

# **SHIVAJI UNIVERSITY, KOLHAPUR.**



Accredited by NAAC with 'A++' Grade

**CHOICE BASED CREDIT SYSTEM**

Syllabus for

**B. Sc. Part – II (MICROBIOLOGY)**

**(Faculty of Science and Technology)**

**Semester-III and IV**

**(To be implemented from June, 2023 as per NEP 2020)**

## **Learning Outcomes:**

A candidate who wish to graduate in B.Sc. (Microbiology Course) needs to have acquired/developed following competencies:

1. Acquired knowledge and understanding of the microbiology concepts as applicable to diverse areas such as medical, industrial, environment, genetics, agriculture, food and others.
2. Demonstrate key practical skills/competencies in working with microbes for study and use in the laboratory as well as outside, including the use of good microbiological practices.
3. Competent enough to use microbiology knowledge and skills to analyze problems involving microbes, articulate these with peers/ team members/ other stake holders, and undertake remedial measures/studies etc.
4. Developed a broader perspective of the discipline of Microbiology to enable him to identify challenging societal problems and plan his professional career to develop innovative solutions for such problems.

## B.Sc. Part II (Microbiology) Level-5

### SEMESTER-III

<b>Paper V</b>	<b>C-9-DSC- 5: Microbial Physiology &amp; Metabolism</b> <b>(CREDITS:02;TOTAL HOURS : 30)</b>	
	<b>Learning Objectives:</b> <ol style="list-style-type: none"> <li>1) To make the students to learn concepts of microbial physiology.</li> <li>2) To develop a good understanding regarding effect of environmental factors on growth of microorganisms</li> <li>3) To understand the mechanism of transport across microbial cell membrane.</li> <li>4) To clear the basic concept of microbial metabolism.</li> </ol>	
<b>Unit I / Credit I</b>	<b>Microbial Physiology &amp; Metabolism</b>	<b>No. of hours per Unit / Credit</b>
	<p>A) Growth : Growth phases, measurement of growth, continuous growth, synchronous growth and diauxic growth</p> <p>B) Effect of environmental factors on microbial growth :</p> <ol style="list-style-type: none"> <li>i. Temperature : Mesophiles, psychrophiles, thermophiles and hyperthermophiles. Thermal destruction of bacteria – D, F and Z values, TDP and TDT</li> <li>ii. pH: Neutrophiles, Acidophiles and Alkalophiles</li> <li>iii. Osmotic pressure -Isotonic, hypotonic and hypertonic environments, xerophiles and halophiles.</li> <li>iv. Heavy metals</li> <li>v. Radiations- U.V. rays</li> </ol> <p>C) Transport across cell membrane - Diffusion, active transport and group translocation</p>	<b>15</b>
<b>Unit II / Credit II</b>	<b>Microbial Metabolism</b>	<b>15</b>
	<p>A) Catabolism of glucose - EMP, HMP, ED and TCA cycle</p> <p>B) Fermentation - Homolactic &amp; Heterolactic fermentation</p> <p>C) Bacterial electron transport chain – Components, flow of electrons &amp; mechanism of ATP generation - Chemiosmotic hypothesis</p>	
<b>Paper VI</b>	<b>C9-DSC- 6 : Applied Microbiology (CREDITS:02; TOTAL HOURS : 30)</b>	
	<b>Learning Objectives:</b> <ol style="list-style-type: none"> <li>1) To develop the knowledge regarding air microflora and its role and analysis.</li> </ol>	
		<b>No. of Hours per Unit / Credit</b>

	<ul style="list-style-type: none"> <li>2) To study water microbiology, water analysis and its purification and disinfection.</li> <li>3) To study milk microbiology and quality control of milk.</li> <li>4) To learn the basic understanding of industrial microbiology.</li> </ul>	
<b>Unit I / Credit I</b>	<b>Applied Microbiology</b>	15
	<p><b>A) Air Microbiology:</b></p> <ul style="list-style-type: none"> <li>a) Sources of microorganisms in air.</li> <li>b) Definitions of - Infectious dust, Droplets &amp; Droplet nuclei</li> <li>c) Sampling methods for microbial examination of air <ul style="list-style-type: none"> <li>i) Solid impaction - Sieve device</li> <li>ii) Liquid Impingement – Bead-bubbler device</li> </ul> </li> </ul> <p><b>B) Water Microbiology:</b></p> <ul style="list-style-type: none"> <li>a) Sources of microorganisms in water.</li> <li>b) Fecal pollution of water, Indicators of fecal pollution of water- <i>E. coli</i></li> <li>c) Routine Bacteriological analysis of water. <ul style="list-style-type: none"> <li>1) SPC &amp; 2) Tests for coliforms - <ul style="list-style-type: none"> <li>i. Qualitative-Detection of coliforms - Presumptive test, Confirmed Test, Completed test.Differentiation between coliforms - IMViC test, Eijkman test.</li> <li>ii. Quantitative – MPN, Membrane filter technique</li> </ul> </li> </ul> </li> <li>d) Municipal water purification process and its significance.</li> </ul> <p><b>C) Dairy Microbiology:</b></p> <ul style="list-style-type: none"> <li>a) Sources of microorganisms in milk</li> <li>b) General composition of Milk.</li> <li>c) Microbiological examination of Milk – DMC, SPC and dyereduction test- MBRT test</li> <li>d) Pasteurization - Definition, Methods – LTH , HTST ,UHT, Efficiency of Pasteurization– Phosphatase test (Qualitative) Water Microbiology</li> </ul>	

<b>Unit II/ Credit II</b>	<b>Industrial Microbiology</b>	15
	<p>A) Basic concepts of fermentation.</p> <ol style="list-style-type: none"> <li>1. Definition, concept of primary and secondary metabolites</li> <li>2. Types of fermentations – Batch, continuous, dual and multiple</li> <li>3. Typical Fermentor design – Parts and their functions.</li> <li>4. Factors affecting fermentation process</li> </ol> <p>B) Screening - Primary and secondary screening</p> <p>C) Fermentation Media - Water, carbon source, nitrogen source, precursors, growth factors , antifoam agents &amp; chelating agents.</p>	

## SEMESTER-IV

<b>Paper VII</b>	<p><b>C-5-:DSC- 7 : Microbial Genetics &amp; Molecular Biology(CREDITS:02; TOTAL HOURS : 30)</b></p> <p><b>Learning Objectives:</b></p> <ol style="list-style-type: none"> <li>1) To learn the basic concepts of Microbial genetics.</li> <li>2) To gain knowledge regarding types of mutation.</li> <li>3) To demonstrate the model of gene transfer in bacteria.</li> <li>4) To gain the knowledge about DNA repair and Lac operon.</li> </ol>	<b>No. of Hours per Unit / Credit</b>
<b>Unit I / Credit I</b>	<b>Microbial Genetics</b>	15
	<p><b>A) Basic concepts -</b></p> <ol style="list-style-type: none"> <li>a) Forms of DNA</li> <li>b) Gene, genome, genotype, phenotype, mutagen, recon, muton , cistron</li> <li>c) Split genes.</li> <li>d) Genetic code – definition and properties of genetic code.</li> </ol> <p><b>B) DNA damage by Mutations –</b></p> <ol style="list-style-type: none"> <li>a) Basic Concepts of Mutation: Base pair substitutions, Frame shift , Missense , nonsense, neutral, silent , pleiotropic and suppressor mutations.</li> <li>b) Spontaneous mutation – Definition and basic concept.</li> <li>c) Induced mutations – Definition , Mechanism of mutagenesis by-               <ol style="list-style-type: none"> <li>i. Base analogues : 5-Bromouracil and 2- aminopurines</li> <li>ii. Mutagens modifying nitrogen bases-                   <ol style="list-style-type: none"> <li>a. Nitrous acid</li> <li>b. Hydroxylamine</li> <li>c. Alkylating agents</li> </ol> </li> <li>iii. Mutagens that distort DNA -                   <ol style="list-style-type: none"> <li>a. Acridine dyes</li> <li>b. UV light</li> </ol> </li> </ol> </li> </ol>	
<b>Unit II / Credit II</b>	<b>Molecular Biology</b>	15
	<p><b>A) Gene transfer in bacteria.</b></p> <ol style="list-style-type: none"> <li>a. Fate of exogenote in recipient cell.</li> <li>b. Modes of gene transfer - Transformation, Conjugation, Transduction</li> </ol> <p><b>B) Plasmids –</b></p> <ol style="list-style-type: none"> <li>a. Natural – Properties, types , structure and applications</li> <li>b. Artificial – pBR 322- structure and applications</li> </ol> <p><b>C) DNA repair :</b></p> <ol style="list-style-type: none"> <li>i) Photoreactivation</li> <li>ii) Dark repair mechanism (Excision repair )</li> </ol> <p><b>D) Lac operon – structure and working</b></p>	

<b>Paper VIII</b>	<b>C5: DSC- 8 : Basics in Medical Microbiology &amp; Immunology(CREDITS:02; TOTAL HOURS : 30)</b>  <b>Learning Objectives:</b> <ol style="list-style-type: none"> <li>1) To learn about basic concept of medical microbiology.</li> <li>2) To make aware students about disease.</li> <li>3) To understand the defense mechanism of vertebrate body.</li> <li>4) To learn about concept of antigen and antibody.</li> </ol>	<b>No. of Hours per Unit / Credit</b>
<b>Unit I / Credit I</b>	<b>Medical Microbiology</b>	<b>15</b>
	<ol style="list-style-type: none"> <li>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.</li> <li>b) Virulence factors (production of endotoxins, exotoxins, enzymes, escaping of phagocytosis)</li> <li>c) Types of diseases – i) Epidemic, ii) Endemic, iii) Pandemic, iv) Sporadic.</li> <li>d) Types of infections – Chronic, acute, primary, secondary, reinfection, Iatrogenic, congenital, local, generalized, Covert, Overt, Simple, Mixed, Endogenous, Exogenous, Latent, Pyogenic, Nosocomial.</li> <li>e) Modes of transmission of diseases <ol style="list-style-type: none"> <li>1. Transmission by air, water &amp; food</li> <li>2. Contact transmission</li> <li>3. Vector borne transmission</li> </ol> </li> <li>f) General principles of prevention and control of microbial diseases. Normal flora of human body &amp; its significance</li> </ol>	

<b>Unit II/ Credit II</b>	<b>Immunology</b>	15
	<p>1. Immunity    i) Definition                    ii) Innate Immunity- types, factors influencing innate immunity                    iii) Acquired Immunity – Active &amp; passive</p> <p>2. Non Specific defense mechanisms of the vertebrate body            i) First line of defense            ii) Second line of defense</p> <p>3. Antigen : Chemical nature, types of antigens, factors affecting antigenicity.</p> <p>4. Antibody : Types of antibodies – Structure, properties and functions.</p> <p>5. Theories of antibody production.</p> <p>6. Immune Response : Primary and secondary immune responses.</p> <p>7. Mechanism of antigen – antibody reaction- Lattice hypothesis</p> <p>8. Types of antigen-antibody reaction- Precipitation and Agglutination</p>	



## PRACTICAL COURSE

<b>Paper V &amp; VI (DSC 5+6)</b>	<b>Practical Course III (DSC-5+6) (CREDITS:04; TOTAL HOURS : 60)</b>  <b>Learning objectives:</b> <ol style="list-style-type: none"> <li>1) To understand basic techniques n special staining.</li> <li>2) To study the biochemical characteristics of different microorganisms.</li> <li>3) To study the effect of environmental factors of microorganisms</li> </ol>	<b>No. of Hours per Unit / Credit</b>
<b>Unit I / Credit I</b>	<b>Stains and staining procedures :</b> <ol style="list-style-type: none"> <li>i) Spore staining (Dorner's method)</li> <li>ii) Flagella staining (Bailey's method)</li> <li>iii) Nucleus staining (Giemsa's method) using yeast cells.</li> </ol>	<b>15</b>
<b>Unit II / Credit II</b>	<b>Preparation of media :</b> Gelatin agar, Amino acid decarboxylation medium, Amino acid deamination medium, Arginine broth, Christensen's medium, Peptone nitrate broth, Hugh and Leifson's medium and Wilson-Blair's medium.	<b>15</b>
<b>Unit III / Credit III</b>	<b>Biochemical tests :</b> <ol style="list-style-type: none"> <li>i) Gelatin hydrolysis test.</li> <li>ii) Amino acid decarboxylation test</li> <li>iii) Amino acid deamination test</li> <li>iv) Urea hydrolysis test</li> <li>v) Nitrate reduction test</li> <li>vi) Hugh and Leifson's test</li> </ol>	<b>15</b>
<b>Unit IV / Credit IV</b>	<b>Effect of environmental factor on microorganisms :</b> <ol style="list-style-type: none"> <li>i) Temperature</li> <li>ii) pH</li> <li>iii) Heavy metals – Copper</li> <li>iv) Antibiotic – Penicillin</li> <li>v) Salt – NaCl</li> </ol>	<b>15</b>
<b>Paper VII &amp; VIII (DSC-7+8)</b>	<b>Practical Course IV(DSC-7+8) ( CREDITS:04; TOTAL HOURS : 60 )</b>  <b>Learning objectives:</b> <ol style="list-style-type: none"> <li>1) To study the techniques of bacteriology analysis of water.</li> <li>2) To understand the primary screening techniques of industrially important microorganisms.</li> <li>3) To study isolation and identification of pathogens.</li> </ol>	<b>No. of Hours per Unit / Credit</b>
<b>Unit I / Credit I</b>	<ol style="list-style-type: none"> <li>1. Bacteriological analysis of water               <ol style="list-style-type: none"> <li>a. Qualitative tests – Presumptive , confirm and completed test</li> <li>b. Quantitative - MPN</li> </ol> </li> <li>2. Bacteriological analysis of milk-                Qualitative tests: MBRT and Phosphatase test             </li> </ol>	<b>15</b>

<b>Unit II / Credit II</b>	1. Primary Screening of - i. Antibiotic procedures – crowded plate technique ii. Amylase procedures 2. Determination of growth phases of <i>E. coli</i> by Optical density	<b>15</b>
<b>Unit III/ Credit III</b>	1. Isolation of lac negative mutants of <i>E.coli</i> by visual detection method 2. Effect of U.V. light on growth of bacteria	<b>15</b>
<b>Unit IV/ Credit IV</b>	1. Isolation and identification of pathogenic microorganisms from clinical sample. (a) <i>Salmonella species</i> (b) <i>Proteus species</i> 2. Determination of Blood groups – ABO and Rh. 3. Serological tests - Widal test – qualitative slide test	<b>15</b>

## THEORY EXAMINATION

Nature of Question paper		40 Marks
Q. 1 Multiple choice questions (8- Questions)	----	8 marks
Q. 2 Attempt <b>any two</b> of the following. (Essay type/Broad answer questions)	----	16 marks
Q. 3 Write short notes ( <b>any four</b> )	----	16 marks

## PRACTICAL EXAMINATION

- (A) The practical examination will be conducted on two consecutive days for six 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.
- (C) Candidates have to visit at least one place of microbiological interest (pharmaceutical / industry/dairy/research institute etc.) and submit the report of their visit

### Nature of the Practical Examination Question Paper and Distribution Marks

	Marks
Q.1 Determination of lag phase / staining	15
Q.2 Isolation and identification of pathogen from clinical sample	20
Q.3 Serology / blood groups	05
Q.4 Primary screening technique / isolation of lac negative mutant	10
Q.5 Biochemical tests/MBRT/Phosphatase test	10
Q.6 Effect of environmental factors	10
Q.7 Spot tests (on culture media)	10
Q.9 Journal	10
Q.10 Tour report	10

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Total marks – 100

### **Books Recommended for Theory Papers**

1. Foundation in Microbiology – by Kathleen Park talaro, Arther Talaro.
2. Introduction to Microbiology – John I. Ingraham, Catherine A. Ingraham A. Ingraham A. Ingraham, Ronald M; Second edition.
3. Zinsser's Microbiology – by Wolfagang K. Joklik, (1995) Mc Graw-Hill Co.
4. Microbial Genetics – by Stanley R. Maloy, David Freifelder and John E. Cronan.
5. Molecular Genetics of Bacteria – by Larry Snyder, Wendy Champness.
6. Microbiology – Pelczar, Reid and Chan
7. Fundamentals of Microbiology – Frobisher et al.
8. Fundamental principles of Bacteriology – A. G. Salle.
9. Industrial microbiology – Prescott and Dunn
10. Industrial microbiology – Casida, E.
11. Industrial microbiology – Miller and Litsky
12. General Microbiology – R. Y. Stainer
13. Chemical Microbiology – A. H. Rose.
14. General Microbiology – Vol. I and Vol. II – Pawar and Diganawala
15. Text book of Microbiology – Ananthnarayan
16. Biochemistry – Lehninger.
17. Outlines of Biochemistry – Cohn and Stumph
18. A Text book of Microbiology – R. Dubey, D. K. Maneshwari, S. Chand Co. Ltd. Ramnagar New Delhi 110055

### **Books recommended for Practicals**

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.
9. Medical Lab Technology – Mukharji Vol. II
10. Medical Lab Technology – Godkar
11. Medical Microbiology – Cruickshank et al. Vol. II.

### **List of the minimum equipments for B.Sc. II Microbiology Course**

All the equipments required for B.Sc. Part I Microbiology course