
# 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 2018-19)

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<br>Fundamentals Of Microbiology<br>(Practicals Based On Unit-I, II & III Of SBSMCB101 | |
| | 2 | SECTION-2<br>Basic Techniques In Microbiology<br>(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<br>Exploring Microbiology<br>(Practicals Based On Unit-I, II & III) | |
| | 2 | SECTION-2<br>Advanced and Applied Microbiology<br>(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

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| 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

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| 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

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| 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 | 25 | 75 |
| PASSING MARKS | 10 | 30 |

COURSE OBJECTIVES:

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| 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:

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| CLO 1 | The learner will be able to enlist the major events in the history of microbiology, including the 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. |

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| 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 *Saccharomyces cerevisiae, Rhizopus, Chlamydomonas , Myxomycetes , Entamoeba* using a diagram |

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| UNIT 1 | HISTORY OF MICROBIOLOGY AND CHEMICAL BASIS OF LIFE (15 Lectures) |
| 1.1 | History Of Microbiology<br>a. Discovery of microorganisms<br>b. Conflict over spontaneous generation<br>c. Golden Age Of Microbiology-Koch Postulate, Medical Microbiology and Immunology |
| 1.2 | Chemical Basis of Life<br>a. Types of bonds and their importance: Electrovalent, covalent, ester, phosphodiester, thioester, peptide and glycosidic.<br>b. Water: Structure and Role of water. |
| 1.3 | Definition, general characteristics and functions of<br>a. Carbohydrates: Monosaccharides, Oligosaccharides (maltose, cellobiose, sucrose, lactose) and Polysaccharide (starch, glycogen, peptidoglycan, cellulose)<br>b. Lipids: Simple and complex lipids, storage and structural lipids. Liposomes and their applications<br>c. Amino acids & 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.<br>d. Nucleic acids: Nitrogenous bases- Purines, Pyrimidines, Pentoses-Ribose, Deoxyribose. Structure of RNA and DNA. |
| UNIT 2 | PROKARYOTIC CELL STRUCTURE AND FUNCTION (15 lectures) |
| 2.1 | Bacteria - Morphology and Arrangement |
| 2.2 | Cell wall |
| 2.3 | Plasma membrane |
| 2.4 | Chromosomes and plasmids. |

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| 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:<br>a. Plasma membrane and Cytoplasmic matrix,<br>b. Endoplasmic reticulum<br>c. Golgi apparatus.<br>d. Ribosomes<br>e. Mitochondria and Chloroplasts<br>f. Nucleus –Nuclear Structure<br>g. Cytoskeletal elements -<br>h. External cell coverings viz Cilia and Flagella |
| 3.3 | Morphological characteristics, Life Cycle, Cultivation, and significance of:<br>a. Yeast and Molds (*Saccharomyces cerevisiae* and *Rhizopus*)<br>b. Algae (*Chlamydomonas*)<br>c. Slime Molds and Myxomycetes<br>d. Protozoa (*Entamoeba histolytica*) |

**REFERENCES:**


1. Willey, J. M.; & Woolverton, C. J. (2008). Prescott, Harley & Klein's Microbiology 9th edn. Singapore: McGraw Hill International edition.
2. Stanier, R. Y.; Ingraham, J. L.; Wheelis, M. L. & Painter, R. P. (1992). General Microbiology 5th edn. Cornell university: Macmillan, Hampshire & London.
3. Pelczar Jr, M. J.; Chan, E.C.S. & Krieg, N. R. (1986). Microbiology 5th edn. New York:Tata McGraw-Hill Education Pvt. Ltd.
4. Madigan, M. T.; Martinko, J. M.; Dunlap, P. V. & Clark, D. P. (2008). Brock Biology of Microorganisms. San Francisco: Pearson International edition.
5. Nelson, D. L. & Cox, M. M. (2012). Lehninger Principles of Biochemistry 6th edn.W.H. Freeman.


COURSE OBJECTIVES:

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| 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 | 25 | 75 |
| PASSING MARKS | 10 | 30 |

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| 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:

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| 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. |

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| 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. |

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| UNIT 1 | MICROSCOPY & STAINING PROCEDURES (15 LECTURES) |
| 1.1 | Microscopy:<br>a. History of microscopy<br>b. Structure and functions of different parts of a microscope<br>c. Magnification, resolving power, Numerical aperture, Use of oil immersion objective<br>d. Simple and compound light microscope<br>e. Dark field Microscope<br>f. Phase contrast microscope |
| 1.2 | Staining procedures<br>a. Stains: Types of stains (Acidic, Basic, Compound)<br>b. Fixatives, Mordants and Decolorizers.<br>c. Simple and differential staining (Gram and Acid Fast)<br>d. Special staining (Cell wall, Capsule, Lipid granules, Spores, Metachromatic granules & Flagella) |
| UNIT 2 | CULTIVATION OF MICROORGANISMS (15 lectures) |
| 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) |
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| 3.1 | Definition and Factors affecting the effectiveness of antimicrobial agents |
| 3.2 | Physical methods of microbial control<br>a. Moist and Dry heat<br>b. Radiation<br>c. Filtration<br>d. Low temperature<br>e. High pressure<br>f. Desiccation and Osmotic pressure |
| 3.3 | Chemical methods of microbial control<br>a. Phenolics<br>b. Alcohols<br>c. Heavy metals<br>d. Halogens<br>e. Quaternary ammonium compounds<br>f. Sterilizing gasses<br>g. Surface active agents<br>h. Aldehydes<br>i. Peroxgens<br>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.M., Sherwood, L.M., Woolverton, C.J. 2015. Prescott's Microbiology, 9th International edn, McGraw Hill publication.
3. Tortora G.J., Funke, B.R., Case, C.L., 2016 Microbiology: an introduction. 11th edn. Pearson India ltd.
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
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

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| 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

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| 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, steak 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 environment on the growth of microorganisms. |
| CO 9 | To train learners to identify various groups of microorganisms based on their cultural characteristics on various selective, differential and enriched media |
| CO 10 | To acquaint learners with the research environment through a visit to a research laboratory. |

COURSE LEARNING OUTCOMES:

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| 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 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 analyze the impact of diffusion of oxygen into the medium on the growth of unicellular and multicellular microorganisms. |
| CLO 6 | The learner will be able to describe the macroscopic and microscopic characteristics of various fungi aiding in their identification. |
| CLO 7 | The learner will be able to focus and observe stained and unstained preparations using the low, high and oil immersion objectives of a compound microscope. |
| 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. |
| CLO 9 | The learner will be able to identify groups of bacteria based on their cultural characteristics on selective, differential and enriched media. |
| CLO 10 | The learner will be able to comprehend the work environment in a research laboratory and get motivated to choose research as a potential career option. |

| Sr. no. | **SECTION-1 FUNDAMENTALS OF MICROBIOLOGY.** |
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| 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) |

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| 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 | Student activity:<br>Observing intracellular inclusions of algae / protozoa from natural environments using phase contrast microscope |
| 14 | Isolation of *Saccharomyces cerevisiae* |
| 15 | Study of Morphological characteristics (Wet mount): Rhizopus |
| 16 | Cultivation of fungi<br>a. On Sabouraud's agar<br>b. Using Static & Shaker conditions |
| 17 | Study of Permanent slides of Algae and Protozoa |
| 18 | Assignment: Characteristics indicating similarities and differences amongst algae, protozoa and fungi (Tabulation) |

| Sr. no. | **SECTION-2 BASIC TECHNIQUES IN MICROBIOLOGY** |
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| 1 | Use and care of a microscope |
| 2 | Dark field and Phase contrast microscopy: Demonstration |

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| 3 | Monochrome staining |
| 4 | Negative Staining |
| 5 | Differential staining:<br>a. Gram staining<br>b. Acid fast staining (observing stained slides) |
| 6 | Assignment: Tabulation of names, morphology, arrangement, Gram nature and motility of 10 common microorganisms with diagrams. |
| 7 | Introduction to Laboratory equipments, disinfection & discarding techniques in laboratory |
| 8 | Methods of sterilization of glass and plasticware (Pipettes, Petri Plates, Flasks, Micropipettes, tips and Microtitre plates) |
| 9 | Sterilization of microbiological media |
| 10 | Inspissation (Demonstration) |
| 11 | Type of filters and Efficiency of filtration (Demonstration) |
| 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:<br>a. Liquid medium (Nutrient Broth)<br>b. Solid Media (Nutrient agar, Sabouraud's agar)<br>c. Preparation of slant, butts & plate |
| 17 | Inoculation techniques and Study of Growth:<br>a. Inoculation of Liquid Medium<br>b. Inoculation of Solid Media (Slants, Butts and Plates) |
| 18 | Study of Colony Characteristics of pigment & non-pigment producing bacteria. |

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| 19. | Use of special purpose media<br>a. Differential & Selective (MacConkey Agar)<br>b. Enriched and differential: Superimposed Blood agar |
| 20. | Student activity: Carrying out preservation of a fungal /bacterial culture using any two methods of preservation. |
| 21. | Visit to Microbiology laboratory in a research Institute |

ASSESSMENT DETAILS:

Internal assessment (25 marks)

Part 1: Test (20 marks)

- Students will be given a written test from any of the 3 units for 20 marks. The duration of the test will be 50 minutes. (Multiple choice questions- 05 marks, Answer in one word/sentence - 05 marks, Subjective questions- HWY, Justify, Differentiate between, Diagrammatically etc. - 10 marks).

Part 2: Attendance (05 marks)

Semester end examination (75 marks)

- The duration of the paper will be two and a half 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 3 for Part A and any 4 of 6 or 8 of 10 for Part B). Q1-3 shall carry a maximum of 20 marks (12 marks Part A and 08 marks for Part B)
- Q4 shall be from Unit 1 to 3. Q4 shall carry a maximum of 15 marks (attempt any 3 of 4)

Practical Assessment

- 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

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| 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 | 25 | 75 |
| PASSING MARKS | 10 | 30 |

COURSE OBJECTIVES:

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| 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:

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| 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. |

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| 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. |

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| UNIT 1 | STUDY OF VIRUSES, RICKETTSIA, CHLAMYDIA, ACTINOMYCETES AND ARCHAEA (15 Lectures) |
| 1.1 | Viruses:<br>a. Historical highlights, general properties of viruses,<br>b. Structure of viruses-capsids, envelopes and genomes.<br>c. Overview of cultivation of viruses.<br>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 | MICROBIAL INTERACTIONS (15 lectures) |
| 2.1 | Types of Microbial Interactions:<br>a. Mutualism: Lichens, Rhizobia, Mycorrhizae and Frankia.<br>b. Commensalism: Normal flora of the human body, relationship between microbiota and the host.<br>c. Normal flora of<br>i. Skin,<br>ii. Respiratory tract,<br>iii. Gastrointestinal tract and<br>iv. Genitourinary tract.<br>d. Amensalism<br>e. Predation and Parasitism |
| 2.2 | Role of microorganisms in cycling of nutrients.<br>Carbon, Nitrogen, Sulphur, Phosphorus and Iron. |
| UNIT 3 | MICROBES & HUMAN HEALTH (15 lectures) |
| 3.1 | Important terminologies: Infection and disease: Primary and secondary infections, Contagious infections, Opportunistic pathogens, Zoonoses and Vector borne infections. |

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| 3.2 | Germ free animals and Significance of Gnotobiotic studies |
| 3.3 | Factors affecting infection:<br>a. Pertaining to Hosts: Natural, Species and Racial resistance.<br>b. Pertaining to individual resistance.<br>c. Microbial virulence factors in adherence, invasion, colonization and disease. |
| 3.4 | Host defense against infection: An Overview<br>a. First line of defense: Skin, respiratory tract, gastrointestinal tract, genitourinary tract and eyes.<br>b. Second line of defense: Fever, Inflammation and Phagocytosis<br>c. Third line of defense: Brief introduction to Immunity (active passive, natural and acquired) |

REFERENCES


1. Willey, J. M. & Woolverton, C. J. (2008). Prescott, Harley & Klein's Microbiology 9th edn. Singapore: McGraw Hill International edition.
2. PelczarJr, 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, R. P. (1992). General Microbiology 5th edn. Cornell university: Macmillan, Hampshire & London.
4. Madigan, M. T.; Martinko, J. M.; Dunlap, P. V. & Clark, D. P. (2008). Brock Biology of Microorganisms. San Francisco: Pearson International edn.
5. Tortora G.J., Funke, B.R., Case, C.L., 2016 Microbiology: an introduction. 11th edn. Pearson India ltd.
6. Stanier, R. Y.; Ingraham, J. L.; Wheelis, M. L. & Painter, R. P. (1992). General Microbiology 5th edn. Cornell university: Macmillan, Hampshire & London.
7. Cowan, M. K. & Smith, H. Microbiology fundamentals- A Clinical Approach, 3rd edn. United States: McGraw Hill publication.
8. Collins, C. H. & Lyne, P. M. (2001). Collins And Lyne's Microbiological methods, 7th edn. London:ARNOLD.

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| NAME OF THE COURSE | ADVANCED AND APPLIED MICROBIOLOGY | |
| CLASS | FYBSc | |
| COURSE CODE | SBSMCB202 | |
| 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 | 25 | 75 |
| PASSING MARKS | 10 | 30 |

COURSE OBJECTIVES:

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| CO 1 | To provide the understanding of advanced light microscopes. |
| CO 2 | To provide knowledge of types of electron microscopes and familiarize with a variety of specimen preparation methods for electron microscopy. |
| CO 3 | To comprehend the details of use of lab instruments such as pH meter, and colorimeter. |
| CO 4 | To review fundamental aspects of microbial growth and train students to use various techniques of estimating microbial growth. |
| CO 5 | To review the applications of microorganisms and their products in various industries. |
| 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. |

COURSE LEARNING OUTCOMES:

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| CLO 1 | The learner will be able to differentiate between fluorescence and confocal microscope based on construction and the working and applications |
| 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. |

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| 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<br>a. Direct microscopic count and Haemocytometer.<br>b. Viable count – Spread plate and Pour plate technique<br>c. Measurements of cell constituents<br>d. Turbidity measurements – Nephelometer and spectrophotometer |
| 2.3 | Influence of environmental factors on growth,<br>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)<br>Overview of<br>a. Applications of microorganisms in Food industry<br>i. Fermented food products<br>Alcoholic beverages<br>ii. Dairy Products |

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| | ii. Probiotics<br>b. Commercial Production of Microorganisms:<br>Feed / SCP production<br>Biofertilizers,<br>Biopesticides<br>c. Products from Microorganisms: antibiotics, enzymes,vitamins, polysaccharides<br>d. Bioconversions using microorganisms:<br>-Microorganisms in Fuel production<br>-Biomining and bioleaching of ores |
| 3.2 | Recombinant Microbial biotechnology<br>a. Bacterial genes, genomes and genetics<br>b. Techniques of gene manipulation (outline)<br>c. Genetically engineered microorganisms and their applications in<br>i. Human health (Insulin)<br>ii. Agriculture (BT cotton)<br>iii. Environment (Bioremediation of Oil spill)<br>iv. Research (reporter microbes) |

REFERENCES


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2. Tortora G.J., Funke, B.R., Case, C.L., 2016 Microbiology: an introduction. 11th edn. Pearson India Ltd.
3. Madigan M. T., Martinko, J. M., Bender K. S., Buckley, D H., Stahl D. A., 2015 Brock Biology of Microorganisms 14th global edn: Pearson edu ltd.
4. Stanier, Ingraham et al. 1986. General Microbiology. 5th edn, Macmillan education limited.
5. Talaro, K. P., Chess K. 2012. Foundations in Microbiology 8th International edition, NewYork:McGraw Hill.
6. Pelczar M., Chan E.C, Krieg N. R., 1993. Microbiology- Concepts and Applications, International edn, McGraw Hill
7. Plummer D. 2004. An Introduction to Practical Biochemistry 3rd Indian edn. Tata McGraw-Hill

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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

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| 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 familiarize learners with 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. |
| 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

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| CLO 1 | The learners will be able to detect the presence and enumerate bacteriophages using the plaque assay. |

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| CLO 2 | The learners 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 learners will be able to perform the Hemolysin, Lecithinase or Coagulase test and in order to confirm pathogenicity of bacteria. |
| CLO 5 | 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 6 | The learners will be able to recognise and identify the phases of bacterial growth curve after culturing microorganisms under standard conditions. |
| CLO 7 | The learners will be able to perform experiments involving common laboratory equipment. |
| CLO 8 | The learners will be able to comprehend the work environment in industry and consider exploring it as a potential career option. |
| CLO 9 | The learners will be able to communicate their experimental findings in the form of diagrams, tables and comprehensive text. |

| Sr. no. | **SECTION-1 EXPLORING MICROBIOLOGY** |
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| 1 | Spot assay of Bacteriophage<br>a. Spot assay<br>b. Plaque Assay (Demonstration) |
| 2 | Slide Culture technique (Actinomycetes) |
| 3 | Enrichment of Thermophiles |
| 4 | Student activity: Isolation of halophiles from sea water/ Psychrophiles from frozen food |
| 5 | Wet Mount of Lichen |
| 6 | Rhizobium: Staining & Isolation. |
| 7 | Azotobacter: Isolation & staining |
| 8 | Normal flora: Isolation of microorganisms from |

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| | a. skin<br>b. saliva |
| 9 | Student activity: Cultivation of bacteria involved in sulphur cycle (e.g. photosynthetic sulphur bacteria / sulphate reducing bacteria) |
| 10 | Demonstration of WBCs in blood (Blood smear) |
| 11 | Study of virulence factors of pathogens –<br>a. Hemolysin<br>b. Lecithinase<br>c. Coagulase |
| 12 | Study of role of fomites in spread of diseases |
| 13 | Assignment: Preparation of chart/poster/model showing different WBCs and their role in human immune system |

| **Sr. no**. | **SECTION-2 ADVANCED AND APPLIED MICROBIOLOGY** |
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| 1 | Use of standard buffers for calibration of the pH meter and determination of pH of a given solution. |
| 2 | Determination Of $\lambda_{max}$ of coloured solutions. |
| 3 | Verification of Beer's law. |
| 4 | Assignment: Collect and make a collage of SEM & TEM images of Eukaryotic organelles / cells . |
| 5 | Enumeration of bacteria by<br>a. Breed's Count.<br>b. Haemocytometer<br>c. Brown's opacity tubes |
| 6 | Measurement of cell dimensions-Micrometry |
| 7 | Viable count by<br>a. Spread plate method<br>b. Pour plate method |
| 8 | Study of bacterial growth curve (Demonstration) |

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| 9 | Study of effect of pH and temperature on growth of microorganisms |
| 10 | Student activity: Preparation of biofilm and staining |
| 11 | Wine production from grapes / Bread making |
| 12 | Study of microorganisms in fermented food by Gram Stain (curd or idli batter) |
| 13 | Student activity: Study the effect of biofertilizer on plant growth |
| 14 | a.Demonstrating separation of DNA using Gel electrophoresis using videos.<br>b. Demonstration of use of restriction enzymes in genetic engineering using animations. |
| 15 | Visit to an Industry (Food/ Dairy/ Pharma) |

ASSESSMENT DETAILS:

Internal assessment (25 marks)

Part 1: Test (20 marks)

- Students will be given a written test from any of the 3 units for 20 marks. The duration of the test will be 50 minutes. (Multiple choice questions- 05 marks, Answer in one word/sentence - 05 marks, Subjective questions- HWY, Justify, Differentiate between, Diagrammatically etc. - 10 marks).

Part 2: Attendance (05 marks)

Semester end examination (75 marks)

- The duration of the paper will be two and a half 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 3 for Part A and any 4 of 6 or 8 of 10 for Part B). Q1-3 shall carry a maximum of 20 marks (12 marks Part A and 08 marks for Part B)
- Q4 shall be from Unit 1 to 3. Q4 shall carry a maximum of 15 marks (attempt any 3 of 4)

Practical Assessment

- 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.