RAJARSHI SHAHU MAHAVIDYALAYA (AUTONOMOUS), LATUR

B. Sc. GENERAL (SEMESTER PATTERN)

B. Sc. FIRST YEAR

SUBJECT: MICROBIOLOGY

CURRICULUM (CBCS)

Effective progressively from June 2017

UNDER ACADEMIC AUTONOMOUS STATUS 2013 -2018

w. e. f. JUNE, 2017-18

RAJARSHI SHAHU MAHAVIDYALAYA, LATUR

PROGRAMME: B. Sc. GENERAL

COURSE: MICROBIOLOGY

INTRODUCTION

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. I, II, &III. Students passed 10+2 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 programme 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.

RAJARSHI SHAHU MAHAVIDYALAYA (Autonomous), LATUR

Syllabus for B.Sc. First year (C.B.C.S.)

Under academic autonomy from 2013 -18

Core Course: Microbiology

Effective progressively from June 2017

Sr. No.	Semester	Paper No	Title of paper	Total periods/week	Total period	Total Marks	Credits
1	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	2
2	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.

RAJARSHI SHAHU MAHAVIDYALAYA (Autonomous), LATUR

CBCS PATERN

Syllabus for B.Sc. First year (Semester- I)

Effective progressively from June 2017

Core Course: Microbiology

Credits: 02 Periods: 45

Title of Course: **INTRODUCTORY MICROBIOLOGY**

(**Course Code: U-MIB-153)**

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 **08**

1.1 Definition and concept
1.2 General characters of Microorganisms
1.3 Distribution of Microorganisms in nature.
1.4 Role of microorganisms in applied and advanced fields of microbiology.
1.5 Harmful role of Micro-organisms with suitable examples.

UNIT II: Historical developments in microbiology **15**

2.1 Discovery of microbial world and microscope.
2.2 Conflict of spontaneous generation - Contribution of different scientists
2.3 Recognition of microbial role in diseases – Robert Koch and contribution of Louis Pasteur, Edward Jenner.

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, Alexander Flemming, Winogradsky and Bejrinck

UNIT III: Types of microorganisms and their characteristics **12**

3.1 The eukaryotic cell : algae,Fungi and protozoa
3.2 Prokaryotic cell structure.
3.3 Comparison between Eukaryotic and Prokaryotic cell
3.4 Prokaryotic groups with unusual characteristics –
Photosynthetic bacteria, Rickettsia, Chlamydia and Mycoplasma.
3.5 Characteristics of Archae .

UNIT IV: Taxonomy of Microbes **10**

a) Microbial Classification and Nomenclature. Whittaker's five kingdom concept.
b) Taxonomic Groups.
c) Goals of classification.
d) Nomenclature.

4.2 Polyphasic taxonomy.
4.3 Bergey's Scheme of classification-a brief account

RAJARSHI SHAHU MAHAVIDYALAYA (Autonomous), LATUR

Syllabus for B.Sc. First year (Semester- I)

Effective progressively from June 2017

Core Course: Microbiology

Credits: 02 Periods: 45

Paper II: Methods in Microbiology
(Course Code: U-MIB-154)

Course Objectives:

Understand principle and working of light microscope.
Gain knowledge about microbial staining technique
Understand cultivation and management of bacterial growth.
Learn control of microbial 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 12

1.1 Principles of Microscopy

a) Metric units and properties of light.
b) Definition: Magnification, Resolving power, Depth of focus, Focal length.Angular aperture, Numerical aperture
c) Objectives (Low, High, Oil immersion) and Oculars Function
d) Condensers: Abbes, Cardioids, Parabolic and their functions

1.2 Principle and applications of Compound, Dark field, Phase Contrast and Fluorescent microscope.
1.3 Electron Microscope (SEM and TEM).

UNIT II: Microbial Staining Techniques 10

2.1 Definition: Stain, Dye, Acidic stain, Basic stain, Auxochrome, Chromophore, Mordent, Chromogen, Leuco compound, Natural stain, Flurochrome, Decolorizing agent and Counter stain.
2.2 Theories of Staining
2.3 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 13

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

3.2 Chemical Disinfectants

a) Characterization of an ideal disinfectant

b) Chemical Agents: Phenol and Phenolic compounds, Alcohols,
Gaseous sterilizing Agents: Formaldehyde, Ethylene Oxide,β- Propiolactone.

3.3 Evaluation of Disinfectant by Phenol Coefficient method.

3.4 Sterilization by Physical Agent

a) Heat: Moist Heat:Steam under pressure(Autoclaving) , Boiling, Tyndallization, Pasteurization
Dry heat: Incineration, Hot air Oven.

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

c) Filtration:- Types of filters (Bacteriological)

UNIT IV: Isolation and management of bacterial culture 10

4.1 Pure culture Techniques.

a) Definition and Significance of Streak plate, Pour plate, Spread plate,. Single Cell isolation.

4.2 Cultivation of Bacteria

a) Properties of a good culture medium.

b) General ingredients of culture media and their role

c) 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

4.3 Cultivation of anaerobes: GasPak method, Anaerobic jar

RAJARSHI SHAHU MAHAVIDYALAYA, LATUR

B. Sc. First year (Semester – I)
Semester Pattern effective from June -2013
Microbiology

Credits: 02 **Experiments : 12**

Lab Course-01
(Course Code: U-MIB-153)

Course Objectives:

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

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.

---

1) Biosafety in microbiology laboratory
2) Microscopy- Different parts of compound microscope. Use care & of compound microscope
3) Study of laboratory equipments used for Sterilization
   a) Autoclave
   b) Hot air oven
   c) Bacterial filters
4) Study of laboratory equipments used for Cultivation
   a) Incubator
   b) Anaerobic jar
5) Study of laboratory equipments used for other purposes
   a)pH meter
   b) High speed centrifuge
   c) Colorimeter/Spectrophotometer
   d) Laminar air flow
6) Simple staining : Monochrome, Negative
7) Differential: Gram's staining
8) Structural staining:
   I. Capsule staining (Manvel's Method)
   II. Cell wall staining (Chance's method)
   III. Endospore staining (Schaefer and Fulton's Method)
9) Micro chemical Staining: PHB staining (Burdon's method.)/ Metachromatic

Granule staining

10) Hanging drop technique.

11) Measurement of bacterial cell size: Micrometry

12) Preparation of culture media

a) Nutrient broth and Agar
b) MacConkey's Broth and Agar
c) Sugar Media

13. Handling of microbial cultures precaution and disposal
14. Biosafety measures-Laboratory sanitation
15. Training to laboratory staff regarding biosafety

RAJARSHI SHAHU MAHAVIDYALAYA (Autonomous), LATUR

CBCS Syllabus for B.Sc. First year (Semester- II)

Effective progressively from June 2017

Core Course: Microbiology

Credits: 02 **THEORY PAPER-III** Periods: 45

BASICS OF MICROBIOLOGY and BIOMOLECULES

(**Course Code: U-MIB-252)**

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 Importance of functional and informational biomolecules.

UNIT I: **Ultra structure of bacterial cell** **15**

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, Mesosomse, , Ribosome
e) Reserve materials and other cellular inclusions.
f) Dormant forms of prokaryote: Endospore and cyst

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

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, Mucopolysaccharides)

UNIT IV: Functional and Informational Biomolecules **10**

4.1 Proteins:

a) Definition and Classification

b) Peptide bond: Configurations of proteins

c) Functional proteins

d) 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

CBCS Syllabus for B. Sc. First year (Semester- II)

Effective progressively from June 2017

Core Course: Microbiology

Credits: 04(Four) **THEORY PAPER-IV** Periods: 45

Microbial Nutrition and Growth

(Course Code: U-MIB-253)

Course Objectives :

- Gain knowledge about microbial nutrition.
- 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: Microbial Nutrition **10**

1.1 Major bio-elements, minor bio-elements and growth factors
1.2 Sources of energy
1.3 Nutritional categories of microorganisms on the basis of carbon and energy source.

UNIT II: Nutrient Transport **12**

2.1 Modes of nutrition: osmotrophic, phagotrophic
2.2 Nutrient transport and membrane function: primary and secondary transport, porins, OMP, carrier proteins
2.3 Passive diffusion
2.4 Facilitated diffusion
2.5 Active transport mechanism
2.6 Group translocation

UNIT III Bacterial Reproduction and Growth **11**

3.1 Microbial Reproduction – Binary fission, Budding, fragmentation and formation of conidiophores
3.2 New cell formation (Macromolecular synthesis, septum formation)
3.3 Definition of growth and growth phases
3.4 The mathematical nature and expression of growth, generation time
3.5 Measurement of growth: cell number, cell mass, cell activity
3.6 Different types of bacterial cultures –Batch culture, continuous culture, synchronous culture

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

4.1 Environmental factors affecting growth - temperature, pH, osmotic pressure, oxygen, hydrostatic pressure, heavy metals

4.2 Survival of bacteria-Bacterial sporulation and cyst formation

RAJARSHI SHAHU MAHAVIDYALAYA (Autonomous), LATUR

CBCS Syllabus for B. Sc. First year (Semester- II)

Effective progressively from June 2017

Microbiology

Credits: 02 Periods: 45

Lab Course-02

(Course Code: U-MIB-254)

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) Isolation of bacteria from mixed culture
   a) Streak plate method
   b) Spread plate method
   c) Pour plate method

2 .Isolation or anaerobic spore forming bacteria from –cow dung and agriculture waste.

3)Preservation of bacterial cultures by refrigeration, subculturing on agar slant, oil overlay

4)Isolation of fungi,

5)Effect of physical agents on growth of bacteria
   a) pH
   b) Temperature
   c) U.V. rays(Demonstration)

6)Effect of chemical agents on growth of bacteria
   d) Heavy metal ions (Oligodynamic Action)
   e) Antibiotics

7) Qualitative and quantitative analysis of Carbohydrates:Benedict's Test

8) Qualitative and quantitative analysis of Protein: Biuret test

9). Qualitative and quantitative analysis nucleic acid
Diphenyl amine test(DPA) for DNA and orcinol test for RNA

10)Study of ultrastructure of cell with phase contrast

microscope**(Demonstration**)

11)Study of bacterial growth curve

12) Isolation and enumeration of coliphages

Reference Books

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