# JAI HIND COLLEGE
# BASANTSING INSTITUTE OF SCIENCE
# &
# J.T.LALVANI COLLEGE OF COMMERCE
# (AUTONOMOUS)

**"A" Road, Churchgate, Mumbai - 400 020, India.**

## Affiliated to
## University of Mumbai

Program: B.Sc

Proposed Course: Microbiology

Semester I

Credit Based Semester and Grading System (CBCS) with effect from the academic year 2020-21

## *F.Y.B.Sc. Microbiology Syllabus*

## Academic year 2020-2021

| Semester 1 | | | |
|---|---|---|---|
| **Course Code** | **Course Title** | **Credits** | **Lectures /Week** |
| **SMIC101** | Fundamentals of Microbiology | 2 | 3 |
| **Unit 1** | Introduction To Microbiology and Prokaryotic cell structure | | |
| **Unit 2** | Biosafety and Biomolecules | | |
| **Unit 3** | Nucleic acid Structure and Chemistry | | |
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| **SMIC 102** | Basic Techniques in Microbiology | 2 | 3 |
| **Unit 1** | Microscopy & Staining | | |
| **Unit 2** | Controlling Microbial Growth in the environment | | |
| **Unit 3** | Microbial Nutrition, Cultivation, Isolation and Preservation | | |
| **SMIC1PR** | | 2 | 6 |

## SEMESTER I – THEORY

| Course Code: SMIC 101 | **FUNDAMENTALS OF MICROBIOLOGY**<br>**( Credits: 2 ; Lectures /week:3)** | **(45L)** |
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| **Learning Objectives:** | ➢ To study the historical developments in the Fields of Microbiology<br>➢ Be aware of the scope and relevance of Microbiology<br>➢ Learn the structure and function of Prokaryotic cells and to differentiate them from eukaryotic cells<br>➢ To study the significant role micro-organisms play in the living world<br>➢ To understand the basic safety measures to be adopted in a microbiology laboratory<br>➢ Understand the basic structure and function of Biomolecules | |
| **Outcomes:** | On completion of the course, students will be able to:<br>➢ Get an idea about the historical events in Microbiology<br>➢ Know the scope of Microbiology<br>➢ Know the structural details of prokaryotic cell<br>➢ Develop fundamental knowledge about various biomolecules | |
| **Unit I** | **Introduction To Microbiology and Prokaryotic cell structure** | **15 L** |
| **1.1** | **History and scope of Microbiology :**<br>a. Microscopy and the discovery of micro-organisms<br>b. The conflict over spontaneous generation<br>c. The golden age of Microbiology: Koch's Postulates, Medical Microbiology, Immunology<br>d. The development of Industrial Microbiology and Microbial Ecology<br>e. The Scope and Relevance of Microbiology | **05** |
| **1.2** | **The Place of Micro-organisms in the Living world:**<br>a. Haeckel's Kingdom Protista<br>b. Prokaryotic and Eukaryotic Protists<br>c. Whitaker's 5 Kingdom concept<br>d. Carl Woese's three kingdom Classification | **01** |
| **1.3** | **Prokaryotic Cell Structure and Function:**<br>a. Morphology of Bacteria<br>b. Prokaryotic Cell Membranes- Bacteria and Archaebacteria<br>c. The Cytoplasmic matrix: cytoskeleton, inclusion bodies, ribosomes<br>d. The Nucleoid , Plasmids<br>e. The Bacterial and Archaebacterial Cell wall<br>f. Components external to the cell wall: Capsules, Slime layers, S-layers, Pili and Fimbriae, Flagella<br>g. The Bacterial Endospore<br>h. Comparison of Bacterial, Archaebacterial and Eucaryotic cell | **09** |

| Unit II | Biosafety and Biomolecules | 15 L |
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| 2.1 | **Biosafety in the Microbiology Laboratory:**<br>a. Routes of infection in the laboratory<br>b. Hazardous procedures<br>c. Exposure control plan<br>i. Employee education and orientation<br>ii. Disposal of hazardous waste<br>iii. Universal/ Standard Precautions<br>iv. Engineering controls( Laboratory environment, Biological safety cabinet)<br>d. Personal Protective equipment<br>e. Post exposure control<br>f. Biosafety levels<br>g. Mishaps with infective material | **03** |
| **2.2** | **Biomolecules** | **12** |
| **2.2.1** | **The Hierarchy of Molecular organization of cells** | **01** |
| **2.2.2** | **Types of bonds and their importance**<br>a. Covalent( ester, phosphate ester, thioester, peptide, glycosidic)<br>b. Non Covalent interactions ( Hydrogen bonds, Vander Waals interaction, ionic interactions, hydrophobic interactions) | |
| **2.2.3** | **Water : Structure and properties** | **01** |
| **2.2.4** | **Carbohydrates:**<br>**Definition, Classification, Biological importance and structures**<br>**a. Monosaccharides**<br>i. Aldoses and ketoses<br>ii. Occurrence, structure and significance of Glucose, Fructose, Galactose and Mannose<br>iii. Fischer and Haworth Projection<br>iv. Stereoisomers ( D and L isomers, Epimers, Anomers)<br>**b. Oligosaccharides**<br>i. Formation of glycosidic bonds ( α ,β )<br>ii. Occurrence, structure and significance of Maltose, Lactose and Sucrose. ( disaccharides)<br>**c. Polysaccharides**<br>i. Classification based on composition: Homopolysaccharides and Heteropolysaccharides<br>ii. Occurrence, structure and significance of storage (Starch, Glycogen) and structural Polysaccharides( Cellulose, Chitin) | **04** |
| **2.2.5** | **Lipids:**<br>**a. Definition and Bloor's classification :(** Simple, Complex, Derived and Miscellaneous )<br>**b. Fatty Acids**<br>i. Classification ( saturated , unsaturated)<br>ii. Structure and Nomenclature of Palmitic acid, Stearic acid , MUFA – Oleic acid, PUFA – Linoleic and | **02** |

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| | Linolenic acid<br>**c. Triacylglycerol**<br>i. General structure<br>ii. Properties ( hydrolysis, saponification and rancidity )<br>**d. Functions of compound lipids**<br>i. Phospholipids (glycerophospholipids and spingophospholipids)<br>ii. Glycolipids<br>**e. Steroids**: (Structure and significance) | |
| **2.2.6** | **Amino Acids and Proteins:**<br>**a. Amino Acids**<br>i. General structure: D and L forms of amino acids<br>ii. Classification based on (Structure, nutritional classification, metabolic fate)<br>iii. Properties : Physical and chemical<br>**b. Peptides and Proteins**<br>i. Classification and Properties<br>ii. 3-D Structure of Proteins : primary, secondary, tertiary and quaternary | **04** |
| **Unit III** | **Nucleic acid structure and chemistry** | **15 L** |
| **3.1** | **Nucleic acid structure:**<br>a. Definition and functions of Nucleotides and Nucleic acids<br>b. Structure and nomenclature : Purines, Pyrimidines, Ribose, Deoxyribose , Nucleosides and Nucleotides<br>c. Formation of Polynucleotide strand<br>d. DNA and RNA<br>e. Watson and Crick model of DNA<br>f. A and Z forms of DNA<br>g. Unusual structures of certain DNA sequences<br>h. Types ,structures and functions of RNA: mRNA, tRNA, rRNA, snRNA, miRNA, hn RNA | **10** |
| **3.2** | **Nucleic acid chemistry:**<br>a. Denaturation of double helical DNA and RNA<br>b. Hybrid formation of nucleic acid from different species<br>c. Non enzymatic transformations of nucleotides and nucleic acids<br>d. Methylation of nucleotide bases in DNA | **04** |
| **3.3** | **Overview of Structure of Chromosomes** | **01** |

**Textbooks and Additional References:**


1. Pelczar M., Reid R. and Chan E.,Microbiology, McGraw-Hill 5thEd., 1977.
2. Black B., Jacquelyn G. & Laura J. O, Microbiology :principles and explorations, Hoboken, NJ : Wiley, 8thEd., 2013.
3. Mackie T. J., Collee J. G & McCartney J. E., Mackie & McCartney practical medical microbiology, New York :Churchill Livingstone, 14th Ed., 1996.
4. Forbes B.A., Sahm D.F. & Weissfeld A.S., Bailey and Scott's Diagnostic Microbiology, Mosby, Inc, 11th Ed., 2002.

5. Mahon C.R., Lehman D.C. & Manuselis G, Textbook of Diagnostic Microbiology, Saunders, 3rd Ed., 2007.
6. Garrett R. H. & Grisham C. M. Biochemistry, Belmont, CA: Brooks/Cole, Cengage Learning, 2010.
7. Frobisher M., Fundamentals of microbiology, Philadelpia: Saunders, 9th Ed., 1974.
8. Lehninger A. L., Nelson D. L. & Cox M. M., Lehninger principles of biochemistry, New York: Worth Publishers, 5th Ed., 2008.
9. Conn E & Stumpf P.K., Outlines of Biochemistry, New York: Wiley, 2005.
10. Satyanarayana U. & Chakrapani U., Essentials of Biochemistry, Kolkatta:Books and allied, 2ndEd., 2008.
11. Pierce B.A, Genetics: A conceptual approach, New York:W.H, 3rd Ed., 2008.
12. Das D., Biochemistry, Academic Publishers, 14th Ed., 2012.

| Course Code: SMIC102 | Course Title: BASIC TECHNIQUES IN MICROBIOLOGY ( Credits: 2; Lectures /week:3) | 45L |
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| **Learning Objectives** | ➢ Learn the basic principles underlying the working of different Microscopes<br>➢ Understand the principles of staining and to use various types of staining techniques to differentiate between organisms and special staining techniques to demonstrate special structures of a cell<br>➢ To study the role of various physical and chemical agents in controlling the growth of micro-organisms<br>➢ Learn the methods used to cultivate micro-organisms and how to preserve them. | |
| **Outcomes** | On completion of the course, students will be able to:<br>➢ Know parts of microscope, type and its principle<br>➢ Understand different methods of staining techniques<br>➢ Use various methods to control microbes.<br>➢ Understand nutritional requirements of bacteria.<br>➢ Understand the need and the different ways of preservation of microbes | |
| **Unit I** | **Microscopy & Staining** | **15 L** |
| **1.** | a. Lenses & bending of light<br>b. Resolution of the Microscope | **02** |
| **2.** | **The Light Microscope**<br>a. Bright Field Microscope<br>b. The Dark Field Microscope<br>c. The Phase Contrast Microscope<br>d. Micrometry | **07** |
| **3.** | **Staining of specimens**<br>a. Dyes and stains**:** Types (natural, synthetic, acidic, basic, neutral)<br>b. Fixation (heat and chemical)<br>c. Simple staining (positive and negative staining)<br>d. Differential staining (gram staining, acid fast staining)<br>e. Staining of specific structures (Cell wall, Capsules, Spores, Metachromatic granules) | **06** |
| **Unit II** | **Controlling Microbial Growth in the environment** | **15L** |
| **1.** | a. General Considerations in Microbial Control<br>b. Terminology and Methods of Microbial Control<br>c. Microbial Death and factors affecting microbial death<br>d. How Antimicrobial agents work **:** Mode of action | **02** |
| **2.** | **Physical methods of Microbial Control**<br>a. Heat **:** Moist & Dry | **06** |

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| | b. Low temperature<br>c. Filtration<br>d. Radiations | |
| **3.** | **Chemical methods of Microbial Control**<br>a. Choosing a Microbicidal Chemical<br>b. Factors that affect the germicidal activity of chemicals<br>c. Germicidal Categories<br>i. Halogens<br>ii. Phenols<br>iii. Alcohols<br>iv. Hydrogen Peroxide<br>v. Detergents<br>vi. Heavy Metals<br>vii. Aldehydes<br>viii. Gaseous Sterilants<br>ix. Dyes | **05** |
| **4.** | **Evaluation of effectiveness of Antimicrobial agent**<br>a. Agar diffusion<br>b. Tube dilution<br>c. Phenol co-efficient<br>d. Use dilution | **02** |
| **Unit III** | **Microbial Nutrition, Cultivation, Isolation and Preservation** | **15L** |
| **1.** | a. Nutritional requirements:Carbon, Oxygen, Hydrogen, Nitrogen, Phosphorus, Sulphur and growth factors.<br>b. Nutritional types of microorganisms | **06** |
| **2.** | a. Types of Culture media with examples<br>b. Isolation of microorganisms and pure culture techniques. | **06** |
| **3.** | a. Preservation of microorganisms<br>b. Culture Collection Centres | **03** |

**Textbooks and Additional References:**


1. Willey J. M., Sherwood L., Woolverton C. J., Prescott L. M., & Willey J. M., Prescott's microbiology, New York: McGraw-Hill, 8th Ed., 2011.
2. Pelczar M., Reid R. and Chan E., Microbiology, New York: McGraw-Hill, 5th Ed., 1977.
3. Talaro K. P.& Talaro A., Foundations in microbiology: Basic principles, Boston: WCB/McGraw Hill, 7th Ed., 2009.
4. Patel A.H., Industrial Microbiology, New Delhi: MacMillan, 2005.

## SEMESTER I- PRACTICAL

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| **Course code: SMICIPR** | **Practicals based on SMIC 101 and SMIC 102 (Credits: 2 Practicals /Week: Equivalent to 6 lectures/week)** |
| **Learning Objectives:** | This course is designed to demonstrate practical skills in the use of tools and techniques common to microbiology. |
| **Outcomes:** | Students will be able to perform and explain the theoretical basis of the tools, techniques and methods common to Microbiology |
| | **PRACTICAL I:**<br><br>1. Assignment: Contribution of Scientists to the field of Microbiology since the last 20 years<br>2.Special Staining: Cell wall, Capsule, Endospores, Metachromatic granules<br>3 Handling corrosive chemicals using rubber teat method for pipetting and use of auto-pipettes<br>4.Safety inoculation hood and laminar air flow<br>5 Qualitative detection:<br>a. Carbohydrates:, Molisch's , Benedicts tests<br>b. Proteins and amino acids: Biuret ,Ninhydrin<br>c. Nucleic acid detection: DPA and Orcinol<br>6. Isolation of DNA from onion<br><br>**PRACTICAL II:**<br>1 Microscopy: Parts of a microscope<br>2 Measurement of cell dimensions : Micrometry<br>3 Dark field and Phase Contrast Microscope : Demonstration<br>4 Monochrome and differential staining procedures :Gram Staining and negative staining<br>5 Introduction to laboratory equipments , disinfection and discarding techniques in the laboratory<br>6 Methods of preparation of glassware for sterilization ( pipettes, petri plates, plastic wares, flasks, micropipettes, microtitre plates) and Control of micro-organisms using moist heat and dry heat sterilization.(Sterilization of dry powders, rubber gloves, bandages, screw capped tubes , sterilizable plastic wares)<br>7 Determination of the performance efficiency of the Autoclave and Hot air oven<br>8 Effect of UV light on bacteria<br>9 Effect of heavy metals (Oligodynamic action ) on bacteria<br>10 Effect of dyes and phenolic compounds on bacteria<br>11 Preparation of culture media:<br>a. Liquid medium ( Nutrient broth)<br>b. Solid media ( Nutrient agar, Sabouraud's agar)<br>c. Aseptic transfer of liquid media and preparation of slants, Butts and plates.<br>12 Inoculation techniques and study of growth:<br>a. Inoculation of liquid medium<br>b. Inoculation of solid media ( slants, butts and plates) |

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| | c. Study of colony characteristics of pigment and non-pigmented producing bacteria<br>d. Study of motility by stab inoculation and (hanging drop preparation – demonstration)<br>13. Use of Differential and Selective media ( MacConkey's agar)<br>14. Methods of Preservation of cultures<br>a. Sub culturing<br>b. Mineral oil overlay<br>c. Soil stock method<br>d. Glycerol stock method |

# EVALUATION SCHEME:

| Examination | | Time Duration | Marks |
|---|---|---|---|
| **A. EVALUATION SCHEME FOR THEORY COURSES (2 PAPERS)** | | | |
| **I. Continuous Assessment (C.A.)** | | | **40** |
| C.A.I Test | MCQ, 1M answers etc | 40 mins | 20 |
| C.A.II Test | Assignment/Project /Posters/ Presentations etc | | 20 |
| **II. Semester End Examination (SEE)** | | **2 hours** | **60** |
| **Each Theory Paper** | | | **40+60= 100** |
| **B. EVALUATION SCHEME FOR PRACTICAL COURSES ( 2 COURSES)** | | | |
| **Semester End Practical Examination** | | | **100** |
| **For Each Practical course** | | | **50** |
| **Practical Course (2 courses)** | | **2 days** | **100** |