics.

Lectures per week (1 Lecture is 120 minutes)	**2**
Total number of Hours in a Semester	**60**
Credits	**2**

Evaluation System	**Semester End Examination**	**3 Hours**	**50 marks**
	Internal Assessment	**--**	

Microbial Growth And Its Control Practical	1	Enumeration of bacteria by Breed's Count.	60 hours
	2	Enumeration of microorganisms using Haemocytometer.	
	3	Enumeration of microorganisms using Brown's opacity tubes.	
	4	Measurement of cell dimensions-Micrometry	
	5	Viable count: Spread plate method	

	6	Viable count: Pour plate method	
	7	Study of Growth curve of *E.coli* (Demonstration)	
	8	Study of effect of pH and temperature on growth	
	9	Demonstration of use of membrane filter and efficiency of sterilization	
	10	Effect of UV light on microorganisms. (Demonstration)	
	11	Effect of desiccation on the growth of microorganisms	
	12	Effect of chemical disinfectants on the growth of bacteria by disc diffusion method	
	13	Effect of osmotic pressure on microorganisms	
	14	Oligodynamic action of heavy metals	

ASSESSMENT DETAILS:

1. Internal Assessment (IA): Any one activity / assignment / test of 20 marks
2. Semester End Examination (SEE): Theory exam of 30 marks – One hour duration
3. Semester End Examination (SEE): Practical exam of 50 marks – Three hours duration

REFERENCES:

SMCB122 Microbial Growth and Its Control

1. Tortora G.J., Funke, B.R., Case, C.L., 2020 Microbiology: an introduction. 13th Global edn. Pearson
2. Willey J. , Sandman K , Wood D. Prescott's Microbiology (ISE)(2019) 11th edn– McGraw-Hill Education.
3. Madigan, M. T.; Bender K. , Buckley D. (2021). Brock Biology of Microorganisms. 16th Global edn- San Francisco: Pearson International edition.
4. Pelczar Jr, M. J.; Chan, E.C.S. & Krieg, N. R. (1986). Microbiology 5th edn. New York:Tata McGraw-Hill Education Pvt. Ltd
5. Talaro, K. P., Chess K. 2012. Foundations in Microbiology 8th International edn, NewYork:McGraw Hill.
6. Stanier, R. Y.; Ingraham, J. L.; Wheelis, M. L. & Painter, R. P. (1992). General Microbiology 5th edn. Cornell university: Macmillan, Hampshire & London.

SMCB122P Microbial Growth and Its Control

1. Cappuccino, J. G., & Sherman, N. (2020). Microbiology: A laboratory manual (12th ed.). Pearson.

2. Khuntia, B. K. (2011). Basic microbiology: An illustrated laboratory manual. Daya Publishing House.