

SHIVAJI UNIVERSITY, KOLHAPUR.



Accredited By NAAC with 'A' Grade

CHOICE BASED CREDIT SYSTEM

Syllabus For

**B.Sc. Part - I
MICROBIOLOGY**

SEMESTER I AND II

(Syllabus to be implemented from June, 2018 onwards.)

B. Sc. Part – I Semester – I**MICROBIOLOGY**

Theory: 60 hrs. (75 lectures of 48 minutes)

Total Marks-100 (Paper I and II, **Credits: 04**)**PAPER I DSC- 25 A Introduction to Microbiology****CREDIT II****MARKS-50**

Unit/Credit – 1 (15 hrs.)

Unit/Credit – 2 (15 hrs.)

PAPER II DSC- 26 A Microbial Diversity**CREDIT II****MARKS-50**

Unit/Credit – 1 (15 hrs.)

Unit/Credit – 2 (15 hrs.)

SHIVAJI UNIVERSITY, KOLHAPUR**CBCS SYLLABUS WITH EFFECT FROM JUNE 2017****B. Sc. Part – I Semester – II****MICROBIOLOGY**

Theory: 60 hrs. (75 lectures of 48 minutes)

Total Marks-100 (Paper III and IV, **Credits: 04**)**PAPER III DSC –25 B Bacteriology****CREDIT II****MARKS-50**

Unit/Credit – 1 (15 hrs.)

Unit/Credit – 2 (15 hrs.)

PAPER IV DSC- 26 B Microbial Biochemistry**CREDIT II****MARKS-50**

Unit/Credit – 1 (15 hrs.)

Unit/Credit – 2 (15 hrs.)

B.Sc. I Microbiology

Semester I

Paper I:	DSC- 25 A: Introduction to Microbiology (CREDITS: 02; TOTAL HOURS: 30)	No. of Hours per Unit/Credit
Unit I/ Credit I	History and mile stones in microbiology	15
	<p>A History of microbiology</p> <ol style="list-style-type: none"> 1. Spontaneous generation vs. biogenesis. 2. Contributions of <ol style="list-style-type: none"> 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. 3. Beneficial and harmful activities of microorganisms. 4. Classification of microorganisms –Whittaker’s five kingdom and Carl Woese’s three kingdom classification systems <p>B General Principles of bacterial nomenclature</p> <ol style="list-style-type: none"> 1. Taxonomic ranks <ol style="list-style-type: none"> a. Common or Vernacular name b. Scientific or International name 2. An overview of Scope of Microbiology <ol style="list-style-type: none"> a) Air b) Water c) Sewage d) Soil e) Dairy f) Food g) Medical h) Industrial i) Biotechnology j) Geomicrobiology 	

Unit II/ Credit II	Staining techniques and microscopy	15
	<p>A. Stains and staining procedures</p> <ol style="list-style-type: none"> 1. Definition and Classification of stain <ol style="list-style-type: none"> a) Acidic, Basic and Neutral 2. Principles, Procedure, Mechanism and application of staining procedures <ol style="list-style-type: none"> a) Simple staining b) Negative staining c) Differential staining <ol style="list-style-type: none"> i) Gram staining ii) Acid fast staining d) Special staining methods <ol style="list-style-type: none"> i) Cell wall (Chance's method) ii) Capsule (Maneval's method) iii) Volutin granule (Albert's method) <p>B General Principles of Microscopy</p> <ol style="list-style-type: none"> 1. Types of microscopes: light and electron microscopes <ol style="list-style-type: none"> 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 : <ol style="list-style-type: none"> a) Compound Microscope b) Electron Microscope 	

Paper II	DSC- 26 A Microbial Diversity (CREDITS: 02; TOTAL HOURS: 30)	No. of Hours per Unit/Credit
Unit I/ Credit I	Microbial world and control of Microorganisms	15
	<p>A. Introduction to types of Microorganisms :</p> <ol style="list-style-type: none"> 1. General characteristics of different groups <ol style="list-style-type: none"> a) Acellular microorganisms-Viruses, Viroids, Prions b) Cellular microorganisms- Bacteria, 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 microorganisms. <p>B. Control of Microorganisms</p> <ol style="list-style-type: none"> 1. Definitions of <ol style="list-style-type: none"> a) Sterilization b) Disinfection c) Antiseptic d) Germicide e) Microbiostasis, f) Antisepsis g) Sanitization. 2. Physical agents for control of microorganisms <ol style="list-style-type: none"> a) Temperature <ol style="list-style-type: none"> i) Dry heat ii) Moist heat, b) Desiccation c) Osmotic pressure d) Radiations <ol style="list-style-type: none"> i) U.V. Ray ii) Gamma rays, e) Filtration <ol style="list-style-type: none"> i) Asbestos and Membrane filter 3. Chemical Agents for control of microorganisms: Mode of action, application and advantages <ol style="list-style-type: none"> 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 and 	

Unit II/ Credit II	Microbial Nutrition	15
	<p>A. Nutritional requirements of microorganisms:</p> <ol style="list-style-type: none"> 1. Nutritional requirement <ol style="list-style-type: none"> a) Water b) Micronutrients c) Macronutrients d) Carbon e) Energy source f) Oxygen and g) Hydrogen h) Nitrogen i) Sulphur and Phosphorous and growth factors-auxotroph, prototroph and fastidious organisms. <p>B. Nutritional types of microorganism based on carbon and energy sources.</p> <ol style="list-style-type: none"> 1. Nutritional types of microorganisms <ol style="list-style-type: none"> a. Autotrophs b. Heterotrophs c. Phototrophs d. Chemotrophs e. Photoautotrophs f. Chemoautorphos g. Phtoheterotrophs h. Chemoheterotrophs. 2. Types of Culture media: <ol style="list-style-type: none"> a) components of media b) natural and synthetic media c) chemically defined media d) complex media e) selective, differential f) enriched and enrichment media. 3. Cultivation of microorganisms: <ol style="list-style-type: none"> a) Use of culture media for cultivation b) Conditions required for growth of the microorganisms. 	

B.Sc. I Microbiology Semester II

Paper III:	DSC –25 B Bacteriology (CREDITS: 02; TOTAL HOURS: 30)	No. of Hours per Unit/Credit
Unit I/ Credit I	Microbial structure and functions	15
	<p>A. Bacterial Cell organization</p> <p>1) Cell size, shape and arrangement</p> <p>2) Cytology of Bacteria :</p> <p>a) Cell-wall : Composition and detailed structure of Gram-positive and Gram-negative bacterial cell walls</p> <p>b) Cell Membrane: Structure, function and chemical composition of bacterial cell membranes.</p> <p>c) Structure and functions of Capsule and slime layer.</p> <p>d) Structure and functions of Flagella</p> <p>e) Structure and functions of Pili.</p> <p>B. Structure and functions of Cytoplasmic components</p> <p>1. Cytoplasmic Components:</p> <p>a) Ribosomes</p> <p>b) mesosomes</p> <p>c) inclusion bodies</p> <p>d) nucleoid</p> <p>e) chromosome</p> <p>f) plasmids</p> <p>g) Endospore: Structure, stages of sporulation.</p> <p>h) Reserve food materials – Nitrogenous and non nitrogenous</p>	
Unit II/ Credit II	Isolation, preservation of Microorganisms	15
	<p>A. Isolation of Microorganisms from natural habitats.</p> <p>1. Pure culture techniques</p> <p>a) Streak plate</p> <p>b) Spread plate</p> <p>c) Pour Plate and micromanipulator</p> <p>2. Isolation and cultivation of anaerobic organisms by using media components and by exclusion of air/O₂</p> <p>3. Preservation of microbial cultures –</p> <p>a) Sub-culturing</p> <p>b) overlaying cultures with mineral oils</p>	

	<p>c) storage at low temperature d) lyophilization.</p> <p>B. Systematic study of pure cultures:</p> <ol style="list-style-type: none"> 1. Morphological characteristics. 2. Cultural characteristics – <ol style="list-style-type: none"> a) Colony characteristics on solid media, b) growth in liquid media c) growth on agar slants. 3. Biochemical Characteristics - <ol style="list-style-type: none"> a) Sugar fermentation b) Production of metabolites - H₂S gas c) Production of enzymes - Amylase, Caseinase and Catalase. 	
Paper IV:	26 B Microbial Biochemistry (CREDITS: 02; TOTAL HOURS: 30)	No. of Hours per Unit/Credit
Unit I/ Credit I	Biomolecules	15
	<p>A. Proteins :</p> <ol style="list-style-type: none"> 1 General structure of amino acids , peptide bond. <ol style="list-style-type: none"> a) Types of amino acids based on R group – <ol style="list-style-type: none"> 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. <p>B. Carbohydrates: Definition, classification and brief account of</p> <ol style="list-style-type: none"> 1. Monosaccharides: 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. <p>C. Lipids :</p> <ol style="list-style-type: none"> 1. Simple lipids – Fats and oils, waxes. 2. Compound lipids – Phospholipid, Glycolipids 3. Derived lipids – Cholesterol <p>D. Enzymes:</p> <ol style="list-style-type: none"> 1. Definition, 2. Structure- Concept of apoenzyme, coenzyme, cofactor 	

	<p>and active site.</p> <p>3. Types- Extracellular, Intracellular, Constitutive and Inducible.</p> <p>4. Features of enzyme - substrate reaction.</p> <p>E. Nucleic Acids :</p> <p>1. DNA – structure and composition (Watson and Crick Model)</p> <p>2. RNA – Types (m-RNA, t-RNA, r-RNA), structure and functions.</p>	
Unit II/ Credit II	Microbial Metabolism	15
	<p>A. Metabolism in bacteria</p> <p>1. Concept of Catabolism and anabolism with examples</p> <p>2. Fundamental principles of energetics-</p> <p>a) Exergonic and endergonic reactions,</p> <p>b) High energy compounds.</p> <p>B. ATP generation by:</p> <p>1. Substrate level phosphorylation.</p> <p>2. Oxidative phosphorylation - Respiration electron transport chain aerobic and anaerobic respiration.</p> <p>3. Bacterial Photophosphorylation – Cyclic and Non- cyclic.</p> <p>4. Catabolism of glucose – EMP, TCA cycle.</p>	

B. Sc. I Microbiology Practical Course

Paper –I & Paper-II	Practical Course I: Introduction to Microbiology and Microbial diversity (CREDITS: 02; TOTAL HOURS: 30)	No. of Hours per Unit/Credit
Unit I/ Credit I	Introduction to Microbial Techniques	15
	<ol style="list-style-type: none"> 1. Microbiology Good Laboratory Practices <ol style="list-style-type: none"> a) preparations of- stains (0.5% basic fuchsin, 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- <ol style="list-style-type: none"> a) Aseptic techniques: <ol style="list-style-type: none"> 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: <ol style="list-style-type: none"> 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) 5. Study of the principle and applications of instruments used in the microbiology laboratory: <ol style="list-style-type: none"> a) biological safety cabinets b) autoclave, incubator c) hot air oven d) colorimeter e) Colony counter and bacteriological filter assembly. 	

Unit II/ Credit II	Use of Media to Study Microbial diversity	15
	<ol style="list-style-type: none"> 1. Preparation of liquid and solid culture media and their sterilization. <ol style="list-style-type: none"> a) Preparation of - agar plates, butts and slants. 2. Simple media: <ol style="list-style-type: none"> a) Peptone water b) nutrient broth c) nutrient agar 3. Selective media: <ol style="list-style-type: none"> a) Sabourauds agar b) Glucose yeast extract agar 4. Differential and selective media: <ol style="list-style-type: none"> a) MacConkey's agar. 5. Sterilization of culture medium using Autoclave and assessment for sterility. 6. Sterilization of glassware using Hot Air Oven and assessment for sterility 	
Paper –III & Paper-IV	Practical Course II: Bacteriology and Microbial biochemistry (CREDITS: 02; TOTAL HOURS: 30)	No. of Hours per Unit/Credit
Unit I/ Credit I	Study of Bacteria	15
	<ol style="list-style-type: none"> 1. Demonstration of presence of microflora in water and air by solid impaction technique on nutrient agar plates and in water by direct cultivation method. 2. Demonstration of presence of microbes from hand nails, Teeth and skin (swabbing) by cultivation methods. 3. Isolation of pure cultures of bacteria by four quadrant streaking method, and studies of Colony characteristics, Gram staining and motility of – <ol style="list-style-type: none"> a) <i>Escherichia coli</i> b) <i>Bacillus species</i> c) <i>Staphylococcus aureus</i> 4. Enumeration of bacteria from water and milk by SPC method 	

Unit II/ Credit II	Microbial Biochemistry	15
	<ol style="list-style-type: none"> 1. Biochemical tests : <ol style="list-style-type: none"> 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 2. Detection of enzyme production ability of bacteria – <ol style="list-style-type: none"> a) Amylase b) Catalase c) Caseinase 3. Detection of sugar fermentation ability of bacteria – <ol style="list-style-type: none"> a) Glucose b) Lactose 4. Study of MBRT test. 	

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Books recommended for Theory

1. Microbiology by Pelczar, M.J.Jr., Chan E.C.S., Krieger, N.R. 5th edition, 1986 (McGraw Hill Publication).
- 2) Fundamental Principles of bacteriology by A. J. Salle, Tata McGraw Hill.
2. Fundamentals of Microbiology by Frobisher, Hindsdill, Crabtree, Good Heart, W.B. Saunders Company, 7th edition.
3. Medical Microbiology Vol. I and II by Cruick Shank R., Duguid J.P., Marmion B.P., Swain R.H.A., XIIth edition, Churchill Livingstone, New York.
4. A textbook of Microbiology by Ananthnarayan – Orient Longman, Bombay
5. General Microbiology by Stanier R. Y. Vth edition, McMillan, London.
6. General Microbiology Vol I and II by Powar and Dagainawala, Himalaya Publications.
7. Medical Bacteriology by Dey and Dey – Allied Agency, Calcutta.
8. Food Microbiology by W. C. Frazier.
9. Basic Experimental Microbiology by Ronal M. Atlas, Alfred E. Brown, Kenneth W. Dobra, Wonas Miller (1986) Prentice Hall.
10. General Microbiology by Robert F. Boyd (1984), Times, Mirror/Mosby College.
11. A Biologics guide to principles, techniques of Practical Biochemistry by K. Wilson and K. H. Goulding, Edward Arnold Publication.
12. Introduction to Practical Biochemistry by D. Plummer, J. Willey and Sons.

13. Microbiology by Prescott, Herley and Klein, IInd edition.
 14. Bacteriological Techniques by F. K. Baker
 15. Introduction to Microbial Techniques by Gunasekaran.
 16. Biochemical methods by Sadasivam & Manickam
 17. Elementary Microbiology Vol. I by Dr. H.A.Modi , Akta Prakashan, Nadiad, Gujrat.
 18. Principles of Biochemistry by Nelson and Cox (Lehninger) – Fifth edition.
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Books recommended 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
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List of minimum equipments

1. Hot air oven – 1
2. Incubator - 1
3. Autoclave - 1
4. Refrigerator – 1
5. Medical microscopes - 10 nos. for one batch
6. Chemical balance - 2
7. pH meter - 1
8. Seitz filter – 1
9. Centrifuge - 1
10. Colorimeter - 1
11. Distilled Water Plant – 1
12. Laminar air flow cabinet - 1
13. Arrangements for gas supply and fitting of two burners per table.
14. One working table of 6' x 2½' for two students.
15. One separate sterilization room attach to the laboratory (10' x 15')
16. At least one wash basin for a group of five students
17. Colony counter
18. Water bath
19. One separate instrument room attached to lab (10' x 15')
20. One laboratory for one batch including working tables (6' x 2½') per two students for one batch
21. Store room (10' x 15')

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 Practical Examination

Q. No	Questions	Marks
Q.1	Special Staining	10
Q.2	Isolation and study of colony characters, gram nature and motility of bacteria / Enumeration of bacteria from water / milk /air by SPC	15
Q.3	Biochemical tests / MBRT test	05
Q4	Detection of enzyme activity	05
Q.5	Spotting	10
Q.6	Journal	05
	Total Marks	50
