



Shiv Chhatrapati Shikshan Sanstha's

RAJARSHI SHAHU MAHAVIDYALAYA (AUTONOMOUS), LATUR

Department of Microbiology

Syllabus for B.Sc. Microbiology

(2023-2024)

Framed Under National Education Policy (NEP-2020)

Undergraduate Program in Microbiology

B. Sc. (SEMESTER PATTERN)

COURSE: MICROBIOLOGY

(DSC/ DSE/MAJOR/MINOR/GE)

B.Sc. FIRST YEAR

Semester I and II

UNDER ACADEMIC AUTONOMOUS STATUS: 2018-2024

With Effect progressively from June 2023-24

RAJARSHI SHAHU MAHAVIDYALAYA (AUTONOMOUS), LATUR

PROGRAMME: MICROBIOLOGY

INTRODUCTION

Microbiology is study of microorganisms such as bacteria, protozoa, algae, fungi, bacteria, viruses, etc. These studies integrate cytology, physiology, ecology, genetics and molecular biology, evolution, taxonomy and systematics with a focus on microorganisms. It is one of the significant branches of sciences to understand the principles of life which has roots in the study of various microbial systems.

Microbiology has been at the forefront of research in industry, environment, agriculture, food, dairy, medicine and biology. It is one of the rapidly growing and applied areas of the science. Many job opportunities available for student in this stream. Trained manpower is required in industrial production of microbial products. Considering rural and agro based life background and awareness about the general health and hygiene, our curriculum is designed to educate our pupil in various important microbiological domains, as well as to promote and develop skills and competencies that have great value.

Program Outcomes

Students of the B.Sc. (Honors) Microbiology programme

- 1 Learn to execute scientific logic as they study subjects such as Bacteriology, Virology, Biochemistry, Microbial Physiology, Immunology, Cell Biology, Molecular Biology, Genetics, Systems Biology, Immunology and Molecular biology. They become aware of the applied aspects of microbiology such as Industrial Microbiology, Food and Dairy Microbiology, Environmental Microbiology and Medical Microbiology.
- 2 Students will acquire and demonstrate proficiency in good laboratory practices in a microbiological laboratory and be able to explain the theoretical basis and practical skills of the tools/technologies commonly used to study this field.
- 3 Students will develop proficiency in the quantitative skills necessary to analyze biological problem.
- 4 Students of microbiology will be promoted for self employment such as industrial production of biofertilizers, biopesticides, single cell protein bio fuel etc.
- 5 Knowledge gained through the program is useful for making carrier in related fields.
- 6 Receive basic knowledge and skills to promote students in research and social scientific awareness.

PROGRAMME SPECIFIC OUTCOMES:

Becoming a graduate, the Microbiology students acquire a meticulous knowledge and understanding of the basic concepts of different Microbiology disciplines and will develop an ability to:

1. Understand and use methods of visualizing microorganisms, controlling growth of microorganisms, isolation of microorganisms from different sources and their maintenance.
2. Describe the importance of existence, beneficial and harmful role of microorganisms in air, water, food and waste.
3. Understand, describe and apply various methods of microbiological analysis and controlling microbial growth and activities for making these life governing factors safe.
4. Describe the immunological concepts with reference to infection, immunity, immunological reactions, diagnostic methods.
5. Demonstrate that microorganisms have an indispensable role in the environment, including elemental cycles, environmental cleanup, etc. and the role of microorganisms in plant growth promotion and disease management.
6. Describe the basic concepts of bacterial mutations, damage of DNA and its repair mechanisms, the recombination, transposition and genetic exchange processes.
7. Describe the gene and its expression, exploit the highly advanced molecular and gene cloning techniques
8. Cite examples of the crucial role of microorganisms in agriculture, biotechnology, fermentation, medicine, and other industries important to human well being.

Professional Competence: A student successfully completing B.Sc. microbiology will exhibit ability to will exhibit ability to demonstrate and follow the standard and safe laboratory practices with respect to Microbiological procedures. Appropriately perform microbiological analysis. Appropriately use aseptic techniques for the transfer and handling of microorganisms and instruments. Prepare and use appropriate microbiological culture media and test systems. Able to handle standard microbiology laboratory equipments properly

Relevance of curriculum to the local, national, regional and global developmental needs

Sr. No.	Program	DSC	Course Name	Linkage with Local/National/Regional/Global development
1	B.Sc. Semester I	DSC I	Introductory Microbiology	Linkage with Regional and Global development: 1.4 Role of Micro-organisms in- i. Agriculture, ii. Human health, iii. Food iv. Industries Basics of microbiological techniques studied by students are helpful in exploring and study of the microorganisms from various local to global environments.
2	B.Sc. I. Semester II	DSC II	Methods in Microbiology	Local/Regional/global demonstrate the skills in aseptic handling of microbes including isolation, identification and maintenance
3	B.Sc. I Semester III	DSC III	Basics of Microbiology and Biomolecules	Local/Regional/ National/global Students gain knowledge will be able to understand and use methods of visualizing microorganisms, controlling growth of microorganisms
4	B.Sc. I Semester IV	DSC IV	Microbial Nutrition and growth	Local/Regional Effect of environmental factors on microorganisms

Cross-cutting issues relevant to Professional Ethics, Gender, Environment and Sustainability, and Human Values integrated into the curriculum:

Sr. No.	Program /Sem	Course Title	Relevant to	Description
1	B.Sc. I, Sem. I	DSC I, Introductory Microbiology Role of Micro-organisms in human welfare	Human values	Ecofriendly applications of microbial activities for better human life
		Practicum I Bio safety measures	Human values	Virtue, Duties, Community safety awareness, Outcome of efforts
2	B.Sc. I, Sem. I	DSC II, Methods in Microbiology	Professional Ethics	professional skills in handling microbes, contaminants in laboratory and disposal of the cultures
		Practicum II	Environment and Sustainability	Control of microbial growth
3	B.Sc. I, Sem. II	DSC III. Basics of Microbiology and Biomolecules	Human Values	Understanding biochemical and physiological aspects of microbes
4	B.Sc. I, Sem. II	DSC IV. Microbial Nutrition and growth	Professional ethics	to find innovative solutions for present and future challenges posed by microbes

RAJARSHI SHAHU MAHAVIDYALAYA (Autonomous), LATUR

B.Sc. First year (Semester- I)

SUBJECT: MICROBIOLOGY

Curriculum under NEP-2020

DSC I: INTRODUCTORY MICROBIOLOGY

Credit: 03, Marks: 75

45 HOURS

Course Objectives:

- To learn scope of microbiology and role of microorganism,
- To learn Historical developments in microbiology.
- To learn types of microorganisms and their characteristics.
- To learn taxonomy of Microbes and methods of their classification.

Course Outcomes:

- Microbiology students will be able to describe the
 - scope and historical developments in microbiology
 - Characteristics of different types of microorganisms and methods of their classification
 - Ecofriendly applications of microbial activities for better human life
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UNIT I: Scope of Microbiology

09

- 1.1 Definition and concept
- 1.2 Distribution of Microorganisms in nature.
- 1.3 Scope in applied and advanced fields of microbiology.
- 1.4 Role of Micro-organisms in-
 - i. Agriculture
 - ii. Human health
 - iii. Food
 - iv. Industries

UNIT II: Historical developments in microbiology

12

- 2.1 Contribution of Antony van Leeuwenhoek in discovery of microbial world
- 2.2 Controversy over spontaneous generation - Contribution of Fransisco Redi, John Needham, Lazzaro Spallanzani, Theodor Schwan, Franz Schulze, Friedrich Schroder, Von Dusch, Louis Pasteur, John Tyndall
- 2.3 Recognition of microbial role in diseases – Robert Koch and contribution of Louis Pasteur.
- 2.4 Recognition of microbial role in fermentation.
- 2.5 Discovery of pure culture concept
- 2.6 Aseptic surgery.
- 2.7 Contributions of Elie. Matchnikoff, Edward Jenner, Alexander Flemming, Winogradsky and Beijerinck

1.5 Contribution of Indian Scientist in the field of Microbiology

UNIT III: Types of microorganisms and their characteristics

12

- 3.1 General characters of Microorganisms
- 3.2 The eukaryotic cell
- 3.3 Prokaryotic cell structure.
- 3.4 Comparison between Eukaryotic and Prokaryotic cell
- 3.5 Prokaryotic groups with unusual characteristics –Rickettsia, Chlamydia and Mycoplasma.

UNIT IV: Taxonomy of Microbes

12

4.1 Microbial Classification and Nomenclature:

- a) Whittaker's five kingdom concept
 - b) Taxonomic Groups
 - c) Goals of classification
 - d) Nomenclature.
- 4.1 Polyphasic taxonomy.
 - 4.2 Bergey's Scheme of classification-a brief account

RAJARSHI SHAHU MAHAVIDYALAYA (Autonomous), LATUR

B.Sc. First year (Semester- I)

SUBJECT : MICROBIOLOGY

Curriculum under NEP-2020

Practical-I

Lectures:30H

Credits: 01

Course Objectives:

- To learn staining skills and observe microbial morphology.
- To understand principles involved in working of light microscope.
- To study principle and working of laboratory instruments.

Course outcomes:

After completing lab course student will exhibit ability to.

- Appropriately prepare slides for microbiological analysis.
 - Use a light microscope and use aseptic techniques for the transfer and handling of microbial cultures.
 - Prepare and use appropriate microbiological culture media and test systems; Estimate the number of microbes in a sample using serial dilution and other related techniques.
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1. Biosafety in microbiology laboratory
2. Biosafety measures-Laboratory sanitation
3. Good laboratory practices
4. Handling of microbial cultures precaution and disposal
5. Microscopy- Different parts of compound microscope.
6. Use care & Handling of compound microscope
7. Study of laboratory equipments used for Sterilization.
 - a) Autoclave
 - b) Hot air oven
 - c) Bacterial filters
8. Study of laboratory equipments used for Cultivation-Incubator, Biosafety cabinet Anaerobic jar
9. Simple staining: Monochrome, Negative
10. Differential: Gram's staining, acid fast staining
11. Observation of Algae, fungi and protozoa

Reference Books

- 1) Brocks Biology of Microorganisms (Eleventh Edition) by Michael T. Madigan, John M. Martinko (2006), Pearson Prentice Hall.
- 2) Bisen P.S., Varma K.: Handbook of Microbiology CBS Publishers and Distributors, Delhi. Amita
- 3) Biswas S.B Biswas, Introduction to viruses: Vikas Publishing House Pvt. Ltd., New Delhi.
- 4) Dubey H.C.: A textbook of fungi and Viruses, Vikas Publishing House Pvt. Ltd. Delhi.

- 5) Dubey R.C. and D. K, Maheshwary, A textbook of Microbiology S Chand and Co. New Delhi.
- 6) Frobisher, Hinsdill, Crabtree, Goodheart: Fundamentals of microbiology: W.B. Saunders Company, U.S.A. Toppan Company Ltd., Japan.

RAJARSHI SHAHU MAHAVIDYALAYA (Autonomous), LATUR

B.Sc. First year (Semester- I)

SUBJECT: MICROBIOLOGY

Curriculum under NEP-2020

DSC II: METHODS IN MICROBIOLOGY

45 HOURS

CREDIT: 03, MARKS : 75

Course Objectives:

- Understand principle and working of light microscope.
- Gain knowledge about microbial staining technique
- Study techniques for visualization of microorganisms
- Study controlling growth of microorganisms,

Course Outcomes:

Completing first semester, Microbiology students will be able to

- Understand and use methods of visualizing microorganisms
 - Use methods for controlling growth of microorganisms.
 - Perform pure culture techniques
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.UNIT I: Bio-imaging

09H

1.1 Principles of Microscopy

- a) Absorption, reflection and refraction of light rays
- b) Definition: Magnification, Resolving power, Angular aperture, Numerical aperture
- c) Objectives (Low, High, Oil immersion) and Oculars Function
- d) Condensers: Abbes, variable focus and achromatic

1.2 Principle and applications of Compound, Dark field.

1.3 Electron Microscope

UNIT II: Microbial Staining Techniques

12H

2.1 Definition: Stain, Dye, Mordant, Chromogen, Leuco compound, Flurochrome, Decolorizing agent and Counter stain.

2.2 Types of stains: Auxochrome, chromophore, Acidic stain, Basic stain, Neutral stain ,Chromogen

2.3 Theories of Staining: Physical and chemical

2.4 Principles, Mechanism, Procedure and Observation of

- a) Simple staining: Monochrome & Negative staining
- b) Differential staining: Gram's & Acid Fast staining
- c) Structural staining: Cell wall, Capsule, endospore, Flagella.
- d) PHB and Metachromatic granule Staining.

UNIT III – Sterilization and disinfection

10

12H

3.1 Definition of Sterilization,

3.2 Sterilization by Physical Agent

a) Heat: Moist Heat: Steam under pressure (Autoclaving) , Boiling,
Pasteurization

b) Dry heat: Incineration, Hot air Oven.

c) Radiation: - Ionizing and Non-ionizing radiations.

d) Filtration:- Types of Bacteriological filters

e) Sterility Testing

3.3 Definition of Disinfection, Antiseptic, Germicide, Sanitizer, Fungicide, Vermicide, Bacteriostatic and Bactericidal agent.

3.4 Chemical Disinfectants

a) Characteristics of an ideal disinfectant

b) Chemical Agents: Phenol and Phenolic compounds, Alcohols, Halogens

Gaseous sterilizing Agents: Formaldehyde, Ethylene Oxide, β - Propiolactone.

3.5 Evaluation of Disinfectant by Phenol Coefficient method.

UNIT IV: Effect of environmental factors on microbial growth and survival 12H

4.1 Environmental factors affecting growth :

a) Temperature

b) pH (Acidic environment)

c) Osmotic pressure (Saline environment)

d) Oxygen

e) Hydrostatic pressure

f) Heavy metals

RAJARSHI SHAHU MAHAVIDYALAYA (Autonomous), LATUR

B.Sc. First year (Semester- I)

SUBJECT : MICROBIOLOGY

Curriculum under NEP-2020

Practical-II

Lectures: 30 H

Credits: 01

Course Objectives:

- To gain insight into ultra structure of bacterial cell.
- To stain and observe structural features of bacterial cells.
- To study methods of controlling microbial growth and contaminants.

Course outcomes:

After completing lab course student will exhibit ability to.

- Appropriately prepare slides for microbiological analysis.
 - Ability to stain and demonstrate the microbial cell structure.
 - Prepare and use appropriate microbiological culture media and sterility testing
 - Control growth and spread of microbes in laboratory.
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- 1 .Measurement of bacterial cell size: Micrometry (Demonstration)
2. Staining and observation of Cell wall and Capsule.
3. Staining of Endospores by Dorner's method
4. Staining of Flagella by PKG method
5. Staining and observation of PHB granules
6. Preparation and sterilization of Nutrient broth and Agar
7. Preparation and sterilization of Mac Conkey's Broth and Agar
8. Preparation and sterilization Sugar fermentation media.
- 9.Preparation of Simple medium for cultivation of autotrophs.
10. To Study methods for Controlling growth and spread of microbes in laboratory.

Reference Books

- 1) Prescott L.M. Harley J.P. and Klein Donald A.: Microbiology , W.M.C.. Brown publishers
- 2) The Bacteria. Volume by I.C. Gunsalus and Rogery Stainer. Academic Press.
- 3) Salvador Edward Luria, James E. Darnell, Jr., David Baltimore, Allan Campbell Luria: General Virology, Wiley.
- 4) Modi H.A.: Elementary Microbiology (Fundamentals of Microbiology) Vol. II Ekta Prakashan, Nadiad, Gujrat.
- 5) Parasher Y.K.: Modern Microbiology : Campus Books International: New Delhi
- 6) Pelczar Michael J., Jr./E.C.S Chan, Elements of Microbiology: McGraw, Hill International Book Company, New Delhi.

RAJARSHI SHAHU MAHAVIDYALAYA (Autonomous), LATUR

B.Sc. First year (Semester- I)

SUBJECT : MICROBIOLOGY

Curriculum under NEP-2020

DSC III: BASICS OF MICROBIOLOGY AND BIOMOLECULES

45 HOURS

CREDIT: 03

Course Objectives:

- Understand structure of cell, cell organelles and their functions.
- Understand viral structure, replication and cultivation.

Course Outcomes:

After successfully completing course, the students will be able to

- Describe ultra-structure of bacterial cell.
 - Understand general characteristics and importance of viruses.
 - Understand classification and properties of biomolecules.
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UNIT I: Ultra structure of bacterial cell

09 H

1.1 Structure, Chemical composition and function of following:-

- a) Capsule and slimes
- b) Cell wall and Cytoplasmic membranes
- c) Flagella and Motility, fimbriae and pili
- d) Nuclear material, Plasmids, Mesosomes, Ribosome
- e) Reserve materials and other cellular inclusions.
- f) Dormant forms of prokaryote: Endospore and cyst

UNIT II: The Viruses: Distribution and structure

12H

- 2.1) Viruses: History
- 2.2) General characteristics of viruses
- 2.3) Bacterial, plant and animal viruses
- 2.4) Multiplication of Virulent phage: The lytic cycle
- 2.5) The development of temperate phages: Lysogeny
- 2.6) Cultivation of viruses
- 2.7) Viruses like agent :Viroids Prion, Satellites

Tutorial: Students are expected to prepare models, draw diagrams/posters

UNIT III: Biomolecules

3.1 Carbohydrates

12H

Definition and classification and biochemical analysis

- a) Triose, Pentose, Hexose (Examples and Structure)
- b) Disaccharides:- Glycoside linkage (Lactose, Maltose and Sucrose)
- c) Oligosaccharides:- Trisaccharides (Structure of Raffinose)

- d) Polysaccharides:- Homo and Heteropolysaccharides Structure (Starch, Cellulose,)

3.2 Lipids:

- a) Definition and classification and biochemical analysis
- b) Properties

UNIT IV: Functional and Informational Biomolecules

12 H

4.1 Proteins:

- a) Definition and Classification
- b) Peptide bond: Configurations of proteins
- c) Biological significance of proteins

4.2 Nucleic Acids

- a) Nucleosides and Nucleotides.
- b) DNA: - Properties, structure and functions
- c) RNA: - Properties, structure and functions

RAJARSHI SHAHU MAHAVIDYALAYA (Autonomous), LATUR

B.Sc. First year (Semester- II)

SUBJECT : MICROBIOLOGY

Curriculum under NEP-2020

Practical-III

Lectures: 30 H

Credits: 01

Course Objectives:

- Learn microbial technique and related skill.
- To observe presence of viruses in Environmental sample.
- To study effect of physicochemical factors on bacterial growth
- To learn qualitative and quantitative analysis of bio-molecules

Course Outcomes:

After successfully completing the course student will exhibit ability to

- Demonstrate the presence of viruses.
 - Study effect of physicochemical factors on bacterial growth.
 - Perform qualitative and quantitative analysis of biomolecules.
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1. Isolation of coliphages from sewage water.
2. Qualitative and quantitative analysis of Carbohydrates by Sumner's method
3. Qualitative and quantitative analysis of Protein by Biuret test
4. Qualitative and quantitative analysis of DNA by Diphenyl amine test
5. Qualitative and quantitative analysis of RNA by Orcinol test
6. Effect of physical agents on growth of bacteria: pH, Temperature U.V. rays(Demonstration)
7. Effect of chemical agents on bacterial growth: Antibiotic and Phenolic compounds.
8. Effect of Heavy metal ions (Oligodynamic Action).

Reference Books

- 1) Biochemistry, Seventh Edition by Jeremy M. Berg, John L. Tymoczko and Lubert Stryer (Dec 24, 2010), W.H. Freeman & Company.
- 2) Lehninger: Principles of Biochemistry by Albert L. Lehninger, Michael Cox and David L. Nelson (4 May 2004), W. H. Freeman.
- 3) Purohit S.S.: Microbiology: Fundamentals and Applications: Agro-Botanical publishers Bikaner, India.
- 4) Pelczar Michael J., Jr. E.C.S Chan, Noel R. Krieg: Microbiology: Concepts and applications- McGraw Hill Inc.
- 5) Pelczar Michael J., Reid R.D. and Chan E.C.s.: Microbiology, Tata McGraw hill publishing Co. Ltd., New Delhi.
- 6) Powar C. B. and Dagainawala H.I.: General microbiology Vol I and II Himalaya publishing house, Bombay.

RAJARSHI SHAHU MAHAVIDYALAYA (Autonomous), LATUR

B.Sc. First year (Semester- II)

SUBJECT : MICROBIOLOGY

Curriculum under NEP-2020

DSC IV: MICROBIAL NUTRITION AND GROWTH

45 HOURS

CREDIT: 03, MARKS : 75

Course Objectives:

- Understand mechanism of uptake of nutrients in microbial cells. Study the microbial growth and kinetics of growth.
- Understand influence of environmental factors on microbial growth.

Course Outcomes:

Students will be able to explain

- The nutritional requirements and mechanisms of their transportation in the cell.
 - Bacterial growth and its measurement.
 - Effect of different environmental factors on Growth.
-

UNIT I: Cultivation media and Pure culture methods

09H

- 1.1 Properties of a good culture medium.
- 1.2 General ingredients of culture media and their role
- 1.3 Definition, Concept, Use and Types of different culture media – Living and Nonliving media, Synthetic, Non-synthetic, Natural, Selective, Differential, Enriched, Enrichment, Assay, Minimal, Maintenance and Transport Medium. Buffers in culture medium
- 1.4 Definitions -, pure culture, mixed culture, consortium, axenic culture, contamination.
- 1.5 Isolation of microorganisms: Principle and method of isolation-streak plate, pour plate, spread plate, single cell isolation.
- 1.6 Cultivation of anaerobes: Gas Pak Anaerobic jar

UNIT II: Microbial Nutrition

12H

- 2.1 Major bio-elements
- 2.2 Minor bio-elements
- 2.3 Growth factors
- 2.4 Sources of energy
- 2.5 Nutritional categories of microorganisms on the basis of carbon and energy source

UNIT III: Microbial Transport

12H

- 3.1 Modes of nutrition: osmotrophic, phagotrophic
- 3.2 Nutrient transport and membrane function: primary and secondary transport, porins, OMP, carrier proteins
- 3.3 Passive diffusion

- 3.4 Facilitated diffusion
- 3.5 Active transport mechanism
- 3.6 Group translocation

UNIT IV Microbial Growth

12H

- 4.1 Microbial Growth – Binary fission, Budding, fragmentation and formation of conidiophores
- 4.2 Mathematical expression of growth
- 4.3 Growth curve and diauxic growth
- 4.4 Measurement of growth:
 - a) cell number,
 - b) cell mass,
 - c) cell activity
- 4.5 Different types of bacterial cultures –Batch culture, continuous culture, synchronous culture

RAJARSHI SHAHU MAHAVIDYALAYA (Autonomous), LATUR

B.Sc. First year (Semester- II)

SUBJECT: MICROBIOLOGY

Curriculum under NEP-2020

Practical-IV

Credits: 01

Periods: 30H

Course Objectives:

- To learn microbial technique and related skills
- To gain knowledge related to cultivation of Microbes and SOP for disposal of microbial culture.
- To understand methods of stock culture maintenance.

Course Outcomes:

After successfully completing the course student will exhibit ability to

- Perform isolation and maintenance of bacterial cultures disposal of microbial culture.
- Design experiments for measurement of the bacterial growth.
- To understand, perform and explain the various phases of microbial growth.

Experiments

- 1 Isolation and enumeration of bacteria from mixed culture/environment.
 - a. Streak plate method
 - b) Spread plate method
 - c) Pour plate method
- 2 Isolation of anaerobic spore forming bacteria from cow dung or agriculture waste
- 3 Isolation of fungi
- 4 To study methods of stock culture maintenance.
- 5 Measurement of growth
- 6 To study protocol (SOP) for disposal of microbial culture
- 7 Study of bacterial growth curve (Demonstration)

Reference Books

- 1) R.A. Atlas: Microbiology- Fundamentals and applications Mcmilan..
- 2) Singh R.P., Microbiology Kalyani Publication.
- 3) Stanier Roger Y., Adelberg Edward A.. Ingraham Johan L., General microbiology, Prentice- Hall, Englewood Cliffs, New Jersey, Publishing Co. Ltd., New Delhi..
- 4) Tauro P, Kapoor K.K., yadav K.S.: introduction to Microbiology: Wiley Eastern Ltd., New Delhi..
- 5) Dubey, Maheshwari: Practical Microbiology.
- 6) Yadav Manju, Microbiology Discovery Publishing House, New Delhi Microbiology, Times Mirror/mosby College Publication.
- 7) Gunasekarn: Introduction to Microbial Techniques.

