



SOPHIA COLLEGE FOR WOMEN (AUTONOMOUS)

Affiliated to the University of Mumbai

Programme: Science

Microbiology (Major)

FYBSc MICROBIOLOGY

Syllabus for the Academic Year 2023-2024

based on the National Education Policy 2020



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COURSE DETAILS FOR MAJOR

	SEMESTER 1	SEMESTER 2
TITLE	Fundamentals of Microbiology	Microbial Diversity, Interactions and Growth
TYPE OF COURSE	DSC	DSC
CREDITS	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.



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On completion of B.Sc. Microbiology, the learners should be able to:

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.
PO4	To impart soft skills in learners thereby enhancing employability.

PROGRAMME SPECIFIC OUTCOMES (POs)	
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.



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Programme: SCIENCES Microbiology Major	Semester- 1
Course Title: Fundamentals of Microbiology	Course Code: SMCB111MJ
<u>COURSE OBJECTIVES:</u> It aims to: <ol style="list-style-type: none">1. To provide a glimpse of the microbial world and pioneers in the field of microbiology.2. To promote the understanding of fundamental aspects of microbial cell structure and function as well as the differences between Prokaryotic and Eukaryotic Cells.3. To review the structural details of eukaryotic cells.4. To explore the life cycles and also highlight the morphological characteristics, significance of yeast, molds, protozoa.5. To revise the concept of magnification, resolving power and numerical aperture.6. To provide realization of the crucial role of a light microscope in the study of microorganisms and use oil immersion objective for observing microorganisms.7. To understand the principle of various staining procedures for studying bacterial cell structure.	
<u>COURSE OUTCOMES:</u> The learner will be able to: <ol style="list-style-type: none">1. review the basic characteristics of prokaryotic and eukaryotic cells.2. describe the cellular makeup of bacteria.3. enlist the major events in the history of microbiology, including the major contributors to the early development of microscopy, the germ theory of disease, aseptic techniques and medical advances.4. outline a new system of classification of organisms in domains and cite representatives of each domain.5. describe the morphological characteristics, life Cycle and significance of <i>Saccharomyces cerevisiae</i> , <i>Rhizopus</i>, <i>Chlamydomonas</i>, <i>Slime mold</i>, <i>Entamoeba histolytica</i> .6. explain how the magnified images are formed, and how properties of light/ resolution affects image visibility.7. explain the principle and procedure for simple, differential, and special stainings.8. describe the process of Gram staining and acid fast staining and how the results can aid the identification of pathogens.	



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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 Hours	50 marks
	Internal Assessment	-	50 marks

UNIT 1 History of Microbiology and Prokaryotic Cell Structure (1 Credit)	1.1	Milestones in Microbiology a. History Of Microbiology b. Discovery of microorganisms c. Conflict over spontaneous generation d. Golden Age of Microbiology-Koch Postulate e. Classification of organisms	15 Hours
	1.2	Bacterial cell structure a. Morphology and Arrangement b. Cell wall c. Plasma membrane d. Chromosome and plasmid e. Ribosomes. f. Structures external to the cell wall: Capsule, Slime layer, Flagella, Pili, and Fimbriae. g. Endospores h. Organic and inorganic inclusion bodies	
Unit 2 Eukaryotic Cell Structure And Function (1 Credit)	2.1	Overview of eukaryotic cell structure: a. Plasma membrane b. Cytoplasmic matrix, Cytoskeletal elements c. Endoplasmic reticulum, d. Ribosomes e. Golgi apparatus f. Mitochondria g. Chloroplasts h. Nucleus i. Cilia and Flagella.	15 Hours



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	2.2	Morphological characteristics, Life Cycle and Significance of: a. Yeast and Molds (<i>Saccharomyces cerevisiae</i> and <i>Rhizopus</i>) b. Algae (<i>Chlamydomonas</i>) c. Slime Molds and Myxomycetes d. Protozoa (<i>Entamoeba histolytica</i>)	
Unit 3 Microscopy & Staining procedures (1 Credit)	3.1	Microscopy: a. History of microscopy b. Structure and functions of different parts of a microscope c. Simple and compound light microscope	15 Hours
	3.2	Staining procedures 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)	



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Programme: SCIENCES Microbiology Practical		Semester – 1	
Course Title: Fundamentals of Microbiology Practical		Course Code: SMCB111MJP	
<u>COURSE OUTCOMES:</u> The learner will be able to <ol style="list-style-type: none">1. operate a compound light microscope, adjust the light as well as use different objectives.2. use the compound light microscope to observe the morphology of microorganisms using simple and differential staining techniques and interpret 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. document observations from the wet mount of various samples and microorganisms video recording and PowerPoint presentation as well as describe the microorganisms seen.6. tabulate 10 common microorganisms, including their names, morphology, arrangement, Gram nature, and diagrams, demonstrating their understanding of microbial diversity and characteristics.			
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	-	

Fundamentals of Microbiology Practical	1	Use and care of a microscope	30 hours
	2	Monochrome staining	
	3	Negative Staining.	
	4	Differential staining: Gram staining	



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	5	Cell wall staining	
	6	Demonstration of capsule.	
	7	Endospore staining	
	8	Lipid staining	
	9	Metachromatic granules staining	
	10	Flagella staining (Demonstration)	
	11	Preparation of Wet mount of pond water / hay infusion / flavoured curd: Observations to be recorded as a Video.	
	12	Preparation of Wet mount of molds: Observations to be presented using a Powerpoint Point.	
	13	Assignment: Tabulation of names, morphology, arrangement and Gram nature with diagrams of 10 common microorganisms including Gram variable microorganisms.	

ASSESSMENT DETAILS:

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

REFERENCES:

SMCB111MJ Fundamentals of Microbiology

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



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Programme: SCIENCES Microbiology Major	Semester- 2
Course Title: Microbial Diversity, Interactions and Growth	Course Code: SMCB122MJ
<u>COURSE OBJECTIVES:</u> It aims to: <ol style="list-style-type: none">1. To promote the understanding of fundamental aspects of viruses focussing on general structure and reproduction.2. To give an overview of Rickettsia and Chlamydia.3. To provide a glimpse of the world of Actinomycetes and Archaeobacteria.4. To provide understanding of the key concepts related to microbial growth and outline parameters that affect growth.5. To train the students to evaluate and choose appropriate methods for estimating microbial growth.6. To give realization of the crucial role of microorganisms in the cycling of nutrients.	
<u>COURSE OUTCOMES:</u> The learner will be able to: <ol style="list-style-type: none">1. summarize the features of different types of viruses.2. study the growth pattern of bacterial culture in a closed system.3. describe direct -indirect methods of enumerating microorganisms.4. apply these methods for estimating growth in various scenarios .5. explain the concept of pure culture.6. define the major terms of microbial associations.7. outline different types of microbial interactions with examples.8. identify the role of microbial species in the nutrient cycles .9. select appropriate growth conditions/ techniques for experimental work.	
Lectures per week (1 Lecture is 60 minutes)	3



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Total number of Hours in a semester		45	
Credits		3	
Evaluation System	Semester End Examination	2 Hours	50 marks
	Internal Assessment	-	50 marks

UNIT 1 Study of Viruses, Rickettsia, Chlamydia, Actinomycetes and Archaea (1 Credit)	1.1	a. Viruses: i. Historical highlights, general properties of viruses, Structure of viruses-capsids, envelopes and genomes. ii. Overview of methods for cultivation of viruses. iii. Bacteriophages: Life cycle of Lytic (T4 phage) and Lysogenic (lambda) phage. b. Rickettsia and Chlamydia: General characteristics, diseases and vectors.	15 Hours
	1.2	a. Actinomycetes: General characteristics, groups and Significance. b. Introduction to Archaea- General characteristics , groups and Significance.	
Unit 2 Study of Microbial Interactions (1 Credit)	2.1	Types of Microbial Interactions: a. Mutualism: Lichens, Rhizobia, Mycorrhizae and Frankia. b. Amensalism: Antibiosis c. Predation and Parasitism d. Commensalism: Normal flora of the human body i. Skin, ii. Respiratory tract, iii. Gastrointestinal tract and iv. Genitourinary tract.	15 Hours
	2.2	Role of microorganisms in cycling of nutrients: Carbon, Nitrogen, Sulphur, Phosphorus and Iron.	
Unit 3 Microbial Growth	3.1	Definition of growth, Mathematical Expression and Growth curve	15 Hours



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(1 Credit)		Influence of environmental factors on growth	
	3.2	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	

Programme: SCIENCES Microbiology Practical	Semester – 2
Course Title: Microbial Diversity, Interactions and Growth Practical	Course Code: SMCB122MJP
<u>COURSE OUTCOMES:</u> The learner will be able to <ol style="list-style-type: none">1. perform spot assay for detection of bacteriophages.2. demonstrate the ability to prepare and examine slide cultures of Actinomycetes, identifying the changes in morphology characteristics with respect to time.3. prepare and examine wet mounts of lichens and identify the fungal and algal components.4. isolate and study the characteristics of Rhizobium and Azotobacter from root nodules and soil respectively and understand their role in Nitrogen fixation.5. enumerate bacteria by Breed's Count, using Haemocytometer, Brown's opacity tubes, and viable count method.6. plot the bacterial growth curve and identify the phases of the bacterial growth curve after culturing microorganisms under standard conditions.7. suggest the optimum growth pH and temperature of microorganisms based on experimental findings under laboratory conditions.	
Lectures per week (1 lecture is 120 minutes)	1
Total number of Hours in a Semester	30



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

Microbial Diversity, Interactions and Growth Practical	1	Spot assay of Bacteriophage	30 hours
	2	Slide Culture technique (Actinomycetes)	
	3	Wet Mount of Lichen	
	4	Rhizobium: Staining & Isolation.	
	5	Azotobacter: Enrichment, Isolation & staining.	
	6	Normal flora: Isolation of microorganisms from skin and saliva	
	7	Enumeration of bacteria by Breed's Count.	
	8	Haemocytometer.	
	9	Brown's opacity tubes.	
	10	Measurement of cell dimensions-Micrometry	
	11	Viable count: Spread plate method	
	12	Viable count : Pour plate method	
	13	Study of Growth curve (Demonstration)	
	14	Study of effect of pH and temperature on growth	

ASSESSMENT DETAILS:

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



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REFERENCES:

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1. Madigan, M. T., Bender, K. S., Buckley, D.H., Sattley, W. M., & Stahl, D. A. (2021). Brock Biology of Microorganisms. 16th Global edn- San Francisco: *Pearson International edition*.
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3. Stanier, R. Y., Ingraham, J. L., Wheelis, M. L., & Painter, P. R. (1992). General Microbiology 5th edn. Cornell university: *Macmillan, Hampshire & London*.
4. Talaro, K. P., & Chess K. (2012). Foundations in Microbiology 8th International edn, *New York: McGraw Hill*.
5. Tortora G.J., Funke, B.R., & Case, C.L., (2020). Microbiology: an introduction. 13th Global edn. *Pearson*
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