



# SOPHIA COLLEGE (AUTONOMOUS)

Affiliated to

University of Mumbai

**Programme: Microbiology**  
**Programme code: SBSMCB**

F.Y.B.Sc. Microbiology

(Choice Based Credit System with effect from the year 2021  
2022)

Programme Outline: FYBSc Microbiology (SEMESTER I)

Course code	Unit No.	Name of Unit	Credits
SBSMCB101		FUNDAMENTALS OF MICROBIOLOGY	2 Credits
	1	History of Microbiology and Chemical basis of life	
	2	Prokaryotic Cell Structure And Function	
	3	Eukaryotic Cell Structure And Function	
SBSMCB102		BASIC TECHNIQUES IN MICROBIOLOGY	2 Credits
	1	Microscopy & Staining procedures	
	2	Cultivation of Microorganisms	
	3	Control of Microorganisms	
SBSMCBP1		PRACTICALS	2 Credits
	1	SECTION-1 Fundamentals Of Microbiology (Practicals Based On Unit-I, II & III Of SBSMCB101)	
	2	SECTION-2 Basic Techniques In Microbiology (Practicals Based On Unit-I, II & III Of SBSMCB102)	

Programme Outline: FYBSc Microbiology (SEMESTER II)

Course code	Unit No.	Name of Unit	Credits
SBSMCB201		EXPLORING MICROBIOLOGY	2 Credits

	1	Study Of Viruses, Rickettsia, Chlamydia, Actinomycetes and Archaea	
	2	Microbial Interactions	
	3	Microbes & Human Health	
SBSMCB202		ADVANCED AND APPLIED MICROBIOLOGY	2 Credits
	1	Advanced Microscopy and Instrumentation	
	2	Microbial Growth	
	3	Microbial Technology	
SBSMCBP2		PRACTICALS	2 Credits
	1	SECTION-1 Exploring Microbiology (Practicals Based On Unit-I, II & III)	
	2	SECTION-2 Advanced and Applied Microbiology (Practicals Based On Unit-I, II & III)	

## 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.

## SEMESTER I

NAME OF THE COURSE	FUNDAMENTALS OF MICROBIOLOGY	
CLASS	FYBSc	
COURSE CODE	SBSMCB101	
NUMBER OF CREDITS	2	
NUMBER OF LECTURES PER WEEK	3	
TOTAL NUMBER OF LECTURES PER SEMESTER	45	
EVALUATION METHOD	INTERNAL ASSESSMENT	SEMESTER END EXAMINATION
TOTAL MARKS	50	50
PASSING MARKS	20	20

### COURSE OBJECTIVES:

CO 1	To provide a glimpse of the microbial world and history of microbiology.
CO 2	To highlight the work of pioneers in the field of microbiology.
CO 3	To promote the understanding of fundamental aspects of microbial cell structure and function by studying basic characteristics of a prokaryotic and reviewing the structural details of eukaryotic cells.
CO 4	To comprehend the details of the chemical basis of a cellular makeup.
CO 5	To provide knowledge of the macromolecules.
CO 6	To explore the life cycles and also highlight the morphological characteristics , significance of yeast, molds, protozoa.

### COURSE LEARNING OUTCOMES:

CLO 1	The learner will be able to enlist the major events in the history of microbiology, including the germ theory of disease, aseptic techniques and advances in medical microbiology and explain the contributions of scientists in the early development of microbiology.
CLO 2	The learner will be able to describe the properties and functions of carbohydrates, proteins, nucleic acids
CLO 3	The learner will be able to compare the differences between prokaryotic and eukaryotic cells.
CLO 4	The learner will be able to give an overview of organelles in eukaryotic cells.
CLO 5	The learner will be able to discuss the features and functions of capsule , cell wall , Flagella, Pili, and Fimbriae, plasmids, ribosomes, endospore, storage granules in bacteria

CLO 6	The learner will be able to illustrate the stages in the life cycle of <i>Saccharomyces cerevisiae</i> , <i>Rhizopus</i> , <i>Chlamydomonas</i> , <i>Myxomycetes</i> , <i>Entamoeba</i> using a diagram
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UNIT 1	<b>HISTORY OF MICROBIOLOGY AND CHEMICAL BASIS OF LIFE (15 Lectures)</b>
1.1	History Of Microbiology <ul style="list-style-type: none"> <li>a. Discovery of microorganisms</li> <li>b. Conflict over spontaneous generation</li> <li>c. Golden Age Of Microbiology-Koch Postulate, Medical Microbiology and Immunology</li> </ul>
1.2	Chemical Basis of Life <ul style="list-style-type: none"> <li>a. Types of bonds and their importance: Electrovalent, covalent, ester, phosphodiester, thioester, peptide and glycosidic.</li> <li>b. Water: Structure and Role of water.</li> </ul>
1.3	Definition, general characteristics and functions of <ul style="list-style-type: none"> <li>a. Carbohydrates: Monosaccharides, Oligosaccharides (maltose, cellobiose, sucrose, lactose) and Polysaccharide (starch, glycogen, peptidoglycan, cellulose)</li> <li>b. Lipids: Simple and complex lipids, storage and structural lipids. Liposomes and their applications</li> <li>c. Amino acids &amp; proteins: General structure and features of amino acids (emphasis on amphoteric nature), Classification by R-group, Uncommon amino acids and their functions. Peptides and proteins. Primary, secondary, tertiary, quaternary structures of proteins.</li> <li>d. Nucleic acids: Nitrogenous bases- Purines, Pyrimidines, Pentoses-Ribose, Deoxyribose. Structure of RNA and DNA.</li> </ul>
UNIT 2	<b>PROKARYOTIC CELL STRUCTURE AND FUNCTION (15 lectures)</b>
2.1	Bacteria - Morphology and Arrangement
2.2	Cell wall
2.3	Plasma membrane
2.4	Chromosomes and plasmids.

2.5	Bacterial ribosomes.
2.6	Cytoplasmic matrix, organic and inorganic inclusion bodies
2.7	Components external to cell wall: Capsule, Slime layer, Flagella, Pili, and Fimbriae.
2.8	Bacterial endospores.
UNIT 3	EUKARYOTIC CELL STRUCTURE AND FUNCTION (15 lectures)
3.1	Comparison of Prokaryotic And Eukaryotic Cells
3.2	Overview of eukaryotic cell structure: <ul style="list-style-type: none"> <li>a. Plasma membrane and Cytoplasmic matrix,</li> <li>b. Endoplasmic reticulum</li> <li>c. Golgi apparatus.</li> <li>d. Ribosomes ,</li> <li>e. Mitochondria and Chloroplasts</li> <li>f. Nucleus –Nuclear Structure</li> <li>g. Cytoskeletal elements -</li> <li>h. External cell coverings viz Cilia and Flagella</li> </ul>
3.3	Morphological characteristics, Life Cycle, Cultivation, and significance of: <ul style="list-style-type: none"> <li>a. Yeast and Molds (<i>Saccharomyces cerevisiae</i> and <i>Rhizopus</i>)</li> <li>b. Algae (<i>Chlamydomonas</i>)</li> <li>c. Slime Molds and Myxomycetes</li> <li>d. Protozoa (<i>Entamoeba histolytica</i>)</li> </ul>

#### REFERENCES:

1. Pelczar Jr, M. J.; Chan, E.C.S. & Krieg, N. R. (1986). Microbiology 5th edn. New York:Tata McGraw-Hill Education Pvt. Ltd.
2. Willey J. , Sandman K , Wood D. Prescott's Microbiology (ISE)(2019) 11th edn– McGraw-Hill Education.
3. Stanier, R. Y.; Ingraham, J. L.; Wheelis, M. L. & Painter, R. P. (1992). General Microbiology 5th edn. Cornell university: Macmillan, Hampshire & London.
4. Madigan, M. T.; Bender K. , Buckley D. (2021). Brock Biology of Microorganisms. 16th Global edn- San Francisco: Pearson International edition.
5. Nelson, D. L. & Cox, M. M. (2021). Lehninger Principles of Biochemistry 8th International edn.W.H. Freeman.

NAME OF THE COURSE	BASIC TECHNIQUES IN MICROBIOLOGY	
CLASS	FYBSc	
COURSE CODE	SBSMCB102	
NUMBER OF CREDITS	2	
NUMBER OF LECTURES PER WEEK	3	
TOTAL NUMBER OF LECTURES PER SEMESTER	45	
EVALUATION METHOD	INTERNAL ASSESSMENT	SEMESTER END EXAMINATION
TOTAL MARKS	50	50
PASSING MARKS	20	20

#### COURSE OBJECTIVES:

CO 1	To revise the properties of lenses, concept of magnification, resolving power and numerical aperture.
CO 2	To train the students in using a light microscope with an oil immersion objective for observing microorganisms.
CO 3	To acquaint them with the principle of the concept of pure culture and to train students to use aseptic techniques of inoculation in liquid, solid semisolid media .
CO 4	To introduce various types of microbiological media used for culturing microbes for specific purposes.
CO 5	To provide information on different staining methods for studying bacterial cell structure.
CO 6	To outline the processes and purposes of the procedures that are used in handling, maintaining, and studying microorganisms.

#### COURSE LEARNING OUTCOMES:

CLO 1	The learner will be able to Illustrate how the magnified images are formed in a compound light microscope using a ray diagram.
CLO 2	The learner will be able to identify the purpose of enriched, selective, and differential media and choose appropriate growth medium for cultivation of different groups of microorganisms.
CLO 3	The learner will be able to apply the knowledge of inoculation methods for isolating a variety of bacteria considering the advantages and limitations of each.



CLO 4	The learner will be able to illustrate the classification of microorganisms based on their nutritional modes and prepare microbiological media using basic ingredients for cultivation of specific groups.
CLO 5	The learner will be able to discuss the principle and perform simple, differential, and special stainings and prepare a flow diagram of steps in Gram staining and acid fast staining
CLO 6	The learner will be able to preserve different types of microbial cultures for the desired duration.

<b>UNIT 1</b>	<b>MICROSCOPY &amp; STAINING PROCEDURES (15 LECTURES)</b>
1.1	Microscopy: <ul style="list-style-type: none"> <li>a. History of microscopy</li> <li>b. Structure and functions of different parts of a microscope</li> <li>c. Magnification, resolving power, Numerical aperture, Use of oil immersion objective</li> <li>d. Simple and compound light microscope</li> <li>e. Dark field Microscope</li> <li>f. Phase contrast microscope</li> </ul>
1.2	Staining procedures <ul style="list-style-type: none"> <li>a. Stains: Types of stains (Acidic, Basic, Compound)</li> <li>b. Fixatives, Mordants and Decolorizers.</li> <li>c. Simple and differential staining (Gram and Acid Fast)</li> <li>d. Special staining (Cell wall, Capsule, Lipid granules ,Spores, Metachromatic granules &amp; Flagella)</li> </ul>
<b>UNIT 2</b>	<b>CULTIVATION OF MICROORGANISMS (15 lectures)</b>
2.1	Nutritional requirements – Macro and Micronutrients
2.2	Utilization of Carbon, Oxygen, Hydrogen, Nitrogen, Phosphorus, Sulfur and growth factors.
2.3	Nutritional types of microorganisms
2.4	Types of Culture media with examples
2.5	Isolation of microorganisms and pure culture techniques
2.6	Cultivation of anaerobes

2.7	Preservation of microorganisms & Culture Collection Centres
UNIT 3	CONTROL OF MICROORGANISMS (15 lectures)
3.1	Definition and Factors affecting the effectiveness of antimicrobial agents
3.2	Physical methods of microbial control a. Moist and Dry heat b. Radiation c. Filtration d. Low temperature e. High pressure f. Desiccation and Osmotic pressure
3.3	Chemical methods of microbial control a. Phenolics b. Alcohols c. Heavy metals d. Halogens e. Quaternary ammonium compounds f. Sterilizing gasses g. Surface active agents h. Aldehydes i. Peroxgens j. Biguanides (Chlorhexidine)
3.4	Evaluation of effectiveness of chemical antimicrobial agents

#### REFERENCES:

1. Black J. G., Black L. J. (2015) Microbiology: Principles and Explorations, 9th edn- J Wiley publishers
2. Willey J., Sandman K , Wood D. Prescott's Microbiology (ISE)(2019) 11th edn– McGraw-Hill Education.
3. Tortora G.J., Funke, B.R., Case, C.L., (2020) Microbiology: an introduction. 13<sup>th</sup> Global edn. Pearson
4. Kumar S. (2012) Textbook of Microbiology, First edn. New Delhi: Jaypee Brothers Medical Publishers.
5. Basic Practical Microbiology – A Manual.( 2006 ) editors: Dariel Burdass, John Grainger & Janet Hurst published by the Society for General Microbiology retrieved from [www.microbiologyonline.org.uk](http://www.microbiologyonline.org.uk)
6. Becton, Dickinson and Co.2009. Difco and BBL Manual of Microbiological Culture Media Second Edition Editors: Mary Jo Zimbro, David A. Power, Sharon M. Miller, George E. Wilson, Julie A. Johnson

NAME OF THE COURSE	PRACTICALS	
CLASS	FYBSc	
COURSE CODE	SBSMCBP1	
NUMBER OF CREDITS	2	
NUMBER OF LECTURES PER WEEK	6	
TOTAL NUMBER OF LECTURES PER SEMESTER	90	
EVALUATION METHOD	INTERNAL ASSESSMENT	SEMESTER END EXAMINATION
TOTAL MARKS	-	100
PASSING MARKS	-	40

#### COURSE OBJECTIVES

CO 1	To train learners to follow appropriate safety procedures while working in a microbiological laboratory, including handling and discarding laboratory microbial cultures, operating laboratory equipment and using glassware.
CO 2	To provide learners with practical training in the use of compound light microscope in order to observe the morphology of microorganisms and their specialized structures using simple, differential and special staining techniques.
CO 3	To equip learners with basic skills required in a microbiological laboratory such as preparation of bacteriological media, sterilization of media and reagents, distribution of media into slants, butts and plates.
CO 4	To equip learners with the skills necessary to culture microorganisms by spotting, streaking, stabbing, swabbing, streak isolation and bulk seeding and then studying the growth characteristics, interpret and document experimental observations.
CO 5	To train learners to compare the growth of unicellular and filamentous organisms under static and shaken conditions
CO 6	To train learners to cultivate and identify various groups of fungi based on the morphological characteristics
CO 7	To equip learners with the knowledge of the principles underlying qualitative tests for detection of biomolecules.
CO 8	To train learners to conduct experiments in order to study the effect of the growth environment on the growth of microorganisms.

#### COURSE LEARNING OUTCOMES

CLO 1	The learner will be able to work safely in a microbiological laboratory, identify potential hazards, comply with appropriate safety protocols and disposal of microbiological material, as per approved procedures.
CLO 2	The learner will be able to use the compound light microscope to observe the morphology of microorganisms using simple and differential staining techniques.
CLO 3	The learner will be able to prepare and sterilize media, culture microorganisms using aseptic techniques and describe the growth characteristics of different types of microorganisms based on their morphology and cultural characteristics
CLO 4	The learner will be able to perform qualitative tests to specifically detect carbohydrates, amino acids, proteins, RNA and DNA.
CLO 5	The learner will be able to demonstrate the presence of intracellular and extracellular structures that are characteristics of specific bacteria using special staining techniques.
CLO 6	The learner will be able to analyze the impact of diffusion of oxygen into the medium on the growth of unicellular and multicellular microorganisms.
CLO 7	The learners will be able to describe the macroscopic and microscopic characteristics of various fungi aiding in their identification.
CLO 8	The learner will be able to discern the impact of environmental conditions on the growth of microorganisms and infer the conditions that promote or inhibit the growth of microorganisms.

Sr. no.	<b>SECTION-1 FUNDAMENTALS OF MICROBIOLOGY</b>
1	Qualitative detection of Carbohydrates- Benedicts and Molisch's test.
2	Qualitative detection of Proteins- Biuret
3	Qualitative detection of Amino acids-Ninhydrin.
4	Qualitative detection of Nucleic acid - DPA and Orcinol.
5	Assignment / student activity : Contribution of Scientists in the field of Microbiology or Types of bond and their significance in macromolecules (Diagram & Write up/Poster making/ Model making)
6	Cell wall staining
7	Demonstration of capsule.
8	Endospore staining

9	Lipid staining
10	Metachromatic granules staining
11	Flagella staining (Demonstration)
12	Study of Motility (Hanging Drop Preparation)
13	Isolation of <i>Saccharomyces cerevisiae</i> .
14	Study of Morphological characteristics (Wet mount): Rhizopus
15	Cultivation of fungi a. On Sabouraud's agar b. Using Static & Shaker conditions
16	Study of Permanent slides of Algae and Protozoa

Sr. no.	<b>SECTION-2 BASIC TECHNIQUES IN MICROBIOLOGY</b>
1	Use and care of a microscope
2	Monochrome staining
3	Negative Staining
4	Differential staining: Gram staining
5	Assignment: Tabulation of names, morphology, arrangement, Gram nature and motility of 10 common microorganisms with diagrams.
6	Introduction to Laboratory equipments, disinfection & discarding techniques in laboratory
7	Methods of sterilization of glass and plasticware (Pipettes, Petri Plates, Flasks, Micropipettes, tips and Microtitre plates)

8	Sterilization of microbiological media
9	Inspissation (Demonstration)
10	Type of filters and Efficiency of filtration (Demonstration)
11	Aseptic transfer of media
12	Effect of UV Light on microorganisms.(Demonstration)
13	Effect of Osmotic pressure on microorganisms
14	Testing antimicrobial activity of dyes/ disinfectants (disc diffusion method)
15	Student activity: Testing antimicrobial activity of herbal extracts
16	Preparation of Culture Media: a. Liquid medium(Nutrient Broth) b. Solid Media(Nutrient agar, Sabouraud's agar) c. Preparation of slant, butts & plate
17	Inoculation techniques and Study of Growth: a. Inoculation of Liquid Medium b. Inoculation of Solid Media (Slants, Butts and Plates)
18	Study of Colony Characteristics of pigment & non-pigment producing bacteria.

## ASSESSMENT DETAILS:

### Internal assessment (50 marks)

#### Part 1: Test (25 marks)

- Students will be given a written test from any of the 3 units for 25 marks. The duration of the test will be 50 minutes.

#### Part 2: Test (25 marks)

- Students will be given a written test from any of the 3 units for 25 marks. The duration of the test will be 50 minutes.

#### Part 3: Activity (25 marks)

- An activity for 25 marks would be given in the form of a creative learning process.

The best two marks will be considered for the Internal assessment total out of 50

### Semester end examination (50 marks)

#### If Online

- The question paper will be a 50 mark paper having MCQs of 1 and 2 marks.

#### If Offline

- The duration of the paper will be two hours.
- There shall be four compulsory questions
- Q1-3 shall correspond to the three units. Q1-3 shall contain an internal choice (attempt any 2 of 4). Q1-3 shall carry a maximum of 14 marks
- Q4 shall be from Unit 1 to 3. Q4 shall carry a maximum of 08 marks (attempt any 4 of 8)

### Practical Assessment

#### (A) Internal Assessment:-

There will not be any internal examination/evaluation for practicals.

#### (B) Semester End Practical Examination):- Total - 100 marks

- The duration of the practical exam will be two days.
- There will be 50 marks practical per paper.
- To appear in the practical exam, students must bring a properly certified journal.

## SEMESTER II

NAME OF THE COURSE	EXPLORING MICROBIOLOGY	
CLASS	FYBSc	
COURSE CODE	SBSMCB201	
NUMBER OF CREDITS	2	
NUMBER OF LECTURES PER WEEK	3	
TOTAL NUMBER OF LECTURES PER SEMESTER	45	
EVALUATION METHOD	INTERNAL ASSESSMENT	SEMESTER END EXAMINATION
TOTAL MARKS	50	50
PASSING MARKS	20	20

### COURSE OBJECTIVES:

CO 1	To provide a glimpse of the general characteristics of Rickettsia, Chlamydia, Actinomycetes, Archaea and understand their significance.
CO 2	To provide knowledge about the structural details, life cycle and cultivation of viruses
CO 3	To explore various types of interactions amongst microorganisms and other living organisms in nature
CO 4	To outline the distribution and significance of normal flora of human body
CO 5	To review the crucial role of microbial species in cycling of nutrients.
CO 6	To familiarize with the basic terms related to microbial infections and highlight the role of host defense mechanisms in resisting infections and microbial virulence factors in development of diseases.

### COURSE LEARNING OUTCOMES:

CLO 1	The learner will be able to enlist the general properties of viruses including the structural features along with the lifecycle of the lytic and lysogenic bacteriophages and overview of cultivation methods for viruses
CLO 2	The learner will be able to describe the characteristics and significance of Rickettsia, Chlamydia, Actinomyces and Archaea
CLO 3	The learner will be able to discuss the symbiotic associations such as mutualism, parasitism, predation, amensalism and commensalism in the context of microbial species



CLO 4	The learner will be able to discuss distribution and examples of Normal flora of human skin, respiratory tract, gastrointestinal tract and genitourinary tract.
CLO 5	The learner will be able to illustrate the role of microbial species in Carbon, Nitrogen, Sulphur, Phosphorus and Iron cycle.
CLO 6	The learner will be able to outline the role of various defense mechanisms of the human immune system in fighting against virulent pathogens.

UNIT 1	<b>STUDY OF VIRUSES, RICKETTSIA, CHLAMYDIA, ACTINOMYCETES AND ARCHAEA (15 Lectures)</b>
1.1	Viruses: a. Historical highlights, general properties of viruses, b. Structure of viruses-capsids, envelopes and genomes. c. Overview of cultivation of viruses. d.. Bacteriophages: Lytic cycle, Lysogeny, Structure and Life cycle of T4 phage and lambda phage.
1.2	Rickettsia and Chlamydia: General characteristics, diseases and vectors
1.3	Actinomycetes: General characteristics and Significance.
1.4	Introduction to Archaea
UNIT 2	<b>MICROBIAL INTERACTIONS (15 lectures)</b>
2.1	Types of Microbial Interactions: a. Mutualism: Lichens, Rhizobia, Mycorrhizae and Frankia. b. Commensalism: Normal flora of the human body, relationship between microbiota and the host. c. Normal flora of i. Skin, ii. Respiratory tract, iii. Gastrointestinal tract and iv. Genitourinary tract. d. Amensalism e. Predation and Parasitism
2.2	Role of microorganisms in cycling of nutrients. Carbon, Nitrogen, Sulphur, Phosphorus and Iron.
UNIT 3	<b>MICROBES &amp; HUMAN HEALTH (15 lectures)</b>

3.1	Important terminologies: Infection and disease: Primary and secondary infections, Contagious infections, Opportunistic pathogens, Zoonoses and Vector borne infections.
3.2	Germ free animals and Significance of Gnotobiotic studies
3.3	Factors affecting infection: a. Pertaining to Hosts: Natural, Species and Racial resistance. b. Pertaining to individual resistance. c. Microbial virulence factors in adherence, invasion, colonization and disease.
3.4	Host defense against infection: An Overview a. First line of defense: Skin, respiratory tract, gastrointestinal tract, genitourinary tract and eyes. b. Second line of defense: Fever, Inflammation and Phagocytosis c. Third line of defense: Brief introduction to Immunity (active passive, natural and acquired)

#### REFERENCES:

1. Pelczar Jr, M. J.; Chan, E.C.S. & Krieg, N. R. (1986). Microbiology 5<sup>th</sup> edn. New York: Tata McGraw-Hill Education Pvt. Ltd.
2. Madigan, M. T.; Bender K. , Buckley D. (2021). Brock Biology of Microorganisms. 16<sup>th</sup> Global edn- San Francisco: Pearson International edition.
3. Stanier, R. Y.; Ingraham, J. L.; Wheelis, M. L. & Painter, R. P. (1992). General Microbiology 5<sup>th</sup> edn. Cornell university: Macmillan, Hampshire & London.
4. Tortora G.J., Funke, B.R., Case, C.L., 2020 Microbiology: an introduction. 13<sup>th</sup> Global edn. Pearson
5. Cowan, M. K. & Smith, H.(2018) Microbiology fundamentals- A Clinical Approach, 3<sup>rd</sup> edn. United States: McGraw Hill publication.
6. Collins, C. H. & Lyne, P. M. (2001). Collins And Lyne's Microbiological methods, 7<sup>th</sup> edn.

#### COURSE OBJECTIVES:

#### COURSE LEARNING OUTCOMES:

CLO 1	The learner will be able to differentiate between fluorescence and confocal microscope based on construction and the working and applications
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NAME OF THE COURSE	To provide the understanding of advanced light microscopes.	ADVANCED AND APPLIED MICROBIOLOGY
CLASS	To provide knowledge of types of electron microscopes and familiarize with a variety of specimen preparation methods for electron microscopy.	FYBSc SBSMCB202
COURSE CODE		
NUMBER OF CREDITS		2
NUMBER OF LECTURES PER WEEK	To comprehend the details of use of lab instruments such as pH meter, and colorimeter .	3
TOTAL NUMBER OF LECTURES PER SEMESTER	Aspects of microbial growth and train students to use various techniques of estimating microbial growth.	45
EVALUATION METHOD	To review the applications of microorganisms and their products in various industries.	INTERNAL ASSESSMENT
CO 5		SEMESTER END EXAMINATION
CO 6	To provide a glimpse of the basic tools and techniques used in Recombinant DNA technology and highlight the use of Genetically engineered microorganisms	30 50 20
TOTAL MARKS		100
PASSING MARKS		20

CLO 2	The learner will be able to compare the principle, construction, working and applications of TEM and SEM and describe the process of specimen preparation for electron microscopy.
CLO 3	The learner will be able to derive mathematical expression of growth and calculate the number of bacterial cells formed at the end of a growth period as well as select appropriate enumeration methods to estimate microbial growth.
CLO 4	The learner will be able to discuss the applications and advantages of Microbial technology in food production, agriculture, environment clean up and pharma industry.
CLO 5	The learner will be able to measure absorbance using a colorimeter and construct a graph to determine absorption maxima of colored solutions.
CLO 6	The learner will be able to standardize a pH meter using standard buffers to determine pH of any solution.

UNIT 1	ADVANCED MICROSCOPY AND INSTRUMENTATION (15 Lectures)
1.1	Fluorescent and Confocal Microscope
1.2	Light and Electron Microscope: Comparison between the two.
1.3	Types of electron microscopes: TEM, SEM and scanning probe microscope (Principle, Construction, Working, Advantages, limitations and Applications).
1.4	Specimen preparation for Electron microscopy: Ultrathin sectioning, Negative stains, Surface replica, Shadow casting and Freeze etching
1.5	pH meter: Principle, Construction, Combined electrode, Working, Validation and Calibration.
1.6	Colorimeter: Principle, Construction, Working and Calibration

UNIT 2	MICROBIAL GROWTH (15 lectures)
2.1	Definition of growth, Mathematical Expression and Growth curve
2.2	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
2.3	Influence of environmental factors on growth, Ways to increase yield of microbes, Batch, fed-batch and continuous cultures
2.4	Microbial growth in natural environment-Biofilms.
2.5	Viable but non-culturable bacteria- definition and significance
UNIT 3	MICROBIAL TECHNOLOGY (15 lectures)
3.1	Microbial technology and the four ‘F’(Food, Feed, Fuel and Functional molecules) Overview of a. Applications of microorganisms in Food industry i. Fermented food products Alcoholic beverages ii. Dairy Products ii. Probiotics b. Commercial Production of Microorganisms: Feed / SCP production Biofertilizers, Biopesticides c. Products from Microorganisms: antibiotics, enzymes, vitamins, polysaccharides d. Bioconversions using microorganisms: -Microorganisms in Fuel production -Biomining and bioleaching of ores
3.2	Recombinant Microbial biotechnology a. Bacterial genes, genomes and genetics b. Techniques of gene manipulation (outline) c. Genetically engineered microorganisms and their applications in i. Human health (Insulin) ii. Agriculture (BT cotton) iii. Environment (Bioremediation of Oil spill) iv. Research (reporter microbes)

REFERENCES:

1. Willey J. , Sandman K , Wood D. Prescott's Microbiology (ISE)(2019) 11th edn– McGraw-Hill Education.
2. Tortora G.J., Funke, B.R., Case, C.L., (2020) Microbiology: an introduction. 13<sup>th</sup> Global edn. Pearson.
3. Madigan, M. T.; Bender K. , Buckley D. (2021). Brock Biology of Microorganisms. 16th Global edn- San Francisco: Pearson International edition.
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NAME OF THE COURSE	PRACTICALS	
CLASS	FYBSc	
COURSE CODE	SBSMCBP2	
NUMBER OF CREDITS	2	
NUMBER OF LECTURES PER WEEK	6	
TOTAL NUMBER OF LECTURES PER SEMESTER	90	
EVALUATION METHOD	INTERNAL ASSESSMENT	SEMESTER END EXAMINATION
TOTAL MARKS	-	100
PASSING MARKS	-	40

COURSE OBJECTIVES

CO 1	To familiarize learners with microbiological techniques to detect bacteriophages.
CO 2	To train learners to isolate and identify agriculturally important nitrogen fixing bacteria.

CO 3	To train learners to analyze the normal flora of skin and saliva
CO 4	To train learners to use selective, enriched and differential media to study the properties of microorganisms that aid in establishing their pathogenicity.
CO 5	To provide learners with hands on training in the use and care of common laboratory equipment such as colorimeter and pH meter
CO 6	To train learners to enumerate microorganisms using a variety of methods.
CO 7	To equip learners with the skills to analyze the growth of microorganisms with respect to time enabling them to understand the dynamics of microbial growth under standard laboratory conditions.
CO 8	To promote an understanding of appropriate laboratory techniques and equipment for enumeration of microorganisms.
CO 9	To acquaint learners with the operations in a food / dairy / pharma industry through a visit.
CO 10	To train learners to explore microorganisms found in natural environments and fermented foods.
CO 11	To provide learners an opportunity to develop written communication skills in reporting and presenting results of experiments through journal work.

#### COURSE LEARNING OUTCOMES

CLO 1	The learner will be able to detect the presence and enumerate bacteriophages using the plaque assay.
CLO 2	The learner will be able to isolate symbiotic and free living nitrogen fixing bacteria from plants and soil respectively and study their morphological and cultural characteristics.
CLO 3	The learner will be able to isolate the normal flora and study their cultural characteristics
CLO 4	The learner will be able to differentiate between lactose fermenters and non fermenters based on their growth on selective media such as MacConkey's agar.
CLO 5	The learner will be able to perform the Hemolysin, Lecithinase test and in order to confirm pathogenicity of bacteria.
CLO 6	The learner will be able to enumerate microorganisms using cultural methods such as pour and spread plate technique and microscopic methods using counting chambers such as the Haemocytometer, Breed's count as well as indirect methods such as Brown's opacity tube method, etc.
CLO 7	The learner will be able to plot the bacterial growth curve and identify the phases of the bacterial growth curve after culturing microorganisms under standard conditions.
CLO 8	The learner will be able to perform experiments involving common laboratory equipment.

CLO 9	The learner will be able to comprehend the work environment in industry and consider exploring it as a potential career option.
CLO 10	The learner will be able to communicate their experimental findings in the form of diagrams, tables and comprehensive text.

Sr. no.	<b>SECTION-1 EXPLORING MICROBIOLOGY</b>
1	Spot assay of Bacteriophage
2	Slide Culture technique (Actinomycetes)
3	Student activity: Enrichment of Thermophiles from hot water springs/ Enrichment of halophiles from sea water/ Enrichment of Psychrophiles from frozen food or any other sample
4	Wet Mount of Lichen
5	Rhizobium: Staining & Isolation.
6	Azotobacter: Isolation & staining
7	Normal flora: Isolation of microorganisms from skin and saliva
8	Use of special purpose media: Selective & Differential: MacConkey's Agar Enriched and differential : Superimposed Blood agar (and its use in studying virulence factor hemolysin) Baird Parker's medium (and its use in studying virulence factor lecithinase)
9	Study of role of fomites in spread of diseases
10	Assignment: Preparation of chart/poster/model showing different WBCs and their role in human immune system

Sr. no.	<b>SECTION-2 ADVANCED AND APPLIED MICROBIOLOGY</b>
1	Student activity: Collect and make a collage of SEM & TEM images of Eukaryotic organelles / cells .

2	Use of standard buffers for calibration of the pH meter and determination of pH of a given solution.
3	Determination Of $\lambda_{\max}$ of coloured solutions and Verification of Beer's law.
4	Enumeration of bacteria by Breed's Count.
5	Haemocytometer.
6	Brown's opacity tubes.
7	Measurement of cell dimensions-Micrometry
8	Viable count: Spread plate method
9	Viable count : Pour plate method
10	Study of Growth curve (Demonstration)
11	Study of effect of pH and temperature on growth
12	Student activity: Preparation of biofilm and staining
13	Wine production from grapes / Bread making
14	Study of microorganisms in fermented food by Gram Stain (curd or idli batter)
15	Student activity: Study the effect of biofertilizer on plant growth
16	Visit to Microbiology laboratory in a research Institute Or any Industry



## ASSESSMENT DETAILS:

### Internal assessment (50 marks)

#### Part 1: Test (25 marks)

- Students will be given a written test from any of the 3 units for 25 marks. The duration of the test will be 50 minutes.

#### Part 2: Test (25 marks)

- Students will be given a written test from any of the 3 units for 25 marks. The duration of the test will be 50 minutes.

#### Part 3: Activity (25 marks)

- An activity for 25 marks would be given in the form of a creative learning process.

The best two marks will be considered for the Internal assessment total out of 50

### Semester end examination (50 marks)

#### If Online

- The question paper will be a 50 mark paper having MCQs of 1 and 2 marks.

### If Offline

- The duration of the paper will be two hours.
- There shall be four compulsory questions
- Q1-3 shall correspond to the three units. Q1-3 shall contain an internal choice (attempt any 2 of 4). Q1-3 shall carry a maximum of 14 marks
- Q4 shall be from Unit 1 to 3. Q4 shall carry a maximum of 08 marks (attempt any 4 of 8)

### Practical Assessment

#### (A) Internal Assessment:-

There will not be any internal examination/evaluation for practicals.

#### (B) Semester End Practical Examination):- Total - 100 marks

- The duration of the practical exam will be two days.
- There will be 50 marks practical per paper.
- To appear in the practical exam, students must bring a properly certified journal.