Shri Acharyaratna Deshbhooshan Shikshan Prasarak Mandal, Kolhapur

Mahavir Mahavidyalaya, Kolhapur (Autonomous)

Affiliated to Shivaji University, Kolhapur

Syllabus for National Education Policy (NEP 2.0)
Bachelor of Science (B. Sc.) Programme

Part	I	Course	Microbiology

Under the Faculty of Science &Technology

(To be introduced from Academic Year 2024 – 25 onwards)
Subject to the revisions & modifications made from time to time

Mahavir Mahavidyalaya, Kolhapur (Autonomous)
Affiliated to Shivaji University, Kolhapur

(New syllabus under Autonomy to be introduced from June, 2024 onwards)

Primary Information:			
Programme	**Bachelor of Science (B. Sc.) NEP 2.0**		
Part	**I**	Semester	**I**
Course	**Microbiology**	Course Code	**DSC I1**
Paper No.	**I**	Course Type	**Semester**
Total Marks	**50 Marks**	Implementation	**2024 – 25**
Total Credits	**02**	Contact Hours	**02 / Week**
Course Title	**Introduction to Microbiology**		

Course Objectives:	
i)	To know the historical developments in the fields of Microbiology.
ii)	Be aware of the scope and relevance of Microbiology.
iii)	To understand the principles of staining and to use various types of staining techniques.
iv)	To understand the basic principles underlying the working of different types of Microscopes.

Course Syllabus
(CR = Credits / IH: Instructional Hours)

Modules	**CR**	**IH**
Module I : History and mile stones in microbiology	01	15
A History of microbiology **1.** Spontaneous generation vs. biogenesis. **2.** Contributions of a) Antony von Leeuwenhoek b) Edward Jenner c) Louis Pasteur d) Robert Koch e) Ivanowsky f) Joseph Lister g) Alexander Fleming i) Martinus W. Beijerinck j) Sergei N. Winogradsky. **B. General Principles of bacterial nomenclature** **1.** Taxonomic ranks a. Common or Vernacular name		

b. Scientific or International name **2.** Classification of microorganisms –Whittaker's five kingdom and Carl Woese's three kingdom classification systems **3.** Beneficial and harmful activities of microorganisms. **4.** An overview of Scope of Microbiology a) Air b) Water c) Sewage d) Soil e) Dairy f) Food g) Medical h) Industrial i) Biotechnology j) Geomicrobiology k) Space Microbiology l) Nanobiotechnology.		
Module II : Staining technique and Microscopy	01	15
A. Stains and staining procedures **1.** Definition and Classification of stain a) Acidic, Basic and Neutral **2.** Principles, Procedure, Mechanism and application of staining procedures a) Simple staining b) Negative staining c) Differential staining i) Gram staining ii) acid fast staining d) Special staining methods i) Cell wall (Chance's method) ii) Capsule (Manvel's method) iii) Volutin granule (Albert's method) iv) Spore Staining (Dorner method) **B General Principles of Microscopy** **1.** Types of microscopes: light and electron microscopes a) Light microscopy: Parts, Image formation, Magnification, Numerical aperture (uses of oil immersion objective), Resolving power and Working distance. **2.** Ray diagram, special features, applications and comparative study of: a) Compound Microscope b) Electron Microscope		

Course Outcomes:
On completion of the course, students will be able to: Know history of microbiology and scope of microbiology
Understand different methods of staining.
Know the parts of microscope, type of microscopes and its working.

Primary Information:			
Programme	**Bachelor of Science (B. Sc.) NEP 2.0**		
Part	**I**	Semester	**I**
Course	**Microbiology**	Course Code	**DSC I2**
Paper No.	**II**	Course Type	**Semester**
Total Marks	**50 Marks**	Implementation	**2024 – 25**
Total Credits	**02**	Contact Hours	**02 / Week**
Course Title	**Microbial Diversity**		

Course Objectives:	
i)	To understand the structure and function of Prokaryotic cell and eukaryotic cell.
ii)	To learn the morphological and cytological characters of the bacterial cell.
iii)	To understand nutritional requirements of bacteria.
iv)	To learn the various groups of microorganisms grouped on their nutritional requirements.

Course Syllabus
(CR = Credits / IH: Instructional Hours)

Modules	**CR**	**IH**
Module I : Microbial world, Microbial structure and functions.	01	15
A. Introduction to types of Microorganisms: **1)** General characteristics of different groups a) Acellular microorganisms-Viruses, Viroid's, Prions b) Cellular microorganisms- Bacteria, Actinomycetes, Algae, Fungi and Protozoa; with emphasis on distribution and occurrence, morphology, mode of reproduction and economic importance. c) Ultra structure of Prokaryotic and eukaryotic cell. Difference between prokaryotic and eukaryotic cell. **B. Bacterial Cell organization** **1)**Morphological Characters Cell size, shape and arrangement **2)** Cytology of Bacteria: a) Cell-wall: Composition and detailed structure of Gram-positive and Gram-negative bacteria cell walls b) Cell Membrane: Structure, function and chemical composition. c) Structure and functions of Capsule and slime layer.		

d) Structure and functions of Flagella e) Structure and functions of Pili. **C. Structure and functions of Cytoplasmic components** **1)** Cytoplasmic Components: a) Ribosome b)Mesosome c) Inclusion bodies d) Nucleoid e) chromosome f) plasmids g) Endospore: Structure, stages of sporulation. h) Reserve food materials – Nitrogenous and non-nitrogenous		
Module II : Microbial Nutrition		
A. Nutritional requirements of microorganisms: **1**. Nutritional requirement a) Water b) Micronutrients c) Macronutrients d) Carbon e) Energy source f) Oxygen g) Hydrogen h) Nitrogen i) Sulphur and Phosphorous j) growth factors. **B. Nutritional types of microorganism based on carbon and energy sources.** 1. Nutritional types of microorganisms a. Autotrophs b. Heterotrophs c. Phototrophs d. Chemotrophs e. Photoautotrophs f. Chemoautorphos g. Phtoheterotrophs h. Chemoheterotrophs. **2.** Culture media: i) Components of media ii) Types of culture media and use a) Natural and synthetic media b) Chemically defined media c) Complex media d) Selective media e) Differential media f) Enriched media g)Enrichment media **3.** Cultivation of microorganisms: a) Use of culture media for cultivation b) Conditions required for growth of the microorganisms.	01	15

Course Outcomes:
On completion of the course, students will be able to: Know the structural details of prokaryotic cell
Know the morphological and cytological characters of the bacterial cell with their functions.
Understand nutritional requirements of bacteria and their groups.
Understand the different types of culture media, its types and the components used in it.

Primary Information:			
Programme	**Bachelor of Science (B. Sc.) NEP 2.0**		
Part	**I**	Semester	**II**
Course	**Microbiology**	Course Code	**DSC I3**
Paper No.	**III**	Course Type	**Semester**
Total Marks	**50 Marks**	Implementation	**2024 – 25**
Total Credits	**02**	Contact Hours	**02/ Week**
Course Title	**Bacteriology**		

Course Objectives:	
i)	To understand the biological concepts of sterilization and disinfections.
ii)	To learn the role of various physical and chemical agents in controlling the growth of micro-organisms
iii)	To know the methods used to cultivate micro-organisms and how to preserve them.
iv)	To know the various technique used for cultivation of anaerobes.

Course Syllabus
(CR = Credits / IH: Instructional Hours)

Modules	**CR**	**IH**
Module I: Control of Microorganisms.	01	15
Control of Microorganisms **1.** Definitions of a) Sterilization b) Disinfection c) Antiseptic d) Germicide e) Microbiostasis f) Antisepsis g) Sanitization. **2.** Physical agents for control of microorganisms a) Temperature i) Dry heat ii) Moist heat, b) Desiccation c) Osmotic pressure d) Radiations i) U.V. Ray ii) Gamma rays, e) Filtration i) Asbestos ii) Membrane filter **3.** Chemical Agents for control of microorganisms: Mode of action, application and advantages a) Phenol and Phenolic compounds b) Alcohols (Ethyl alcohol) c) Halogen compounds (chlorine and iodine d) Heavy metals (Cu and Hg) e) Gaseous Agents – Ethylene oxide, Beta-propiolactone		

Module II: Isolation, preservation of Microorganisms.	01	15
Isolation of Microorganisms from natural habitats. **1.** Pure culture techniques a) Streak plate b) Spread plate c) Pour Plate d) use of technique of micromanipulator in the isolation **2**. Isolation and cultivation of anaerobic organisms by using media components and by exclusion of air/O2 **3.** Preservation of microbial cultures- Introduction and concept a) Sub-culturing b) Overlaying cultures with mineral oils c) Storage at low temperature d) Lyophilization. **4.** Systematic study of pure cultures: a. Morphological characteristics. b. Cultural characteristics – i) Colony characteristics on solid media, ii) Growth in liquid media iii) Growth on agar slants. **5.** Biochemical Characteristics - a) Sugar fermentation – Glucose and Lactose b) Production of metabolites - H_2S gas c) Production of enzymes -Amylase, Caseinase and Catalase.		

Course Outcomes:
On completion of the course, students will be able to: Use various methods to control microbes.
Understand the techniques used for isolation of pure culture.
Understand the need and the different ways of preservation of microbes
Understand the morphological, cultural and biochemical characteristics of pure culture.

Primary Information:			
Programme	**Bachelor of Science (B. Sc.) NEP 2.0**		
Part	**I**	Semester	**II**
Course	**Microbiology**	Course Code	**DSC I4**
Paper No.	**IV**	Course Type	**Semester**
Total Marks	**50 Marks**	Implementation	**2024 – 25**
Total Credits	**02**	Contact Hours	**02 / Week**
Course Title	**Microbial Biochemistry**		

Course Objectives:	
i)	To understand the basic structure and function of biomolecules
ii)	To learn essential enzymology and the mechanism of various enzyme.
iii)	To understand the bioinstruments used in microbiology laboratory.
iv)	To understand various biotechniques used in microbiology laboratory.

Course Syllabus
(CR = Credits / IH: Instructional Hours)

Modules	**CR**	**IH**
Module I: Biomolecules.	01	15
Biomolecules **A. Proteins:** 1 General structure of amino acids, peptide bond. a) Types of amino acids based on R group – i) Nonpolar, aliphatic amino acids. ii) Aromatic amino acids. iii) Polar, Uncharged amino acids. iv) Positively charged (basic) amino acids v) Negatively charged (acidic) amino acids. b) Peptides - properties c) Structural levels of proteins: primary, secondary, tertiary and quaternary. **B. Carbohydrates**: Definition, classification and brief account of 1. Monosaccharide's: Classification based on aldehyde and ketone groups; structure of Ribose, Deoxyribose, Glucose, Galactose and Fructose. 2. Disaccharides: Glycosidic bond, structure of lactose and sucrose. 3. Polysaccharides: Structure and biological role of starch, glycogen and cellulose.		

C. Lipids: 1. Simple lipids – Fats and oils, waxes. 2. Compound lipids – Phospholipid, Glycolipids 3. Derived lipids – Cholesterol **D. Enzymes:** 1. Definition, 2. Structure- Concept of apoenzyme, coenzyme, cofactor and active site. 3. Types- Extracellular, Intracellular, Constitutive and Inducible. 4. Features of enzyme - Enzyme - substrate reaction. **E. Nucleic Acids:** 1. DNA – structure and composition (Watson and Crick Model) 2. RNA – Types (m-RNA, t-RNA, r-RNA), structure and functions.		
Module II: Bioinstrumentation and Biotechniques.	01	15
A. Bioinstrumentations: 1. Principle, working and applications of Colorimeter. 2. Principle, working and applications of laminar air flow cabinet. 3. Centrifugation of lab centrifuge: Principle, types and applications 4. pH meter : Principle, types and applications **B. Biotechniques:** 1. Chromatography - Principles, methods and applications of – i) Paper Chromatography -Principle, method, applications. ii) Thin layer Chromatography -Principle, method, applications. 2. Isolation and cultivation of Actinomycetes – a) Slide culture b) Agar cylinder method c) Inclined cover-slip culture d) Direct observation of plate culture		

Course Outcomes:
On completion of the course, students will be able to: Understand the basics of macromolecules like DNA, RNA and proteins.
Understand the fundamentals of carbohydrates.
Understand the principle, working and applications of bioinstruments.
Learn the biotechniques like chromatography.

Practical Course

Semester I

Course Objectives:
This course is designed to demonstrate practical skills in the use of tools and techniques commonly used in microbiology.

Course Syllabus
(CR = Credits / IH: Instructional Hours)

Modules	**CR**	**IH**
Module I: Introduction to Microbial Techniques **And** Microbial diversity 1. Microbiology Good Laboratory Practices a) Preparations of- stains (0.5% basic fuchsine, 0.5% crystal violet), b) Reagents (phosphate buffer of pH 7, 1 N and 1M solutions of HCL and NaOH), c) Physiological saline. 2. Biosafety a)Aseptic techniques: i)Table disinfection ii) Hand wash, iii) Use of aprons b) Proper disposal of used material c) Cleaning and sterilization of glasswares 3. Studying parts of Light compound microscope and its use and care. 4. Microscopic observation of bacteria and its parts: a) Monochrome staining b) Negative staining c) Gram's staining, d) Motility by Hanging-drop method. e) Cell wall staining (Chance's method) f) Capsule staining (Manuval's method) g) Volutine granule staining (Albert' s method) h) Endospore Staining (Dorner method)	02	30

5. Study of the principle and applications of instruments used in the microbiology laboratory: a) Biological safety cabinets b) Autoclave c) Incubator d) Hot air oven e) Colorimeter f) Colony counter g) Bacteriological filter assembly h) pH meter 6. Preparation of liquid and solid culture media and their sterilization. a) Preparation of - agar plates, buts and slants. 7. Simple media: a) Peptone water b) nutrient broth c) nutrient agar 8. Selective media: a) Sabourauds agar b) Glucose yeast extract agar 9. Differential and selective media: a) MacConkey's agar. 10. Sterilization of culture medium using Autoclave and assessment for sterility. 11.Sterilization of glassware using Hot Air Oven and assessment for sterility 12. Detection of enzyme production ability of bacteria – a) Amylase b) Catalase c) Caseinase		

Semester II		
Module I: Bacteriology And Microbial biochemistry 1. Demonstration of presence of microflora in air by solid impaction technique on nutrient agar plates and in water by direct cultivation method. 2. Demonstration of presence of microbes on hand nails, teeth and skin by cultivating microorganisms by swabbing methods. 3. Isolation of pure cultures of bacteria by four quadrant streaking method, and studies of Colony characteristics, Gram staining and motility of – a) *Escherichia coli* b) *Bacillus species* c) *Staphylococcus aureus* 4. Enumeration of bacteria from water and milk by SPC method 5. Biochemical tests : a) Detection of production of indole b) Excess acid c) Acetoin d) Utilization of citrate as a carbon source by IMViC test e) Detection of H2S production ability of bacteria 6. Detection of sugar fermentation ability of bacteria – a) Glucose b) Lactose 7. Mounting and identification of molds – a) *Aspergillus* b) *Penicillium* 8. Paper Chromatography – (Separation of amino acids from a mixture).	02	30

Course Outcomes:
Students will be know and practice the safety measures while working in the Microbiology laboratory and handling of Microscope.
Students will be able to prepare smear and examine bacteria using various staining procedures/techniques.

Students will be able to learn to critically observe and record the observations of all experiments.
Student will be able to weigh ingredients, adjust the pH of medium and operate the autoclave.
Student will be able to carry out various techniques of isolation.
Student will be understand mechanism of enzyme activity and their applications.

Reference Materials -	
Text Books for Reading	
1.	**Microbiology by Pelczar**, M. J. Jr., Chan E. C. S., Krieq, N.R. 5th Edition, 1986 (McGraw Hills Publication).
2.	**A text book of Microbiology by Ananthnarayan –** Orient Longman, Bombay.
3.	**General Microbiology by Stanier R. Y.** 5th edition, Mc Milan, London.
4.	**General Microbiology** Vol 1 and 2 by Powar and Daginawala, Himalaya Publications**.**
5.	**Fundamental Principles of bacteriology** by A. J. Salle, Tata McGraw Hill.
6.	**Fundamentals of Microbiology** by Frobisher, Hindsdill, Crabtree, Good Heart, W.B. Saunders Company, 7th edition.
Books for Reference	
1.	Medical Microbiology Vol. I and II by Cruick Shank R., Duguid J.P., Marmion B.P., Swain R.H.A.,XIIth edition, Churchill Livingston, New York.
2.	Medical Bacteriology by Dey and Dey – Allied Agency, Calcutta.
3.	Microbiology by Prescott, Herley and Klein, IInd edition.
4.	Bacteriological Techniques by F. K. Baker
5.	Principles of Biochemistry by Nelson and Cox (Lehninger) – Fifth edition.
6.	Introduction to Microbial Techniques by Gunasekaran.
7.	Elementary Microbiology Vol. I by Dr. H.A.Modi , Akta Prakashan, Nadiad, Gujrat.
8.	Introduction to Practical Biochemistry by D. Plummer, J. Willey and Sons
Books for Practical	
1.	Medical Microbiology by Cruickshank Vol. II.
2.	Stains and Staining procedures by Desai and Desai.

3.	Introduction to Practical Biochemistry by D. Plummer, J Wiley and Sons.
4.	Bacteriological techniques by F. J. Baker.
5.	Introduction to Microbial techniques by Gunasekaran.
6.	Biochemical methods by Sadasivam and D. Manickam.
7.	Laboratory methods in Biochemistry by J. Jayaraman.
8.	Experimental Microbiology by Patel & Patel

Suggested methods of Teaching:	
i)	Offline Traditional Board Teaching
ii)	Power Point Presentation
iii)	Online Teaching on platform of Zoom or Google Meet

Scheme of Course Evaluation		
1.	End Semester Examination (ESE)	40
2.	Continuous Internal Evaluation (CIE)	10
3.	**Total Marks**	**50**

Suggested techniques for Continuous Internal Evaluation (10 Marks)	
1.	Seminar
2.	Field Report
3.	Assignments
4.	Open book test
5.	Offline / online MCQ test
6.	Diagram test
7.	Visit/Tour report
8.	Surprise test

Question Paper Pattern (40 Marks) Theory Exam		
Q. No.	**Nature / Type of Question**	**Marks**
1.	Multiple Choice Questions (MCQ) 6 Questions	**6 Marks** (1 Marks for each question)
2.	Write answers in short 5 Questions	**10Marks** (2 Marks for each question)
3.	Write Short Notes Attempt any 3 out of 5 questions	**12Marks** (4 Marks for each question)
4.	Write descriptive question	**6 Marks**

	Attempt any 1 out of 2 questions	
5.	Write descriptive question Attempt any 1 out of 2 questions	**6 Marks**
6.	**Total Marks**	**40**