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	**2025-26**
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	**2025-26**
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	**2025-26**
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	**2025-26**
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.		
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.	01	15

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)	30
2.	Continuous Internal Evaluation (CIE)	20
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 3 Questions	**06Marks** (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 Attempt any 1 out of 2 questions	**6 Marks**
6.	**Total Marks**	**30**

Shri Acharyaratna Deshbhooshan Shikshan Prasarak Mandal, Kolhapur

Mahavir Mahavidyalaya, Kolhapur (Autonomous)

Affiliated to Shivaji University, Kolhapur

Syllabus for Choice Based Credit System (NEP 1.0)
Bachelor of Science (B. Sc.) Programme

Part	II	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 1.0**		
Part	**II**	Semester	**III**
Course	**Microbiology**	Course Code	**DSC I5**
Paper No.	**V**	Course Type	**Semester**
Total Marks	**50 Marks**	Implementation	**2024 – 25**
Total Credits	**02**	Contact Hours	**02/ Week**
Course Title	**Microbial Physiology & Metabolism**		

Course Objectives:	
i)	To understand growth phases and measurement of growth
ii)	To understand effect of environmental factors on microbial growth
iii)	To understand catabolism of glucose
iv)	To understand basic concept of fermentation

Course Syllabus (CR = Credits / IH: Instructional Hours)		
Modules	**CR**	**IH**
Module I : Microbial Physiology **A) Growth** : Growth phases, measurement of growth, continuous growth, synchronous growth and diauxic growth **B) Microorganisms at extreme environment and their strategies-** i) Temperature ii) pH ii) Osmotic pressure iv) Heavy metals v) Radiations **C) Transport across cell membrane –** Diffusion, active transport and group translocation	01	15
Module II : Microbial Metabolism **A) Catabolism of glucose -** EMP,HMP, ED and TCA cycle **B) Fermentation –**Homolactic & Heterolactic fermentation **C) Bacterial electron transport chain** –Components, flow of electrons & mechanism of ATP generation - Chemiosmotic hypothesis	01	15

Course Outcomes:
On completion of the course, students will be able to :
Know the growth phases and measurement of growth
Understand effect of environmental factors on microbial growth
Understand catabolism of glucose
Understand the basics of fermentation

Primary Information:			
Programme	**Bachelor of Science (B. Sc.) NEP 1.0**		
Part	**II**	Semester	**III**
Course	**Microbiology**	Course Code	**DSC I6**
Paper No.	**VI**	Course Type	**Semester**
Total Marks	**50 Marks**	Implementation	**2024 – 25**
Total Credits	**02**	Contact Hours	**02 / Week**
Course Title	**Microbial Genetics & Molecular Biology**		

Course Objectives:	
i)	To understand forms of DNA and detail structure of DNA
ii)	To understand basic concept of mutation
iii)	To understand types of mutations
iv)	To understand modes of gene transfer

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

Modules	**CR**	**IH**
Module I : Basics of Genetics	01	15
A) Basic concepts - a) Forms of DNA b)Gene, genome, genotype, phenotype, mutagen, recon, muton ,cistron c) Split genes. d) Genetic code – definition and properties of genetic code. **B) Mutation -** a) Basic Concepts of Mutation: Base pair substitutions, Frame shift, Missense, nonsense, neutral, silent, pleiotropic and suppressor mutations. b) Spontaneous mutation – Definition and basic concept. c) Induced mutations – Definition , Mechanism of mutagenesis by- i)Base analogues : 5-Bromouracil and 2-aminopurines ii) Mutagens modifying nitrogen bases- a) Nitrous acid b) Hydroxylamine c) Alkylating agents iii) Mutagens that distort DNA – a) Acridine dyes b) UV light **C) DNA repair :** i) Photoreactivation ii) Dark repair mechanism (Excision repair)		
Module II : Microbial Genetics	01	15
A) Gene transfer in bacteria. a) Fate of exogenote in recipient cell.		

b)Modes of gene transfer - Transformation, Conjugation, Transduction **B) Plasmids –** a) Natural – Properties, types , structure and applications b) Artificial – pBR 322- structure and applications **D) Lac operon** – structure and working		

Course Outcomes:
On completion of the course, students will be able to :
Understand forms of DNA and detail structure of DNA
Understand basic concept of mutation
Understand types of mutations
Understand modes of gene transfer by transformation, conjugation and transduction.

Primary Information:			
Programme	**Bachelor of Science (B. Sc.) NEP 1.0**		
Part	**II**	Semester	**IV**
Course	**Microbiology**	Course Code	**DSC I7**
Paper No.	**VII**	Course Type	**Semester**
Total Marks	**50 Marks**	Implementation	**2024 – 25**
Total Credits	**02**	Contact Hours	**02/ Week**
Course Title	**Applied Microbiology**		

Course Objectives:	
i)	To understand sources of microorganisms in air
ii)	To understand the routine bacteriological analysis of water
iii)	To understand contamination of milk and examination of milk
iv)	To understand fermentation and types of fermentation

Course Syllabus (CR = Credits / IH: Instructional Hours)		
Modules	**CR**	**IH**
Module I: Applied Microbiology **A) Air Microbiology:** a) Sources of microorganisms in air. b) Definitions of - Infectious dust, Droplets & Droplet nuclei c) Sampling methods for microbial examination of air i) Solid impaction - Sieve device ii) Liquid Impingement – Bead-bubbler device **B) Microbiology for potable water :** a) Sources of microorganisms in water. b) Fecal pollution of water, Indictors of fecal pollution of water –*E. coli* c) Routine Bacteriological analysis of water. 1) SPC & 2) Tests for coliforms - i. Qualitative-Detection of coliforms - Presumptive test, Confirmed Test, Completed test. Differentiation between Coliforms - IMViC test, Eijkman test. ii. Quantitative – MPN, Membrane filter technique d) Municipal water purification process and its significance. **C) Milk Microbiology:** a) Sources of microorganisms in milk b) General composition of Milk. c) Microbiological examination of Milk – DMC, SPC and dye reduction test- MBRT test d) Pasteurization - Definition, Methods – LTH , HTST ,UHT, Determination of efficiency of Pasteurization– Phosphatase test (Qualitative)	01	15

Module II: Industrial Microbiology		
A) Basic concepts of fermentation. 1. Definition, concept of primary and secondary metabolites 2. Types of fermentations – Batch, continuous, dual and multiple 3. Typical Fermentor design – Parts and their functions. 4. Factors affecting fermentation process **B) Screening** - Primary and secondary screening **C) Fermentation Media** - Water, carbon source, nitrogen source, Precursors, growth factors, antifoam agents & chelating agents.	01	15

Course Outcomes:
On completion of the course, students will be able to :
Understand sources of microorganisms in air
Understand the source of microorganisms in water and routine bacteriological analysis of water
Understand contamination of milk and examination of milk
Understand fermentation and types of fermentation

Primary Information:			
Programme	**Bachelor of Science (B. Sc.) NEP 1.0**		
Part	**II**	Semester	**IV**
Course	**Microbiology**	Course Code	**DSC I8**
Paper No.	**VIII**	Course Type	**Semester**
Total Marks	**50 Marks**	Implementation	**2024 – 25**
Total Credits	**02**	Contact Hours	**02/ Week**
Course Title	**Basics in Medical Microbiology & Immunology**		

Course Objectives:	
i)	To understand the basic terms and concept of medical microbiology
ii)	To understand types of diseases and mode of transmission of diseases
iii)	To understand basic concept of immunology
iv)	To understand theories antibody production and antigen-antibody reaction

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

Modules	**CR**	**IH**
Module I: Basics in Medical Microbiology	01	15
A)Definitions – Host, Parasite, Saprophytes, Commensal, Infection, Etiological agent, Disease, Pathogen, Opportunistic pathogen, True pathogen, Virulence, Pathogenicity , Fomite, Incubation period, Carriers, Morbidity rate, Mortality rate, Epidemiology, Etiology, Prophylaxis, Antigen, Antibody, Hapten, Vaccine, Immunity. **B) Virulence factors** (production of endotoxins, exotoxins, enzymes, escaping of phagocytosis) **C) Types of diseases –** i) Epidemic ii) Endemic iii) Pandemic iv) Sporadic. **D) Types of infections** – Chronic, acute, primary, secondary, Reinfection, Iatrogenic, congenital, local, generalized, Covert, Overt, Simple, Mixed, Endogenous, Exogenous, Latent, Pyogenic, Nosocomial. **E) Modes of transmission of diseases -** 1. Transmission by air, water & food 2. Contact transmission 3. Vector borne transmission **F) General principles of prevention and control of microbial diseases.** **G) Normal flora of human body & its significance**		
Module II: Basics in Immunology	01	15
A) Immunity		

i) Definition ii) Innate Immunity- types, factors influencing innate immunity iii)Acquired Immunity – Active & passive **B)Non Specific defense mechanisms of the vertebrate body** i) First line of defense ii) Second line of defense **C) Antigen:** Chemical nature, types of antigens, factors affecting antigenicity. **D) Antibody:** Types of antibodies – Structure, properties and functions. **E) Theories of antibody production.** **F) Immune Response:** Primary and secondary immune responses. **G) Mechanism of antigen – antibody reaction- Lattice hypothesis** **H) Types of antigen-antibody reaction-Precipitation and Agglutination**		

Course Outcomes:
On completion of the course, students will be able to :
Understand the basic terms in medical microbiology
Understand types of diseases and mode of transmission of diseases
Understand basic concept of immunology
Understand theories antibody production and antigen-antibody reaction

Practical Course Semester III

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

1) Micrometry **2) Stains and staining procedures :** i) Flagella staining (Bailey's method) ii) Nucleus staining (Giemsa's method) using yeast cells. **3) Preparation of media :** i)Gelatin agar ii)Amino acid decarboxylation medium iii)Amino acid deamination medium iv)Arginine broth v)Christensen's medium vi)Peptone nitrate broth vii)Hugh and Leifson's medium	Cr 02	30 Hr
4) Biochemical tests : i) Gelatin hydrolysis test. ii) Amino acid decarboxylation test iii) Amino acid deamination test iv) Urea hydrolysis test v) Nitrate reduction test vi) Huge and Leifson's test vii) Arginin hydrolysis viii) Oxidase test **2) Effect of environmental factor on microorganisms :** i) Temperature ii) pH iii) Heavy metals – Copper iv) Antibiotic – Penicillin/Streptomycin v) Salt – NaCl 3) Determination of growth phases of *E. coli* by Optical density		

Semester IV		
1) Bacteriological analysis of water a. Qualitative tests – Presumptive , confirm and completed test b. Quantitative - MPN **2) Primary Screening of -** i. Antibiotic producers – crowded plate technique ii. Organic acid producer 3) MBRT test.		
4) Isolation of lac negative mutants of *E.coli* by visual detection method 5) Effect of U.V. light on growth of bacteria 6) Isolation and identification of pathogenic microorganisms from clinical sample**.** i) *Salmonella* species ii) *Proteus* species 7) Determination of Blood groups – ABO and Rh. 8) Serological tests - Widal test – qualitative slide test		

Course Outcomes:
Students will be understood flagella and nucleus staining.
Students will be able to prepare culture media and know its use.
Students will be able to perform various biochemical tests.
Students will understand the various effect of environmental factors on microbial growth
Students will be able to isolate and identify the pathogens
Students will be able to perform serological tests.

Reference Materials -	
Text Books for Reading	
1.	Microbiology – Pelczar, Reid and Chan
2.	Industrial microbiology – Prescott and Dunn
3.	General Microbiology – R. Y. Stainer
4.	Industrial microbiology – Casida, E.
5.	General Microbiology – Vol. I and Vol. II – Pawar and Diganawala
6.	Text book of Microbiology – Ananthnarayan
Books for Reference	
1.	Introduction to Microbial technique – Gunasekaran.
2.	Outlines of Biochemistry – Cohn and Stumph
3.	Foundation in Microbiology – by Kathleen Park talaro, Arther Talaro.
4.	Introduction to Microbiology – John I. Ingraham, Catherine A. Ingraham A. Ingraham A.

5.	Ingraham, Ronald M; Second edition.
6.	Zinsser's Microbiology – by Wolfagang K. Joklik, (1995) Mc Graw-Hill Co.
7.	Microbial Genetics – by Stanley R. Maloy, David Freifelder and John E. Cronan.
Books for Practical	
1.	Manual of Diagnostic Microbiology – Wadher and Boosreddy.
2.	Diagnostic Microbiology – Fingold.
3.	Introduction to Microbial technique – Gunasekaran.
4.	Biochemical methods – Sadashivam and Manickam.
5.	Basic and Practical Microbiology – Atlas.
6.	Bacteriological techniques F. J. Baker.
7.	Laboratory Fundamentals of Microbiology – Alcamo, I. E.
8.	Clinical Microbiology – Ramnik Sood.

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

Shri Acharyaratna Deshbhooshan Shikshan Prasarak Mandal, Kolhapur

Mahavir Mahavidyalaya, Kolhapur (Autonomous)

Affiliated to Shivaji University, Kolhapur

Syllabus for National Education Policy (NEP 1.0)
Microbiology SEC

Bachelor of Science (B. Sc.) Programme

Part	**II**	**Course**	**Microbiology SEC**

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 1.0**		
Part	**II**	Semester	**III**
Course	**Microbiology**	Course Code	
Paper No.	**II**	Course Type	**Semester**
Total Marks	**25 Marks**	Implementation	**2024 – 25**
Total Credits	**02**	Contact Hours	**02 / Week**
Course Title	**Analytical Microbiology**		

Course Syllabus (CR = Credits / IH: Instructional Hours)		
Analytical Microbiology	**CR 02**	**IH 30**
1. Demonstration of analytical instruments- i. pH meter ii. Spectrophotometer. 2. Estimation of protein by Biuret method 3. Estimation of carbohydrates by Molish methods. 4. Estimation of RNA by Orcinol method 5. Estimation of DNA by diphenyl amine method 6. Estimation of amino acids by Ninhydrine method 7. Dry weight analysis of bacterial cell mass by indirect method 8. Paper chromatography method 9. Thin layer chromatography		

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 1.0**		
Part	**II**	Semester	**IV**
Course	**Microbiology**	Course Code	
Paper No.	**II**	Course Type	**Semester**
Total Marks	**25 Marks**	Implementation	**2024 – 25**
Total Credits	**02**	Contact Hours	**02 / Week**
Course Title	**Microbial analysis of air and water**		

Microbial analysis of air and water		
1. Enumeration of bacteria from water by SPC method. 2. MPN of water 3. Enrichment of coliform from water by MacConkeys broth. 4. Presumptive test for coliform. 5. Total viable count of microorganisms present in water by membrane filter techniques 6. Total viable count of microorganisms present in air 7. Demonstration of presence of microflora in air by exposure of nutrient agar plates to the air. 8.Detection of coliform in water by using biochemical test. (IMViC)	**CR 02**	**IH 30**

Shri Acharyaratna Deshbhooshan Shikshan Prasarak Mandal, Kolhapur

Mahavir Mahavidyalaya, Kolhapur (Autonomous)

Affiliated to Shivaji University, Kolhapur

Syllabus for Bachelor of Science (B. Sc.) (NEP 1.0) Programme

Part	III	Course	Microbiology

Under the Faculty of Science &Technology

(To be introduced from Academic Year 2025 – 26 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, 2025 onwards)

B. Sc III Semester V Structure 22 Credits

DSC Major Compulsory	**Elective** Any one	**Minor** Any one	**Practical Major** Compulsory	**Practical Elective** Any one	**Practical Minor** Any one	**Field Project** Compulsory
Virology (2 Credits)	**Food and Industrial Microbiology** (2 Credit)	**Chemistry** (2 Credit)	**Virology** (2 Credit)	**Food and Industrial Microbiology** (2 Credit)	**Chemistry** (2 Credit)	
Immunology (2 Credit)	**Fermentation Technology I** (2 Credit)	**Botany** (2 Credit)	**Immunology** (2 Credit)	**Fermentation Technology I** (2 Credit)	**Botany** (2 Credit)	
Agricultural Microbiology (2 Credit)			**Agricultural Microbiology** (2 Credit)			
6	2	2	6	2	2	2

B. Sc III Semester VI Structure 22 Credits

DSC Major Compulsory	**Elective** Any one	**Minor** Any one	**Practical Major** Compulsory	**Practical Elective** Any one	**Practical Minor** Any one	**OJT** Compulsory
Genetics (2 Credits)	**Environmental Microbiology** (2 Credit)	**Chemistry** (2 Credit)	**Genetics** (2 Credits)	**Environmental Microbiology** (2 Credit)	**Chemistry** (2 Credit)	
Biochemistry (2 Credit)	**Fermentation Technology II** (2 Credit)	**Botany** (2 Credit)	**Biochemistry** (2 Credit)	**Fermentation Technology II** (2 Credit)	**Botany** (2 Credit)	
Medical Microbiology (2 Credit)			**Medical Microbiology** (2 Credit)			
6	2	2	6	2	2	2

Primary Information:			
Programme	**Bachelor of Science (B. Sc.) CBCS**		
Part	**III**	Semester	**V**
Course	**Microbiology**	Course Code	**DSC MJ01**
Paper No.	**IX**	Course Type	**Semester**
Total Marks	**50 Marks**	Implementation	**2025 – 26**
Total Credits	**02**	Contact Hours	**3 / Week**
Course Title	**Virology (Major)**		

Course Objectives:	
i)	To Understand the basic structure of Viruses.
ii)	To Understand Isolation, cultivation and purification of viruses
iii)	To Understand reproduction of viruses
iv)	To Understand basic concept of oncogenesis.

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

Modules	CR	IH
Module I:	01	23
1) The Structural properties of viruses: Capsids, Nucleic acids and envelope. Structure of T4 bacteriophage, TMV and HIV, Viroid's and prions. **2) Reproduction of Bacteriophages:** a) One step growth experiment. b) Reproduction of T4 phage. **3) Isolation, cultivation and Purification of viruses** a) Isolation and cultivation of viruses: i) Animal virus - Tissue culture, chick embryo and live animals ii) Plant virus – Whole plant, Protoplasts, Insect cell culture iii) Bacteriophages - Plaque method b) Purification of viruses based on physico-chemical properties: i) Density gradient centrifugation ii) Precipitation **4) Methods of Enumeration of viruses** i) Latex droplet method (Direct electron microscopic count) ii) Plaque and pock assay method		
Module II:	01	22
1) Lysogeny a) Introduction i)Definition of lysogeny ii)Temperate phages b) Lysogeny by lambda phage i)Adsorption and penetration of λ phage ii)Circularization of lambda genome iii)Genetic map for lysogenic interaction		

iv)Expression of λ genes v)Establishment of repression vi)Maintenance of repression vii)Integration of λ genome into host genome **2) Reproduction of animal virus -** Adenovirus. **3) Reproduction of plant virus** – TMV **4) Oncogenesis**: a) Definition of oncogenesis b) Types of cancers c) Characteristics of cancer cells. d) Hypothesis about cancer. i) Somatic mutation hypothesis ii) Defective immunity hypothesis iii) Viral gene hypothesis e) Role of DNA viruses in cancer with special emphasis on Papova viruses. f) Role of RNA tumor viruses g) Provirus theory h) Protovirus theory i) Oncogene theory		

Course Outcomes:
On complication of course, student will be able to:
1] Know the basic structure of viruses
2] Understand isolation, cultivation and purification of viruses
3] Know the Reproduction of viruses
4] Understand the types of cancer

Primary Information:			
Programme	**Bachelor of Science (B. Sc.) CBCS**		
Part	**III**	Semester	**V**
Course	**Microbiology**	Course Code	**DSCMJ02**
Paper No.	**X**	Course Type	**Semester**
Total Marks	**50 Marks**	Implementation	**2025 – 26**
Total Credits	**02**	Contact Hours	**3/Week**
Course Title	**Immunology (Major)**		

Course Objectives:	
i)	To understand cells of immune system
ii)	To understand compliment fixation
iii)	To study monoclonal antibodies production
iv)	To study concept of cytokines and Hypersensitivity

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

Modules	**CR**	**IH**
Module I: **A) Cells and organs of the immune system**: **I) Cells of the immune system** i. Haematopoiesis- Characteristics and Types of stem cells ii. Classification of cells of immune system-Lymphoid and myeloid cells iii. Structure and functions of Lymphoid cells- T cells and T cell subsets, NK cells, B cells and dendritic cells iv. Structure and functions of myeloid cells – Granulocytes, Monocytes and macrophages **II) Organs of the immune system** Primary and secondary lymphoid organs - Structure and functions of Thymus, bone marrow, spleen, lymph node and Mucosa associated lymphoid tissue (MALT) B) Molecular mechanism of antibody production: i. Processing and presentation of antigen by Antigen presenting cell. ii. Interaction of APC with TH cell iii. Interaction of B cell and TH cell iv. Proliferation and differentiation of activated B cells v. Role of follicular dendritic cells in selection of high affinity B cells vi. Role of cytokines in proliferation and differentiation **C) Complement:** i. Nature, Properties, Complement activation by classical and alternate pathway. ii. Biological consequences of complement activation **D) Monoclonal antibodies:** i. Concepts of Polyclonal and monoclonal antibodies ii. Production of mouse monoclonal antibodies by hybridoma technology. iii. Types of monoclonal antibodies- Mouse, Chimeric, Humanized and Human antibodies	01	22

iv. Applications of monoclonal antibodies.		
Module II:	01	23
A) Cytokines: i. General characters of cytokines ii. Cytokines produced by different TH cells and Macrophages. iii. Effects of cytokines iv. Interferon–properties- types, inducers of Interferon, Mechanism of action- antiviral and immunoregulatory **B) Hypersensitivity:** i. Basic concept, Gell and Coombs classification ii. Type I-Anaphylaxis iii. Type II-Blood transfusion reactions iv. Type III-Serum sickness. v. Type IV- Delayed type hypersensitivity –Allergy of infection, Allograft rejection. C) Immunological tolerance and Autoimmunity: i. Immunological tolerance a) Natural or self-tolerance and induced tolerance b) Cellular mechanism of immunological tolerance- Central tolerance and peripheral tolerance c) Termination of tolerance ii. Autoimmunity: a) Concept b) Autoimmune diseases: Types, Immunopathological Mechanisms- Rheumatoid arthritis, Treatment of autoimmune diseases		

Course Outcomes:
On complication of course, student will be able to:
1] know the cells of immune system
2] understand compliment fixation
3] know the monoclonal antibodies production
4] know the concept of cytokines and Hypersensitivity

Primary Information:			
Programme	**Bachelor of Science (B. Sc.) CBCS**		
Part	**III**	Semester	**V**
Course	**Microbiology**	Course Code	**DSCMJ03**
Paper No.	**XII**	Course Type	**Semester**
Total Marks	**50 Marks**	Implementation	**2025 – 26**
Total Credits	**02**	Contact Hours	**3/ Week**
Course Title	**Agricultural Microbiology (Major)**		

Course Objectives:	
i)	To Understand characteristics of soil and role of microorganism
ii)	To Understand microbial interaction in soil
iii)	To study Biofertilizer production
iv)	To study various plant disease

Course Syllabus

(CR = Credits / IH: Instructional Hours)

Modules	**CR**	**IH**
Module I: **1) Soil Microbiology** a. Physical characters. b. Chemical characters. c. Types of microorganisms in soil and their role in soil fertility. d. Microbiological interactions - Symbiosis, Commensalism, Amensalism, Parasitism, and Predation. **2) Role of microorganisms in elemental cycles** a. Carbon cycle. b. Nitrogen cycle c. Phosphorous cycle **3) Role of Microorganisms in reclamation of soil.** I) Manure and Compost Methods of Production: a) Green manure and farm yard manure b) City compost- Windrow and pit method. c) Vermicompost II) Optimal conditions for composting with reference to - Composition of organic waste, Availability of microorganisms, Aeration, C: N:P ratio, Moisture content, Temperature, pH and Time. III) Standards of City Compost and Vermicompost as per Fertilizer Control Order.	01	22
Module II: 1) Types, production, methods of application and uses of: **A) Biofertilizers** i) Nitrogen fixing - Azotobacter, Rhizobium, and Azospirillum. ii) Phosphate Solubilizing Microorganisms.	01	23

B) Biopesticides a) Bacillus thuringiensis b) Tricoderma spp. c) Beauveria bassiana **2) Biodegradation of:** a) Cellulose b) Pesticides **3) Plant Pathology:** a) Common symptoms produced by plant pathogens b) Modes of transmission of plant diseases. c) Plant diseases: i) Citrus Canker ii) Tikka disease of groundnut iii) Bacterial Blight of Pomegranate.		

Course Outcomes:
On complication of course, student will be able to:
1] To know the physical, chemical characteristics of soil microbiology
2] To understand plant microbial interaction
3] To know the types, production, techniques of Biofertilizer
4] To understand Types, symptom and mode of transmission of plant diseases

Primary Information:			
Programme	**Bachelor of Science (B. Sc.) CBCS**		
Part	**III**	Semester	**V**
Course	**Microbiology**	Course Code	**DSCE01**
Paper No.	**XI**	Course Type	**Semester**
Total Marks	**50 Marks**	Implementation	**2025 – 26**
Total Credits	**02**	Contact Hours	**3/Week**
Course Title	**Food and Industrial Microbiology (Elective)**		

Course Objectives:	
i)	To Understand food spoilage
ii)	To Understand food poisoning
iii)	To Understand basic concept of probiotic and application
iv)	To study fermentation process and production

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

Modules	**CR**	**IH**
Module I:	01	22
1) Food Microbiology a) Food as a substrate for microorganisms: Intrinsic and extrinsic factors b) Sources of microorganisms to food		

c) Food spoilage: spoilage wine and beer, spoilage of vinegar d) General Principles and methods of food preservation e) Determination of: TDP, TDT, D, F, and Z values f) Food poisoning: a. Role of microorganisms in food poisoning b. Food poisoning: i) Staphylococcal ii) Fungal (aflatoxin) g) Food infections: food infection: Salmonellosis. h) Probiotics: Concept and applications **2) Industrial Microbiology** A) Strain Improvement B) Scale up of fermentations C) Microbiological assays		
Module II: **1) Industrial Microbiology** A. Preservation of industrially important microorganisms: Methods & Culture collection centres. **B. Industrial production of:** a. Alcohol: - Organisms used, Inoculum preparation, Fermentation media, Fermentation conditions, Extraction and Recovery. b. Grape wine: - Definition, types, production of table wine (Red and White) and microbial defects of wine c. Penicillin: - Organisms used Inoculum preparation, Fermentation media, Fermentation conditions, Extraction and Recovery. Concept of semi synthetic penicillin **C. Downstream processing & product recovery:** Centrifugation, flocculation, filtration, solvent extraction, distillation, precipitation, Crystallization and chromatography. **D. Testing of sterility, pyrogen, carcinogenicity, toxicity and allergens**	01	23

Course Outcomes:
On complication of course, student will be able to:
1] Know the details of food spoilage
2] Understand role of microorganism in food poisoning
3] know the application of Probiotic
4]Understand the microbial production of fermented product

Primary Information:			
Programme	**Bachelor of Science (B. Sc.) CBCS**		
Part	**III**	Semester	**V**
Course	**Microbiology**	Course Code	**DSCE02**
Paper No.	**XII**	Course Type	**Semester**
Total Marks	**50 Marks**	Implementation	**2025 – 26**
Total Credits	**02**	Contact Hours	**3/ Week**
Course Title	**Fermentation Technology- I (Elective)**		

Course Objectives:	
i)	To understand types of fermentations
ii)	To understand fermenter parts and functions
iii)	To understand fermentation media
iv)	To understand downstream processing and product recovery

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

Modules	**CR**	**IH**
Module I: **1. Basic concepts of fermentation.** a. Definition, concept of primary and secondary metabolites b. Types of fermentations – Batch, continuous, dual and multiple. c. Typical Fermenter design – Parts and their functions. d. Factors affecting fermentation process. **2. Fermentation Media. Fermentation media –** i) Water, carbon source, nitrogen source, precursors, growth factors, antifoam agents, chelating agents. ii) Use of wastes as Fermentation media – Molasses, sulphite waste liquor & corn steep liquor.	01	22
Module II: **Screening: Primary and secondary screening.** **1. Production strains** i) Concept ii) Preparation of inoculum iii) Strain improvement **2. Scale up of fermentations** Microbiological assays Testing of sterility, pyrogen, carcinogenicity, toxicity and allergens **3. Downstream processing & product recovery-** 1. Centrifugation 2. Flocculation 3. Filtration 4. Solvent extraction 5. Distillation 6. Precipitation 7. Crystallization	01	23

8. Chromatography.		

Course Outcomes:
On complication of course, student will be able to:
Understand types of fermentations
Understand fermenter parts and functions
Understand fermentation media
Understand downstream processing and product recovery

Practical Course V Semester V

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

Modules	CR	IH
Virology (Major) **Major:** 1. Isolation of coliphages from sewage. **Minor:** 1. Testing of carcinogenicity of a substance by Ame's test 2. Demonstration of viruses inoculation by chick embryo technique **Immunology (Major)** **Major:** 1. Determination of MIC of streptomycin against E. coli by broth method **Minor:** 1. Estimation of haemoglobin by Sahli's method 2. Determination of ESR of the blood sample 3. Determination of PCV 4. Total and differential blood cells count. **Agricultural Microbiology (Major)** **Major:** 1. Isolation of *Azotobacter* from soil. 2. Isolation of *Xanthomonas* from infected citrus fruit. 3. Isolation of *Rhizobium* from root nodules. 4. Isolation of phosphate solubilising bacteria from soil. **Minor:** 1. Estimation of Calcium and Magnesium from soil (EDTA method) 2. Determination of organic carbon content of soil (Walkley and Black method)	6	90
Food and Industrial Microbiology and Fermentation Technology I (Elective) **Major:** 1. Bio-assay of Vitamin B12 2. Bio-assay of Penicillin. **Minor:**	2	30

1. Production of wine and examination for pH, colour and alcohol content. 2. Citric acid fermentation, recovery and estimation by titration. 3. Amylase production by using Bacillus species. 4. Isolation of lactic acid bacteria from fermented food. 5. Examination of milk by Direct microscopic count (DMC)		

Primary Information:			
Programme	**Bachelor of Science (B. Sc.) CBCS**		
Part	**III**	Semester	**VI**
Course	**Microbiology**	Course Code	**DSCMJ04**
Paper No.	**XIII**	Course Type	**Semester**
Total Marks	**50 Marks**	Implementation	**2025 – 26**
Total Credits	**02**	Contact Hours	**3/ Week**
Course Title	**Microbial Genetics (Major)**		

Course Objectives:	
i)	To understand chromosomal structure of *E. coli*
ii)	To Understand Mutation
iii)	To Study molecular techniques and applications
iv)	To understand Genetic engineering

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

Modules	**CR**	**IH**
Module I: **1) Basic concepts of bacterial genome -** a) Structural organization of E. coli chromosome - Folded Fiber model. b) One cistron - one polypeptide hypothesis. **2) Molecular mechanism of gene expression** a) Concept of operon b) Pribnow box c) Genetic regulation in tryptophan operon **3) Mutations** a) Expression of mutations - i) Time course of phenotypic expression. ii) Conditional expression of mutation. b) Suppressor mutations (with examples) - Genetic and non-genetic. **4) Methods of isolation and detection of mutants based on -** a) Relative survival b) Relative growth c) Visual detection	01	22
Module II: **1) Genetic complementation - Cis-trans test**	01	23

2) Extrachromosomal inheritance: a) Kappa particles. b) Transposable elements - general properties and types. **3) Techniques in Molecular Biology –** a) DNA sequencing (Sanger's method) b) DNA Finger printing c) PCR **4) Genetic engineering** a) Introduction b) Tools of genetic engineering – i) Enzymes ii) Vectors-phage, plasmid and cosmid iii) DNA probe iv) Linkers and adaptors v) Cloning organisms - (Bacteria and Yeasts) vi) Genomic library and cDNA library c) Techniques – i) Isolation of desired DNA segment- Shotgun Method, cDNA synthesis, Chemical synthesis ii) Construction of r-DNA using appropriate vector- Use of restriction enzymes, Linkers, Adaptors, Homopolymer tails iii) Transfer to cloning organisms (Bacteria and Yeasts) iv) Selection of recombinant bacteria and yeasts – Blue and white screening, Colony hybridization technique. d) Application of genetic engineering in – i) Medicine ii) Agriculture iii) Industry iv) Environment		

Course Outcomes:
On complication of course, student will be able to:
1] To know the chromosomal structure of *E. coli*
2] Understand types of mutation and methods to isolates mutants
3] Understand principle working and application of molecular biology techniques
4] To know the tools and techniques used in Genetic engineering

Primary Information:			
Programme	**Bachelor of Science (B. Sc.) CBCS**		
Part	**III**	Semester	**VI**
Course	**Microbiology**	Course Code	**DSCMJ05**
Paper No.	**XIV**	Course Type	**Semester**
Total Marks	**50 Marks**	Implementation	**2025 – 26**
Total Credits	**02**	Contact Hours	**3/ Week**
Course Title	**Microbial Biochemistry (Major)**		

Course Objectives:	
i)	To study the basic concept of Enzymes and its Kinetics
ii)	To Study regulation of enzyme synthesis
iii)	To study Biosynthesis of DNA, RNA, protein and peptidoglycan
iv)	To study Carbohydrates metabolism

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

Modules	**CR**	**IH**
Module I:	01	22
1) Enzymes - A) Definition, properties, structure, specificity, mechanism of action (Lock & Key, Induced fit hypothesis), Basics of enzyme classification. B) Allosteric enzymes - Definition, properties, models explaining mechanism of action (Concerted and sequential models). Patterns of feedback inhibition. **2) Extraction and purification of enzymes.** A) Methods of extraction of intracellular and extracellular enzymes. i) Choice of source and biomass development B) Methods of homogenization - cell disruption methods C) Purification of enzymes on the basis of - a) Molecular size, b) Solubility differences c) Electrical charge, d) Adsorption characteristic differences e) Differences in biological activity 2) Assay of enzymes - Based on substrate and product estimation. **3) Ribozymes and Isozymes.** 4) **Immobilization of enzymes -** Methods and applications		
Module II:	01	23
1) Factors affecting enzyme activity a) Factors affecting catalytic efficiency of enzymes- i) Proximity and orientation, ii) Strain and distortion, iii) Acid base catalysis, iv) Covalent catalysis b) Environmental factors influencing enzyme activity- i) Substrate concentration,		

ii) Temperature, iii) pH, iv) Metal ions **2) Kinetics of single substrate**-enzyme catalysed reactions - Derivation of Michaelis-Menten equation, Lineweaver Burk Plot, Significance of Km and Vmax. **3) Microbial Metabolism** I) Basics in carbohydrate metabolism a) PP pathway, ED pathway, Phosphoketolase pathway b) Pyruvate as a key intermediate c) Glyoxylate bypass II) Assimilation of - a) Carbon b) Nitrogen with respect to N2 and NH3 (GOGAT) c) Sulphur **4) Biosynthesis of -** a) RNA, b) DNA, c) Proteins, d) Peptidoglycan **5) Regulation of enzyme synthesis.** i) Positive control - Ara operon, ii) Negative control - Lac operon iii) Catabolite repression		

Course Outcomes:
On complication of course, student will be able to:
1] To know the concept of enzymes
2] To understand Regulation of enzyme synthesis
3] The course covers the basics DNA, RNA, protein and peptidoglycan biosynthesis
4] To understand basic carbohydrates metabolism

Primary Information:			
Programme	**Bachelor of Science (B. Sc.) CBCS**		
Part	**III**	Semester	**VI**
Course	**Microbiology**	Course Code	**DSCMJ06**
Paper No.	**XVI**	Course Type	**Semester**
Total Marks	**50 Marks**	Implementation	**2025 – 26**
Total Credits	**02**	Contact Hours	**3/ Week**
Course Title	**Medical Microbiology (Major)**		

Course Objectives:	
i)	To understand various bacterial disease
ii)	To study viral, fungal and protozoa diseases
iii)	To understand general principle of chemotherapy
iv)	To understand mode of action of antimicrobial agents

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

Modules	**CR**	**IH**
Module I:	01	23
BACTERIAL DISEASES Morphology, cultural and biochemical characteristics, antigenic structure, modes of transmission, pathogenesis, symptoms, laboratory diagnosis, prevention and control of diseases caused by i)*Mycobacterium tuberculosis* ii)*Clostridium perfringens* iii)*Treponema pallidum* iv)*Pseudomonas aeruginosa* v)*Vibrio cholera* vi)*Staphylococcus aureus* vii)*Leptospira interorgan* viii)*Klebsiella pneumonia*		
Module II:	01	22
A. Morphology, cultural and biochemical characteristics, antigenic structure, modes of transmission and pathogenesis, symptoms, laboratory diagnosis, prevention and control of diseases caused by 1) Protozoa: Plasmodium falciparum (malaria) 2) Viruses: i) Hepatitis A & B virus ii) Rabies virus iii)Dengue virus 3) Fungus: *Candida albicans* B. Chemotherapy 1) Chemoprophylaxis 2) General principles of chemotherapy		

3) Mode of action of antimicrobial agents: a) Antibacterial drugs: Penicillin, Bacitracin, Piperacillin, cycloserine, Streptomycin, Tetracycline, Trimethoprim, Sulphonamides and Quinolones. b) Antiviral drug: AZT, c) Antifungal drugs: Ketoconazole, Griseofulvin, Nystatin d) Antiprotozoal drugs: Metronidazole, Mepacrine 4)Drug resistance: Reasons and Mechanism of drug resistance 5) Immunoprophylaxis: Vaccines and Immune Sera a) Vaccines-live attenuated, inactive, subunit, conjugate and DNA vaccines b) Immune Sera- examples with applications		

Course Outcomes:
On complication of course, student will be able to:
1] know the pathogenesis symptoms and treatment of various disease
2] Understand viral, fungal and protozoa diseases
3] know the general principle of chemotherapy
4] Understand mode of action of antimicrobial agents

Primary Information:			
Programme	**Bachelor of Science (B. Sc.) CBCS**		
Part	**III**	Semester	**VI**
Course	**Microbiology**	Course Code	**DSCE03**
Paper No.	**XV**	Course Type	**Semester**
Total Marks	**50 Marks**	Implementation	**2025 – 26**
Total Credits	**02**	Contact Hours	**3/Week**
Course Title	**Environmental Microbiology (Elective)**		

Course Objectives:	
i)	To study general characteristics of liquids, solid waste as per MPCB
ii)	To study sewage microbiology and characteristics
iii)	To study basic purpose of environment monitoring along with biological safety measures
iv)	To understand environment impact assessment, bioremediation and bioleaching

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

Modules	**CR**	**IH**
Module I:	01	22
1) General characteristics of waste- Liquid waste - pH, electrical conductivity, COD, BOD, total solids, total dissolved solids, total suspended solids, total volatile solids, chlorides, sulphates, oil & grease. b) Solid waste- pH, electrical conductivity, total volatile solids, ash. c) Standards as per MPCB. **2) Sewage Microbiology** a) Physico-chemical and biological characteristics b) Treatment i)Biological treatment: Trickling filter, Activated sludge process, Oxidation ponds, Anaerobic digestion, Septic tank, Root zone technology ii) Chemical treatment – Chlorination **3) Characteristics and treatment of waste generated by** a) Sugar Industry b) Distillery c) Dairy Industry d) Hospital **4) Eutrophication** a) Classification of lakes b) Sources c) Consequences d) Control		
Module II:	01	23
1) Biological safety in laboratory		

a) Good Laboratory Practices b) Bio safety levels (BSL) **2) Environmental monitoring** a) Definition and purpose b) Cleanroom classification c) Routine Environmental monitoring programme in pharmaceutical industries- Air monitoring, Surface monitoring and Personnel monitoring. d) Bioburden test e) Environmental Impact Assessment- Concept and Brief introduction **3) Bioremediation and Bioleaching** a) Bioremediation i) Definition ii) Types iii) Applications. b) Bioleaching i) Introduction ii) Microorganisms involved iii) Chemistry of Microbial leaching iv) Laboratory scale and pilot scale leaching v) In situ leaching - Slope, heap vi) Leaching of Copper and Uranium		

Course Outcomes:
On complication of course, student will be able to:
1] To know the concept characteristics of liquids, solid waste as per MPCB
2]This point cover sewage microbiology and characteristics
3] To understand environment monitoring along with biological safety measures
4] To understand concept importance and application of environment impact assessment

Primary Information:			
Programme	**Bachelor of Science (B. Sc.) CBCS**		
Part	**III**	Semester	**VI**
Course	**Microbiology**	Course Code	**DSCE04**
Paper No.	**XV**	Course Type	**Semester**
Total Marks	**50 Marks**	Implementation	**2025 – 26**
Total Credits	**02**	Contact Hours	**3/Week**
Course Title	**Fermentation Technology II (Elective)**		

Course Objectives:	
i)	To understand primary metabolites
ii)	To understand production of biofuels
iii)	To understand concept of probiotics
iv)	To understand production of SCP

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

Modules	**CR**	**IH**
Module I:	01	22
A. Industrial production – Organisms used Inoculum preparation, Fermentation media, Fermentation conditions, Extraction and Recovery. **1. Primary metabolite**: i) Vitamin: Vitamin B12, riboflavin, β carotene, ii) Amino acids: Lysine & Glutamic acid iii) Organic acid: Citric acid &Lactic acid acetic acids, lactic acids, kojic acids, Itaconic acids **2. Secondary metabolite** i) Antibiotics: a. Penicillin & semi-synthetic penicillin b. Streptomycin ii) Alcoholic Beverages: Wine: a) Red Table Wine b) Sparkling Wine- Champagne **3. Enzyme**: Amylase, Protease, lipase		
Module II:	01	23
A. Production of biofuels **1. Bioethanol**- microorganisms used, fermentation condition, recovery, purification of Ethanol **2. Biogas**- Biomass used, Microbiology & Biochemistry of biogas production **3. Biodiesel production from algae** **B. Probiotics**- Concept, Production by using Lactobacillus and applications **C. Production of SCP by using yeast**		
Course Outcomes:		
On complication of course, student will be able to:		
Understand primary metabolites		

Understand production of biofuels
Understand concept of probiotics
Understand production of SCP

Practical Course Semester VI

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

Modules	CR	IH
Microbial Genetics (Major) **Major:** 1. Effect of U.V. light on bacteria and graphical presentation of result. 2. Isolation of auxotrophic mutants by replica plate technique 3. Transfer of genetic material by transformation in E. coli 5. Isolation of chromosomal DNA from bacteria (J. Marmurs method) **Minor:** 1. Electrophoretic separation of DNA. 2. Isolation of streptomycin - resistant mutants (gradient plate technique) **Medical Microbiology (Major)** **Major:** 1. Isolation of following pathogens from clinical samples (wherever possible) and identification of the same by morphological, cultural and biochemical characteristics. a) *Pseudomonas aeruginosa* b) *Staphylococcus aureus* c)*Candida albicans* **Minor:** 1. Determination of sensitivity of commom pathogen to antibiotics by paper disc method 2. Widal test -Quantitative 3. Rapid Diagnostic Test for Malaria 4. Demonstration of Enzyme Linked Immunosorbent Assay (ELISA) 5. Urine analysis: Physical and chemical examination of urine. a) microscopic examination of urine-crystals, RBCs, pus cells and bacteria. b) Test for protein (Acetic acid test) c) Test for ketone bodies (Rothra's test) d) Test for bile salt and bile pigments. e) Test for sugar (Benedict's method)		

Biochemistry (Major) **Major:** 1. Assay of amylase by DNSA method (graphical estimation) 2. Immobilization of enzymes by sodium alginate method. **Minor:** 1. Estimation of protein by Biuret method 2. Estimation of carbohydrates by Molish methods.		
Environmental Microbiology (Elective) **Major:** 1. Determination of BOD of sewage 2. Determination of COD of sewage. **Minor:** 1. Determination of texture, colour, pH of water. 2. Determination of total alkalinity of water 3. Determination of chloride content of water		

Reference Materials -	
Books for Reference	
1.	Practical Biochemistry - Plummer
2.	Soil, Plant, and Water Analysis – P. C. Jaiswal
3.	Medical Lab Technology – Ramnik and Sood
4.	Biochemical methods – S. Sadasivam, A. Manickam
5.	Chemical and biological analysis of water - Dr. R. K. Trivedy and P. K. Goel

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

Practical Examination

(A) The practical examination will be conducted on two consecutive days for three hours per day per batch of the practical examination.

(B) Each candidate must produce a certificate from the Head of the Department in her/his college, stating that he/she has completed in a satisfactory manner the practical course on lines laid down from time to time by Academic Council on the recommendations of Board of Studies and that the journal has been properly maintained. Every candidate must have recorded his/her observations in the laboratory journal and have written a report on each exercise performed. Every journal is to be checked and signed periodically by a member of teaching staff and certified by the Head of the Department at the end of the year. Candidates must produce their journals at the time of practical examinations.

Nature of Question paper and distribution of marks for B. Sc III Microbiology Practical Examination Major and Elective papers -

Practical

Q.1 Major Experiment 10 Marks
Q.2 Minor Experiment 05 Marks
Q.3 Journal and Viva 05 Marks
Q.4 Spotting/ Tour Report 05 Marks

Total 25 Marks