



RAJARSHI SHAHU MAHA VIDYALAYA (AUTONOMOUS), LATUR

**Syllabus
(2022-2023)
Under CBCS**

Department of Microbiology

Three Year Degree Program in Microbiology

B. Sc. (SEMESTER PATTERN)

COURSE: MICROBIOLOGY

(CC/ DSE/GE)

B.Sc. FIRST YEAR

Semester I and II

Syllabi approved by the Board of Studies in 2021-22

With Effect progressively from June 2022-23

UNDER ACADEMIC AUTONOMOUS STATUS

w. e. f. JUNE, 2022-23

RAJARSHI SHAHU MAHAVIDYALAYA(AUTONOMOUS), LATUR

PROGRAMME: B. Sc. GENERAL

CORE COURSE: MICROBIOLOGY

INTRODUCTION

Microbiology is study of microorganisms and 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 .

Microbiology is one of the optional subjects for B.Sc. degree course of three years . Students passed 10+2 with biology as one of the subject are eligible for admission

The pattern of question paper, standard of passing is as per norms given by BOE of Rajarshi Shahu Mahavidhyalaya, Latur (Autonomous) .The admission procedure for course is as per college norms. Teacher's qualifications are as per UGC norms.

PROGRAMME SPECIFIC OUTCOMES/ PROGRAMME OUTCOMES:

- . Students of microbiology promoted for self employment such as industrial production of biofertilizers, biopesticides, single cell protein bio fuel etc. Knowledge gained through the program is useful for making carrier in related fields.

LEARNING OBJECTIVES OF THE COURSE

- The syllabus of course is designed to provide knowledge which is useful for making carrier in related fields.
- To promote students for self employment.
- To provide basic knowledge and skills to promote students in research and social scientific awareness.

MICROBIOLOGY COURSE 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:

- i. Understand and use methods of visualizing microorganisms, controlling growth of microorganisms, isolation of microorganisms from different sources and their maintenance.
- ii. Describe the importance of existence, beneficial and harmful role of

- microorganisms in air, water, food and waste.
- iii. Understand, describe and apply various methods of microbiological analysis and controlling microbial growth and activities for making these life governing factors safe.
 - iv. Describe the immunological concepts with reference to infection, immunity, immunological reactions ,diagnostic methods.

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.

- v. Describe the basic concepts of bacterial mutations, damage of DNA and its repair mechanisms, the recombination, transposition and genetic exchange processes.
- vi. Describe the gene and its expression, exploit the highly advanced molecular and gene cloning techniques
- vii. Cite examples of the *crucial role* of microorganisms in agriculture, biotechnology, fermentation, medicine, and other industries important to human well being.

2. **Laboratory-Skills**

A student successfully completing practical's in B. Sc. microbiology will exhibit ability to: Appropriately prepare slides for microbiological analysis; Use a light microscope to observe and interpret smears; Appropriately use aseptic techniques for the transfer and handling of microorganisms and instruments; 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; Use standard microbiology laboratory equipments properly

3. **Laboratory Safety Skills:**

A student successfully completing basic microbiology will exhibit ability to demonstrate and follow the standard and safe laboratory practices with respect to Microbiological procedures.

Sr No	Name of Topic/Unit	Issue Addressed
1.	Semester I / Paper I / UNIT I: 1.4 Role of Micro-organisms in- i. Agriculture, ii. Human health, iii. Food iv. Industries Tutorial: Social responsibilities of microbiologist (Participation and reporting in any related activity)	Ecofriendly applications of microbial activities for better human life Life skills: Effective communication, listening, openness, self- awareness building skills, social accountability.
2.	Semester I/ Lab Course I: 1) Biosafety in microbiology laboratory 2) Biosafety measures-Laboratory sanitation 3) Training to laboratory staff regarding biosafety 4) Handling of microbial cultures precaution and disposal	Professional Ethics: Virtue, Duties, Community safety awareness, Outcome of efforts Human Values: Consideration of human health Environmental: Waste management and disposal Life skills: Decision-making, interpersonal relationship

RAJARSHI SHAHU MAHAVIDYALAYA (Autonomous), LATUR
B.SC. FIRST YEAR (C.B.C.S.)
Semester I and II
COURSE: MICROBIOLOGY

Class	Semester	Paper No	Title of paper	Total periods/week	Total period	Total Marks	Credits
	I		Bridge course	02	10	20	
B.Sc. I	I	Theory Paper I	Introductory Microbiology (U-MIB-153)	03	45	50	02
		Theory Paper II	Methods in Microbiology (U-MIB-154)	03	45	50	02
		Practical Paper-I	Lab Course –I (U-MIB-155)	06	12 practical	50	02
	II	Theory Paper III	Basics of Microbiology and Biomolecules (U-MIB-254)	03	45	50	02
		Theory Paper IV	Microbial Nutrition and Growth (U-MIB-255)	03	45	50	02
		Practical Paper II	Lab Course –I (U-MIB-256)	06	12 practical	50	02

The syllabus is based on six (3x2) theory periods and 4 practical periods per batch per week. Candidates should require passing separately in theory and practical examination.

Note: B.Sc. First year practical includes studies of growth of microorganisms and life activities of microorganisms. These studies needs two consecutive days for completion of practical.

Bridge Course: Microbiology

Introduction:

The essential and fundamentals of higher secondary level subjects are necessary to understand the subject at an ease and this will lead to a better appreciation of the subject education. This course is designed for First Year B.Sc. Microbiology learners, to be completed in ten hours. On the successful completion of bridge course learners will be awarded with certificate of course.

The topics prescribed in the syllabus mainly emphasis on need of Microbiology literacy in the society, Importance of microbiology in daily life, general introduction to the microbial World covering basic concepts and types of microorganisms. In the later section of syllabus, different streams of microbiology will be taught to create awareness about scope of microbiology. This course will fill the gap of subject knowledge between higher secondary level and undergraduate studies.

RAJARSHI SHAHU MAHAVIDYALAYA (AUTONOMOUS), LATUR

B.Sc. First year (Semester- I)

CORE COURSE: MICROBIOLOGY

TITLE OF COURSE: BRIDGE COURSE

Periods: 10

Objectives of the Course:

- To create awareness about scope of microbiology and carrier opportunities..
- To stimulate interest and curiosity in microbial science
- To increase student motivation to learn science

Course Outcome:

- Learners will develop interest in the subject of Microbiology and it will also be useful to fill the gap.
- Stimulating interest and curiosity in Microbiology will increase student motivation to learn applied areas of microbiology.

Unit I: Importance of Microbiology

- 1.1 Need for microbiology literacy in society.
- 1.2 Microbiology in the 21st Century
- 1.3 Importance of microbiology in daily life.
- 1.4 Carrier opportunities in Microbiology

Unit II: Microbes in action

- 2.1 The Mysterious Microbes
- 2.2 Introduction to microbial diversity

RAJARSHI SHAHU MAHAVIDYALAYA (AUTONOMOUS), LATUR

B.Sc. First year (Semester- I)

PAPER: I

TITLE OF COURSE: INTRODUCTORY MICROBIOLOGY

(COURSE CODE: U-MIB-153)

Periods: 40

Credits: 02

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.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

UNIT I: Scope of Microbiology

10

- 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

Tutorial: Social responsibilities of microbiologist (Participation and reporting in any related activity)

UNIT II: Historical developments in microbiology

10

- 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

Tutorial: Preparation of models, posters, sketches.

UNIT III: Types of microorganisms and their characteristics

3.1 General characters of Microorganisms **10**

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.

3.6 Characteristics of Archae .

Tutorial:Study of different types of microorganisms in environment(Collection,photograph and short summery)

UNIT IV: Taxonomy of Microbes **10**

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

Tutorial: Referring Bergey's manual and short summery

RAJARSHI SHAHU MAHAVIDYALAYA (Autonomous), LATUR

B.Sc. First year (Semester- I)

Paper II

COURSE: METHODS IN MICROBIOLOGY

COURSE CODE: U-MIB-154

Periods: 40

Credit 02

Course Objectives:

- Understand principle and working of light microscope.
- Gain knowledge about microbial staining technique
- Gain knowledge about microbial nutrition and growth..

Course Outcomes:

Completing first semester, the Microbiology students will be able to understand and use methods of visualizing microorganisms, controlling growth of microorganisms, isolation of microorganisms from different sources and their maintenance.

.UNIT I: Bio-imaging

10

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

Tutorial: Students are expected to study and write summary in relation to properties of light.

UNIT II: Microbial Staining Techniques

10

2.1 Definition: Stain, Dye, Mordent, 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.

Tutorial: Students are expected to draw diagrams/posters related to staining techniques

UNIT III – Sterilization and disinfection

10

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.

Tutorial: Students are expected to write a short summary related to any one method of microbial control used in daily life.

UNIT IV: Effect of environmental factors on microbial growth and survival 10

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

Tutorial: Students are expected to prepare posters/charts/power point presentation/animations

RAJARSHI SHAHU MAHAVIDYALAYA, LATUR

B. Sc. First year (Semester – I)

Microbiology

Lab Course-I

Course Code: U-MIB-153

Lectures:40

Credits: 02

Course Objectives:

- Gain insight into microbial morphology.
- To Gain knowledge about microbial staining technique.
- Understand principles involved in working of light microscope and related bioinstrumentation.

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) Training to laboratory staff regarding biosafety
 - 4) Handling of microbial cultures precaution and disposal
 - 5) Microscopy- Different parts of compound microscope. Use care & Handling of compound microscope
 - 6) Study of laboratory equipments used for Sterilization.
 - a) Autoclave
 - b) Hot air oven
 - c) Bacterial filters
 - 7) Study of laboratory equipments used for Cultivation-Incubator, Anaerobic jar
 - 8) Simple staining : Monochrome, Negative
 - 9) Differential: Gram's staining Structural staining:
 - a) Capsule staining (Manvel's Method)
 - b) Cell wall staining (Chance's method)
 - c) Endospore staining (Schaefer and Fulton's Method)
 - d) PHB staining (Burdon's method.)

- 7) Hanging drop technique.
- 8) Measurement of bacterial cell size: Micrometry(Demonstration)
- 9) Preparation of culture media (Demonstration)
 - a) Nutrient broth and Agar
 - b) MacConkey's Broth and Agar
 - c) Sugar Media

RAJARSHI SHAHU MAHAVIDYALAYA (Autonomous), LATUR

B.Sc. First year (Semester- II)

PAPER-III

COURSE TITLE: BASICS OF MICROBIOLOGY AND BIOMOLECULES

(COURSE CODE: U-MIB-252)

Lectures:40

Credits:02

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.
-

UNIT I: Ultra structure of bacterial cell

10

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

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

UNIT II: The Viruses: Distribution and structure

10

- 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

10

- a) Definition and classification
- b) Triose, Pentose, Hexose (Examples and Structure)

- c) Disaccharides:- Glycoside linkage (Lactose, Maltose and Sucrose)
- d) Oligosaccharides:- Trisaccharides (Structure of Raffinose)
- e) Polysaccharides:- Homo and Heteropolysaccharides Structure (Starch, Cellulose,)

3.2 Lipids:

- a) Definition and classification
- b) Properties

Tutorial: Students are expected to prepare chart.

UNIT IV: Functional and Informational Biomolecules

10

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

Tutorial: Students are expected to prepare chart,model

RAJARSHI SHAHU MAHAVIDYALAYA (Autonomous), LATUR

B. Sc. First year (Semester- II)

PAPER-IV

COURSE TITLE: MICROBIAL NUTRITION AND GROWTH

COURSE CODE: U-MIB-253

Periods:40

Credits:02

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

10L

- 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

10L

- 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

Tutorial: Students are expected to draw charts.

UNIT III: Microbial Transport(12L)

- 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

Tutorial: Students are expected to prepare posters/charts/power point presentation/animations

UNIT IV Microbial Growth

10

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

Tutorial: Students are expected to prepare posters/charts/power point presentation/animations

RAJARSHI SHAHU MAHAVIDYALAYA (Autonomous), LATUR
B. Sc. First year (Semester- II)
Lab Course-II
Course Code: U-MIB-254

Credits: 02

Periods: 45

Course Objectives:

- Learn microbial technique and related skill
- Gain knowledge related to cultivation of Microbes and analysis of bio-molecules

Course Outcomes:

After successfully completing the course student will exhibit ability to

- Perform isolation and maintenance of bacterial cultures.
 - Design experiments to test effect of physicochemical factors on bacterial growth.
 - Perform qualitative and quantitative analysis of biomolecules.
-

Experiments

- 1) Preparation of culture media (Demonstration)
 - a) Nutrient broth and Agar
 - b) MacConkey's Broth and Agar
 - c) Sugar Media
- 2) Isolation and enumeration of bacteria
 - a. Streak plate method
 - b) Spread plate method
 - c) Pour plate method
- 3) Isolation of anaerobic spore forming bacteria from cow dung or agriculture waste
- 4) Isolation of fungi
- 5) Effect of physical agents on growth of bacteria: pH, Temperature
U.V.rays(Demonstration)
- 6) Effect of chemical agents on bacterial growth
 - a) Heavy metal ions (Oligodynamic Action)
 - b) Phenolic compounds
- 7) Qualitative analysis of
 - a) Carbohydrates: Benedict's Test
 - b) Protein: Biuret test
 - c) DNA by Diphenyl amine test
 - d) RNA by Orcinol test
- 8) Study of bacterial growth curve (Demonstration)
- 9) Isolation and enumeration of coliphages (Demonstration)
- 10) Preparation of culture media (Demonstration)
 - a) Nutrient broth and Agar
 - b) MacConkey's Broth and Agar
 - c) Sugar Media

Reference Books

- 1) Bisen P.S., Varma K.: Handbook of Microbiology CBS Publishers and Distributors, Delhi. Amita
- 2) Biswas S.B Biswas ,Introduction to viruses: Vikas Publishing House Pvt. Ltd., New Delhi.
- 3) Dubey H.C.:A textbook of fungi and Viruses, Vikas Publishing House Pvt. Ltd. Delhi.
- 4) Dubey R.C. and D.K,Maheshwary, A textbook of Microbiology S Chand and Co. New Delhi.
- 5) Frobisher, Hinsdill, Crabtee, Goodheart: Fundamentals of microbiology: W.B. Saunders Company,
- 6) U.S.A. Toppan Company Ltd., Japan.
- 7) Salvador Edward Luria, James E. Darnell, Jr., David Baltimore, Allan Campbell Luria: General Virology, Wiley.
- 8) Modi H.A.: Elementary Microbiology (Fundamentals of Microbiology) Vol. II Ekta Prakashan, Nadiad, Gujrat.
- 9) Parasher Y.K.: Modern Microbiology : Campus Books International: New Delhi
- 10) Pelczar Michael J., Jr./E.C.S Chan, Elements of Microbiology: McGraw, Hill International Book Company, New Delhi.
- 11) Pelczar Michael J., Jr. E.C.S Chan, Noel R. Krieg: Microbiology: Concepts and applications- McGraw Hill Inc.
- 12) Pelczar Michael J., Reid R.D. and Chan E.C.s.: Microbiology, Tata McGraw hill publishing Co. Ltd., New Delhi.
- 13) Powar C. B. and Daginawala H.I.: General microbiology Vol I and II Himalaya publishing house, Bombay.
- 14) Prescott L.M. Harley J.P.. and Klein Donald A.: Microbiology , W.M.C.. Brown publishers
- 15) Purohit S.S.: Microbiology: Fundamentals and Applications: Agro-Botanical publishers Bikaner, India.
- 16) R.A. Atlas: Microbiology- Fundamentals and applications Mcmilan..
- 17) Singh R.P., Microbiology Kalyani Publication.
- 18) Stanier Roger Y., Adelberg Edward A.. Ingraham Johan L., General microbiology, Prentice- Hall, Englewood Cliffs, New Jersey, Publishing Co. Ltd., New Delhi..
- 19) Tauro P, Kapoor K.K., yadav K.S.: introduction to Microbiology: Wiley Eastern Ltd., New Delhi..
- 20) Dubey, Maheshwari: Practical Microbiology.
- 21) Yadav Manju, Microbiology Discovery Publishing House, New Delhi Mcrobiology, Times Mirror/mosby College Publication.
- 22) Gunasekarn: Introduction to Microbial Techniques.