

SOPHIA COLLEGE

Autonomous

Affiliated to University of Mumbai

Syllabus

Program: B.Sc

Class:F.Y.B.Sc.

Course: MICROBIOLOGY

Implemented from 2021-2022

**F.Y.B.Sc MICROBIOLOGY Syllabus Revised for Autonomy
Implemented from the Academic year 2021-2022**

COURSE NAME: MICROBIOLOGY

Semester I		
PAPER CODE	PAPER Title	Credits
SBSMCB101	Fundamentals Of Microbiology	2 Credits (45 lectures)
Unit-I	History of Microbiology and Chemical basis of life	15 lectures.
Unit-II	Procaryotic Cell Structure And Function	15 lectures.
Unit-III	Eucaryotic Cell Structure And Function	15 lectures.
SBSMCB102	Basic Techniques In Microbiology	2 Credits (45 lectures)
Unit-I	Microscopy & Staining procedures	15 lectures.
Unit-II	Cultivation of Microorganisms	15 lectures.
Unit-III	Control of Microorganisms	15 lectures.
SBSMCBP1	PRACTICALS	2 Credits(45 lectures)
PRACTICAL – I	SECTION-1 Fundamentals Of Microbiology (Practicals Based On Unit-I, II & III Of SBSMCB101)	1 Credit
PRACTICAL –II	SECTION-2 Basic Techniques In Microbiology (Practicals Based On Unit-I, II & III Of SBSMCB102)	1 Credit

Semester I

Paper 1- SBSMCB101

Learning Objectives:

Learn the fundamental aspects of Prokaryotic and Eukaryotic Cell structure and function, and the differences between these cells.

Learning Outcomes:

- To be able to apply this knowledge in the laboratory.
- To develop analytical skills.
- To think in a critical & creative manner.

F.Y.B.Sc Microbiology: Detailed Syllabus implemented from the academic year 2021-22		
Semester I		
SBSMCB101	FUNDAMENTALS OF MICROBIOLOGY	2 Credits (45 lectures)
Unit-I	History of Microbiology and Chemical basis of life	
	1.1 History Of Microbiology a. History Of Microbiology b. Discovery of microorganisms c. Conflict over spontaneous generation d. Golden Age Of Microbiology-Koch Postulate, Medical Microbiology and Immunology	15 lectures 01 01 01 01
	1.2 Chemical Basis of Life a. Types of bonds and their importance: Electrovalent, covalent, ester, phosphodiester, thioester, peptide and glycosidic. b. Water: Structure and Role of water. c. Definition, general characteristics and functions of i. Carbohydrates: Monosaccharides, Oligosaccharides (maltose, cellobiose, sucrose, lactose) and Polysaccharide (starch, glycogen, peptidoglycan, cellulose) ii. Lipids: Simple and complex lipids, storage and structural lipids. Liposomes and their applications iii. 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.	01 01 01 01 03 04

	iv. Nucleic acids: Nitrogenous bases- Purines, Pyrimidines, Pentoses-Ribose, Deoxyribose. Structure of RNA and DNA.	
Unit –II	Procaryotic Cell Structure And Function	15 lectures
	Bacteria 2.1 Morphology and Arrangement 2.2 Cell wall 2.3 Plasma membrane 2.4 Chromosome and plasmids. 2.5 Bacterial ribosomes. 2.5 Cytoplasmic matrix organic and inorganic inclusion bodies 2.6 Components external to cell wall: Capsule, Slime layer, Flagella, Pili, and Fimbriae. 2.7 Bacterial endospores.	02 02 02 01 01 02 03 02
Unit –III	Eucaryotic Cell Structure And Function	15 Lectures
	3.1 Comparison of Prokaryotic And Eukaryotic Cells 3.2 Overview of eukaryotic cell structure: A. Plasma membrane and Cytoplasmic matrix, B. Endoplasmic reticulum C. Golgi apparatus. D. Ribosomes ,Mitochondria E. Chloroplasts F. Nucleus –Nuclear Structure G. Cytoskeletal elements - H. External cell coverings viz Cilia and Flagella. 3.3 Morphological characteristics, Life Cycle, Cultivation, 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>)	01 01 01 01 01 01 01 01 01 02 01 02 01

Paper 2 - SBSMCB102

Learning Objectives:

- Learn and understand the principles of working of the light microscope.
- Learn about the various staining procedures.
- Learn about the microbial nutrition, cultivation, isolation, preservation and control of microorganisms.

Learning Outcomes:

- To be able to apply this knowledge in the laboratory.
- To develop analytical skills.
- To think in a critical & creative manner.

SBSMCB102	BASIC TECHNIQUES IN MICROBIOLOGY.	45 lectures
Unit-I	Microscopy & Staining procedures	15 lectures
	1.1 Microscopy: a. History of microscopy b. Structure and functions of different parts of a microscope c. Magnification, resolving power, Numerical aperture, Use of oil immersion objective d. Simple and compound light microscope e. Dark field Microscope f. Phase contrast microscope 1.2 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)	01 01 02 02 01 01 01 01 01 01 01 02 03
Unit –II	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	01 02 02 04 02 02 02
Unit-III	Control of Microorganisms	15 Lectures

	<p>3.1 Definition and Factors affecting the effectiveness of antimicrobial agents 01</p> <p>3.2 Physical methods of microbial control</p> <p>a. Moist and Dry heat 02</p> <p>b. Radiation 01</p> <p>c. Filtration 01</p> <p>d. Low temperature 01</p> <p>e. High pressure 01</p> <p>f. Dessication and Osmotic pressure 01</p> <p>3.3 Chemical methods of microbial control 05</p> <p>a. Phenolics</p> <p>b. Alcohols</p> <p>c. Heavy metals</p> <p>d. Halogens</p> <p>e. Quaternary ammonium compounds</p> <p>f. Sterilizing gases</p> <p>g. Surface active agents</p> <p>h. Aldehydes</p> <p>i. Peroxgens</p> <p>j. Biguanides (Chlorhexidine)</p> <p>3.4 Evaluation of effectiveness of chemical antimicrobial agents 02</p>	
	PRACTICALS	2 Credits
SBSMCBP1	SECTION-1 FUNDAMENTALS OF MICROBIOLOGY.	1 Credit (45 lectures)
	<ol style="list-style-type: none"> 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 	

	<ul style="list-style-type: none"> a. On Sabouraud's agar b. Using Static & Shaker conditions <p>16. Study of Permanent slides of Algae and Protozoa.</p>	
	<p>SECTION-2 BASIC TECHNIQUES IN MICROBIOLOGY.</p>	<p>1 Credit (45 lectures)</p>
	<ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> a) Liquid medium(Nutrient Broth) b) Solid Media(Nutrient agar, Sabouraud's agar) c) Preparation of slant, butts & plates 17. Inoculation techniques and Study of Growth: <ul style="list-style-type: none"> 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. 	

	Semester II	
SBSMCB201	EXPLORING MICROBIOLOGY	2 Credits (45 Lectures)
Unit-I	Study of Viruses, Rickettsia, Chlamydia, Actinomycetes and Archaea	15 lectures.
Unit-II	Microbial Interactions	15 lectures.
Unit-III	Microbes & Human Health	15 lectures.
SBSMCB202	ADVANCED AND APPLIED MICROBIOLOGY	2 Credits (45 Lectures)
Unit-I	Advanced Microscopy and Instrumentation	15 lectures.
Unit-II	Microbial Growth	15 lectures.
Unit-III	Microbial Technology	15 lectures.
SBSMCBP2	PRACTICALS	2 Credits(45 Lectures)
PRACTICAL – I	SECTION-1 Exploring Microbiology (Practicals Based On Unit-I, II & III Of SBSMCB201)	1 Credit
PRACTICAL –II	SECTION-2 Advanced and Applied Microbiology (Practicals Based On Unit-I, II & III Of SBSMCB202)	1 Credit

Semester II:

Paper 1 - SBSMCB201

Learning Objectives -

- Learn about various groups of organisms other than bacteria.
- Learn about microbial interactions.
- Learn about the role of microbes in human health.

Learning Outcomes -

- Develop analytical and problem-solving skills
- Think in a critical and analytical manner

	SEMESTER II	
SBSMCB201	EXPLORING MICROBIOLOGY	45 lectures
Unit-I	Study Of Viruses, Rickettsia, Chlamydia, Actinomycetes and Archaea	15 Lectures
	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.	03 02 02 04
	1.2 Rickettsia and Chlamydia: General characteristics, diseases and vectors.	02
	1.3 Actinomycetes: General characteristics and Significance.	01
	1.4 Introduction to Archaea.	01
Unit- II	Microbial Interactions	15 Lectures

	<p>2.1 Types of Microbial Interactions:</p> <p>a. Mutualism: Lichens, Rhizobia, Mycorrhizae and Frankia. 04</p> <p>b. Commensalism: Normal flora of the human body, relationship between microbiota and the host. 04</p> <p>c. Normal flora of</p> <p>i. Skin,</p> <p>ii. Respiratory tract,</p> <p>iii. Gastrointestinal tract and</p> <p>iv. Genitourinary tract.</p> <p>d. Amensalism 01</p> <p>e. Predation and Parasitism 01</p> <p>2.2 Role of microorganisms in cycling of nutrients. Carbon, Nitrogen, Sulphur, Phosphorus and Iron. 05</p>	
Unit-III	Microbes & Human Health	15 lectures
	<p>3.1 Important terminologies Infection and disease: Primary and secondary infections, Contagious infections, Opportunistic pathogens, Zoonoses and Vector borne infections. 01</p> <p>3.2 Germ free animals and Significance of Gnotobiotic studies 01</p> <p>3.3 Factors affecting infection:</p> <p>a. Pertaining to Hosts: Natural, Species and Racial resistance. 01</p> <p>b. Pertaining to individual resistance. 04</p> <p>c. Microbial virulence factors in adherence, invasion, colonization and disease. 02</p> <p>3.4 Host defence against infection: An Overview</p> <p>a. First line of defence: Skin, respiratory tract, gastrointestinal tract, genitourinary tract and eyes. 02</p> <p>b. Second line of defence: Fever, Inflammation and Phagocytosis 03</p> <p>c. Third line of defence: Brief introduction to Immunity (active passive, natural and acquired)</p>	

Paper 2 - SBSMCB202

Learning Objectives -

- Learn and understand the working and applications of Advanced Microscopes and other instrumental techniques.
- Learn concepts of microbial growth.
- Learn about the applications of microorganisms in various industries.

Learning Outcomes -

- Develop analytical and problem-solving skills
- Think in a critical and analytical manner

SBSMCB202	Advanced and Applied Microbiology	2 Credits (45 lectures)
Unit I	Advanced Microscopy and Instrumentation	15 lectures
	1.1 Fluorescent and Confocal Microscope	02
	1.2 Light and Electron Microscope: Comparison between the two.	01
	1.3 Types of electron microscopes: TEM, SEM and scanning probe microscope (Principle, Construction, Working, Advantages, limitations and Applications).	04
	1.4 Specimen preparation for Electron microscopy: Ultrathin sectioning, Negative stains, Surface replica, Shadow casting and Freeze etching	04
	1.5 pH meter: Principle, Construction, Combined electrode, Working, Validation and Calibration.	02
	1.6 Colorimeter: Principle, Construction, Working and Calibration	02
Unit-II	Microbial Growth	15 lectures
	Microbial Growth:	
	2.1 Definition of growth, Mathematical Expression and Growth curve	02
	2.2 Measurement of growth	
	a. Direct microscopic count and Haemocytometer.	02
	b. Viable count – Spread plate and Pour plate technique	02
	c. Measurements of cell constituents.	02
	d. Turbidity measurements – Nephelometer and spectrophotometer	02
	2.3 Influence of environmental factors on growth, Ways to increase yield of microbes, Batch, fed-batch and continuous cultures	03
	2.4 Microbial growth in natural environment-Biofilms.	01
	2.5 Viable but non-culturable bacteria- definition and significance	01
Unit-III	Microbial Technology	15 lectures.

	3.1 Microbial technology and the four 'F'(Food, Feed, Fuel and Functional molecules) Overview	01
	a. Applications of microorganisms in Food industry -Fermented food products -Alcoholic beverages -Dairy Products --Probiotics	02
	b. Commercial Production of Microorganisms: -Feed / SCP production -Biofertilizers, -Biopesticides	02
	c. Products from Microorganisms: antibiotics, enzymes, vitamins, polysaccharides	02
	d. Bioconversions using microorganisms: -Microorganisms in Fuel production -Biomining and bioleaching of ores	02
	3.2 Recombinant Microbial biotechnology	02
	a. Bacterial genes, genomes and genetics	
	b. Techniques of gene manipulation (outline)	
	c. Genetically engineered microorganisms and their applications in	04
	i. Human health (Insulin)	
	ii. Agriculture (BT cotton)	
	iii. Environment (Bioremediation of Oil spill)	
	iv. Research (reporter microbes)	
SBSMCBP2	PRACTICALS	2 Credits
	SECTION-1 Exploring Microbiology	1 Credit (45 lectures)

	<ol style="list-style-type: none"> 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: <ol style="list-style-type: none"> a. Selective & Differential: MacConkey's Agar b. Enriched and differential : Superimposed Blood agar (and its use in studying virulence factor hemolysin) c. 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 	
	SECTION-2 Advanced and Applied Microbiology	1 Credit (45 lectures)
	<ol style="list-style-type: none"> 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 λ_{max} of coloured solutions. 4. 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 	

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Semester I Paper I

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- Stanier, R. Y.; Ingraham, J. L.; Wheelis, M. L. & Painter, R. P. (1992). General Microbiology 5th edition. Cornell university: Macmillan, Hampshire & London.
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- Willey J., Sandman K , Wood D. Prescott's Microbiology (ISE)(2019) 11th edition– McGraw-Hill Education.
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- 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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- Tortora G.J., Funke, B.R., Case, C.L., (2020) Microbiology: an introduction. 13th Global edition. Pearson.
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- Pelczar M., Chan E.C, Krieg N. R., (1993). Microbiology- Concepts and Applications, International edn, McGraw Hill

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