

**Punyashlok Ahilyadevi Holkar Solapur University, Solapur**



**Name of the Faculty: Science & Technology**

(As per New Education Policy 2020)

**Syllabus: MICROBIOLOGY**

**Name of the Course: B.Sc. I (Sem.-I & II)**

**(Syllabus to be implemented from June 2024)**

**Preamble:**

The Curriculum development plays a very vital role in the development of quality of education. The education system should be such that students will be able to compete locally, regionally, nationally as well as globally. The present situation demands developing “learner-centric approach while redesigning of curriculum. There is also need to allow the flexibility in education system. The choice based credit system (CBCS) allows students to choose inter-disciplinary, intra-disciplinary courses, skill oriented papers and thus offers more flexibility for student. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. In view of this, PAH Solapur University, Solapur has implemented Choice Based Credit System of Evaluation at Undergraduate level. While designing the syllabus of microbiology for undergraduate course for semester I and II an attempt has been made to follow the pattern given in the UGCs Undergraduate Template. This will help to bring a match across all the Indian universities.

**Introduction:**

Microbiology deals with the study of microorganisms. This branch of life science has immensely grown up widening its horizons and opening new frontiers of knowledge. The scope of microbiology as a subject is immense due to its ability to control all critical points of many fields like medical, dairy, pharmaceutical, industrial, clinical, research, water industry, agriculture, nanotechnology, etc. A career in microbiology is lucrative option. There is demand of trained microbiologists in a various sectors of industries and institutes like research and development laboratories of government and private hospitals, research organizations, pharmaceutical, food, beverage and chemical industries. To cater the needs, discipline specific papers on industrial, agricultural, environmental, medical microbiology, microbial biochemistry, virology and immunology have been included in the curriculum for semester V and VI. At the same time, the frame work is so designed as to maintain standards of microbiology degree and the learning outcomes.

**Learning Outcomes based approach to Curriculum Planning:**

The Learning Outcomes-based Curriculum Framework (LOCF) for the B.Sc. (Honours) degree in Microbiology is designed to suit the need of the hour, in keeping with the emergence of new areas of microbiology. The framework is architected to allow for flexibility in programme design and course content development, while at the same time maintaining a basic uniformity in structure in comparison with other universities across the country. The programme is designed to build a strong microbiology knowledge base in the student and furthermore, acquaints the students with the applied aspects of this fascinating discipline as well. The student is thus equipped to pursue higher studies in an institution of her/his choice, and to apply the skills learnt in the programme to solving practical societal problems. The programme offers an elective course to the student for skill enhancement courses that prepares the student for an eventual job in academia or industry.

### **Programme Outcomes (POs):**

PO 1. Students will have a firm foundation in the fundamentals and applications of microbial and scientific theories in microbiology.

PO 2. Students will be able to design and carry out scientific experiments as well as accurately record and analyze the data of such experiments.

PO 3. Students will develop skill in problem solving, critical thinking and analytical reasoning as applied to scientific problems.

PO 4. Students will be able to explore new areas of research in both microbiology and allied fields of science and technology.

PO 5. Students will appreciate the central role of microbiology in our society and use this as a basis for ethical behavior in issues facing microbiologist. understands the importance of safe handling of biochemical, environmental issues and key issues facing our society in energy, health and medicine.

PO 6. Students will be able to function as a member of an interdisciplinary problem-solving team.

### **Programme Specific Outcomes (PSOs):**

PSO1: Apply the basic knowledge of microbiology to perform various tasks assigned at the workplace.

PSO2: Undertake research activities and use modern scientific tools to analyze various topics in the research area.

PSO3: Exhibit professional work ethics and norms of scientific development.

PSO4: Understand and contribute to solve basic societal issues based on principles of scientific knowledge he/she has gained.

PSO5: Practice the art of analytical reasoning to become lifelong learner.

# **Punyashlok Ahilyadevi Holkar Solapur University, Solapur**

## **SYLLABUS FOR B. Sc. – I (MICROBIOLOGY)**

### **CHOICE BASED CREDIT SYSTEM (CBCS) SYLLABUS**

#### **Structure of the Course:**

- Structure of B.Sc. course in faculty of science and Technology has total of 08 semesters for 4 years.
- B.Sc.-I comprises of total two semesters. Each semester will have **One** theory papers of **30** marks for university examination and **20** marks for internal examination for each paper.
- **Practical examination will be conducted at the end of even semester of each academic year. The weightage of practical is of 60 marks for university practical examination and 40 marks for internal practical examination.**
- The titles and marks distribution for each paper are as under.

Level/ Difficulty	Sem.	Faculty			Generic/ Open Elective GE/ OE (Credits)	Vocational and Skill Enhancement Courses (SEC/VSC)	Ability Enhancement Course (AEC), IKS, VEC	Field Project/ RP/CC/Internship/App renticeship/ Community Engagement & Services	Credits	Cumulative Credits
		Major		Minor						
		DSC (Credits)	DSE							
4.5 100-200	I	DSC1-1 (2) Basics in Microbiology (Theory) DSC 1 -1 (2) Basics in Microbiology (Practical)	----	-----	-----	SEC1 Human health and Hygiene (2)	L1-1 (2) IKS (2) – General IKS VEC1 (2) (Environmental Science)	CC1 (2)	22	44
	II	DSC1-2 (2) Applied Microbiology (Theory) DSC1-2 (2) Applied Microbiology (Practical)	----	----	GE1/ OE2(2) Laboratory Techniques in Clinical Microbiology	SEC 2 Basic techniques in Microbiology (2)	L1-2 (2) VEC2 (2) (Constitution of India)	CC2 (2)	22	

Semester	Paper No.	Title of Paper	Total Lectures	Examination			Total Credits
				Univ. Exam	Internal Exam	Total Marks	
Semester I	DSC1-1	Basics in Microbiology (Theory)	30	30	20	50	02
	DSC 1-1	Basics in Microbiology (Practical)	04 hr /Week /batch	30	20	50	02
	SEC 1	Human health and Hygiene	30	30	20	50	02
	IKS	Ancient Indian Microbiology	30	30	20	50	02
Semester II	DSC1-2	Applied Microbiology (Theory)	30	30	20	50	02
	DSC 1-2	Applied Microbiology (Practical)	04 hr /Week /batch	30	20	50	02
	OE 2	Laboratory Techniques in Clinical Microbiology	30	30	20	50	02
	SEC 2	Basic techniques in Microbiology	30	30	20	50	02

Microbiology Practical papers is of 60 marks for university practical examination. Duration of examination will be of **two day (three Hours each day)**. Nature of practical question paper will be as follows,

#### Practical Paper Microbiology-I

- Q. 1. Staining Techniques : 10 marks  
 Q. 2. Mounting of Fungus / Media Components / Parts of Microscope : 10 marks  
 Q. 3. Certified Journal : 05 Marks  
 Q. 4. Oral : 05 Marks

**Total Marks: 30 marks**

#### Practical Paper Microbiology-II

- Q. 1. Isolation of Microorganisms / Study of bacterial motility by Hanging drop technique : 10 marks  
 Q. 2. Biochemical tests : 10 marks  
 Q. 3. Certified Journal : 05 Marks  
 Q. 4. Oral : 05 Marks

**Total Marks: 30 marks**

- **Continuous Internal Assessment :**

- 1) Each theory paper has 20 marks for internal examination.
- 2) Each Practical paper has 20 marks for internal examination.

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## SEMESTER-I PAPER –DSC1-1: Basics in Microbiology

### Learning Objectives:

- 1) Students will know the historical contributions of scientists for the development of subject
- 2) To create awareness in learners about the scope of the subject in modern era.

### Course Outcome:

- 1) Students will know the evolution of the microbiology subject.
- 2) Students will understand the applied branches of microbiology and scope of microbiology.
- 3) Students will be able to understand diversity amongst microorganisms.
- 4) Understand beneficial and harmful effects of microorganisms in different fields of Microbiology

<b>DSC 1-1 Basics in Microbiology (Total credits 2+2)</b>		
<b>THEORY COURSE (02credits)</b>		<b>Total Lectures 30L Total Marks 30+20</b>
<b>Unit No.</b>	<b>Content of Unit</b>	<b>Lectures Allotted</b>
<b>I</b>	<p><b>History, Scope and Branches of Microbiology</b></p> <p><b>A. Historical Background:</b></p> <p>a) Contribution of Robert Hooke, Antony Van Leuwenhoek, Ernst Ruska</p> <p>b) Theory of spontaneous generation: Francisco Redii, John Needham, Friedrich Schroder and Van Dusch, Louis Pasteur (Swan neck flask experiment) and John Tyndall.</p> <p>c) Golden era of Microbiology (1857-1914) - i) Germ theory of fermentation ii) Germ theory of disease</p> <p>d) Contribution of Martinus Beijerinck, Sergei Winogradsky, Joseph Lister and Dmitri Ivanovski, Edward Jenner, Eli Metchnikoff, Salman Waksman, Alexander Fleming. In development of applied microbiology.</p> <p><b>B. a) Branches of Microbiology:</b> (Water, Air, Agriculture, Food and Dairy, Environmental, Medical, Industrial, Geomicrobiology, Space Microbiology)</p> <p><b>b) National Institutes related to Microbiology in India</b>–NIV, NARI, NCCS, CCMB, Serum Institute of India, Vasantdada Sugar Institute, National Research center on Pomegranate (NRCP). IMTECH (Institute of Microbial Technology, Chandigarh), Agharkar Research Institute, Pune, NIN Hydrabad.</p>	<b>15</b>

<b>II</b>	<p><b>Microbial Diversity</b></p> <p><b>A) Concept of prokaryotic and eukaryotic cell</b></p> <p><b>B) General Characteristics of Microorganisms</b></p> <p>i) Bacteria (Size, Shape and Arrangement) ii) <i>Mycoplasma</i> iii) <i>Rickettsia</i> iv) Actinomycetes v) Algae vi) Fungi vii) Viruses</p> <p><b>C) Structure and Functions of Bacterial Cell :</b></p> <p>i) Cell wall - Gram-positive and Gram-negative bacteria, sphaeroplast and protoplast</p> <p>ii) Composition and functions of Cell membrane, Mesosome, Capsule ,slime layer, Flagella and Pili</p> <p>iii) Cytoplasm-Ribosome and nucleoid</p> <p><b>D) Bacterial Taxonomy -</b> a) Basic principles of Nomenclature b) Criteria for bacterial classification and identification– Morphological, Cultural and Biochemical Characteristics.</p>	<b>15 L</b>
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## SEMESTER I

### DSC 1-1 Basics in Microbiology (Practical)

Total Credits: 2

Contact hrs: 4 hrs per week

Total Marks 30+20

1. Good microbiology laboratory practices and Biosafety
2. Principle, working and applications of Common laboratory instruments -
  - a) Autoclave
  - b) Hot Air Oven
3. Principle, working and applications of Common laboratory instruments -
  - a) Incubator
  - b) Colony Counter
4. Principle, working and applications of Common laboratory instruments -
  - a) PH Meter
  - b) Laminar Air flow
  - c) Water Bath
5. Handling and Care of compound Microscope
6. Monochrome staining
7. Negative staining
8. Gram staining
9. Special Staining Procedures - Cell Wall (Chance's Method)
10. Special staining Procedures - Capsule (Maneval's Method)
11. Preparation of Saline and culture media a) Peptone Water b) Nutrient Broth c) Nutrient agar d) MacConkey's agar e) Starch Agar f) Milk agar g) Sabouraud's agar
12. Study of inoculation techniques – Broth, Slant, Stab, Spot.
13. Study of inoculation techniques –Spread and Streak.
14. Study of inoculation techniques –Pour plate.
15. Study of morphology of fungi by Mounting method –
  - (a) *Aspergillus* (b) *Rhizopus* (c) *Penicillium* (d) *Mucor*

**SEC 1: Human Health and Hygiene (Total Credits 2)**

**Learning Objectives:**

- 1) To know the concept of microbiology in health care management.
- 2) To identify and determine the geographical pattern of a particular disease.

**Course Outcome:** After completion of the course, students will learn about

- 1) How to diagnose the health of a community
- 2) Application of good hygienic practices
- 3) The prophylactic measures for the prevention of diseases.

<b>OE – 1 Human health and Hygiene (Total Credits - 02)</b>		
<b>THEORY COURSE (02credits)</b>		<b>Total Lectures 30L Total Marks</b>
<b>30+20</b>		
<b>Unit No.</b>	<b>Content of Unit</b>	<b>Lectures Allotted</b>
<b>I</b>	<p><b>Unit I</b> <b>Concept of Health and health care agencies</b></p> <p><b>a. Concept of Health</b> Health – determinants of health, key health indicators Personal health, environmental health and public health Health Education – principles and strategies, Aims of Health Education, Methods of Health education, Effects of health education, levels and practices of Health Education</p> <p><b>b. Healthcare agencies</b> – 1. Health policies and health organizations 2. National health Mission 3. Disaster Management – a. Containment b. Control and prevention of epidemics and pandemics c. Acts, guidelines and role of govt. and public.</p>	<b>15 L</b>
<b>II</b>	<p><b>Unit II: Concept of Hygiene and preventive measures</b></p> <p><b>a. Hygiene and Microorganisms</b></p> <ol style="list-style-type: none"> <li>1. Hygiene Indicator Microorganisms</li> <li>2. Good Hygiene Practices – Reducing the spread of Infections and Viruses</li> <li>3. Normal flora of Human body and its role in Human health,</li> <li>4. Community and personal Hygiene – Environmental Sanitation and Sanitation in public Places</li> </ol> <p><b>b. Preventive and control measures for measures</b></p> <ol style="list-style-type: none"> <li>1). Water and food borne diseases.</li> <li>2) Air borne diseases.</li> <li>3) Vector borne diseases</li> <li>4) Diseases transmitted through physical contact</li> </ol>	<b>15 L</b>

**General IKS (2- Credit)**

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**SEMESTER-II**

**PAPER-DSC1-2: Applied Microbiology (Total Credits 2+2)**

**Learning Objectives:**

1. Understand the microbial content of air, water, soil and milk.
2. Study the health effects associated with air, water, soil borne microorganisms.
3. Understand the fundamental of microbiology and their importance in environmental process.
4. Study the methods and techniques used for milk, soil, air and water microbial monitoring and assessment.

**Course Outcome:** After completion of the course, students will be able to

1. Assess the types and role of microorganisms present in milk, air and water and sewage.
2. Analyse microbiological quality of milk, air and water.
3. Practice hygiene at individual and community level.
4. Evaluate food and milk safety and incorporate in daily life

<b>DSC1-2 Applied Microbiology (Total Credits 2+2)</b>		
<b>THEORY COURSE (02 credits)</b>		<b>Total Lectures 30L Total Marks 30+20</b>
<b>Unit No.</b>	<b>Content of Unit</b>	<b>Lectures Allotted</b>
<b>I</b>	<p><b>Air, Water and sewage Microbiology</b></p> <p><b>A. Air Microbiology</b></p> <ol style="list-style-type: none"> <li>a) Composition of air. Sources of microorganisms in air</li> <li>b) Definitions of Droplet, droplet nuclei, aerosols, Smog</li> <li>c) microbial examination of air - Liquid impingement and Solid impaction</li> </ol> <p><b>B. Water Microbiology:</b></p> <ol style="list-style-type: none"> <li>a) Sources of Microorganisms in water</li> <li>b) fecal pollution of water and its indicator</li> <li>c) routine bacteriological analysis of water for detection and differentiation of coliforms–               <ol style="list-style-type: none"> <li>i) Qualitative (presumptive, confirmed and completed) and IMViC and Eijkman test</li> <li>ii) Quantitative Test –MPN</li> </ol> </li> <li>d) Municipal water purification process: Sedimentation, Filtration and Disinfection</li> </ol> <p><b>C. Sewage Microbiology :</b></p> <ol style="list-style-type: none"> <li>a) Definition, Types and Microflora of sewage</li> </ol>	<b>15 L</b>

<b>II</b>	<p><b>Milk and Medical Microbiology</b></p> <p><b>A) Milk microbiology</b></p> <ul style="list-style-type: none"> <li>a) Definition and Composition of Milk</li> <li>b) Sources of contamination of milk</li> <li>c) Microbiological examination of Milk: -DMC, SPC , MBRT test</li> <li>d) Pasteurization –Definition and types of pasteurization, Phosphatase test.</li> </ul> <p><b>B) Medical Microbiology</b></p> <ul style="list-style-type: none"> <li>a. Definitions:-Infection, etiology, etiological agents, disease, pathogen, opportunistic pathogen, pathogenicity, incubation period, fomite, virulence, morbidity rate, mortality rate, carriers, host, epidemiology, prophylaxis.</li> <li>b. Types of diseases:-Epidemic, endemic, pandemic &amp; sporadic Types of infections: Primary, Secondary, acute, chronic, re-infection, cross-infection, Mixed infection, congenital, local, systemic and generalized Mode of transmission of diseases: 1) Inoculation 2) Ingestion 3) Contact 4) Inhalation</li> <li>c. Preventive and control of Microbial Diseases</li> </ul>	<b>15 L</b>
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## SEMESTER II

### DSC 1-2 Applied Microbiology (Practical)

Total Credits: 2

Contact hrs: 4 hrs per week

Total Marks 30+20

- 1) Determination of Quality of Milk by MBRT
- 2) Study of colony characteristics of bacterial isolates.
- 3) Study of bacterial motility by Hanging drop technique
- 4) Isolation and identification of *E.coli* from sewage/ water sample by four quadrant method using MacConkeys Agar.
- 5) Isolation and identification of *E.coli* from food sample by four quadrant method using MacConkeys Agar.
- 6) Isolation and identification of *Bacillus spp* from soil by four quadrant method using Nutrient Agar.
- 7) Enumeration of bacteria in Milk sample by DMC .
- 8) Determination of Total viable count of bacteria in Milk sample SPC
- 9) Study of coliforms by IMViC test.
- 10) Study of sugar fermentation - Glucose, Lactose.
- 11) Detection of Amylase activity
- 12) Detection of Caseinase activity
- 13) Isolation of *S.aureus* from skin on milk agar or by Mannitol Salt Agar
- 14) Study of Air Microflora
- 15) Study of efficiency of pasteurization by phosphatase test

## OE – 1: Laboratory Techniques in Clinical Microbiology (Total Credits 2)

### Learning Objectives:

1. Understand the importance of Medical Laboratory techniques.
2. Understand the principle, procedure and applications of the various laboratory techniques.

**Course Outcome:** After completion of the course, students will learn about the procedures and applications of the medical laboratory techniques in disease diagnosis.

OE – 1: Laboratory Techniques in Clinical Microbiology (Total Credits - 02)		
THEORY COURSE (02 credits)		Total Lectures 30L Total Marks 30+20
Unit No.	Content of Unit	Lectures Allotted
I	<b>Collection of Clinical samples</b> <b>A. Types of Clinical Samples</b> – Blood, Urine, Stool, Pus, CSF, sputum, Biopsy. a. Identification and transportation of specimen b. Processing of Specimen <b>B. Microbiological investigations</b> – a. Microscopic Observation b. Cultivation and Identification\ c. Cultural and Sensitivity test	15 L
II	<b>Diagnostic techniques:</b> <b>A. Laboratory Diagnosis</b> a. Hematology – Hb, CBC, ESR, PS Examination b. Biochemistry – BSL, Bilirubin, Urea, Creatinine, c. Serology – Blood Grouping, Widal test, VDRL, CRP, Pregnancy Test, ELISA, RTPCR <b>B. Urine and Stool Analysis-</b> Physical, Chemical and Microbiological Analysis of Urine.	15 L

## SEC2: Basic techniques in Microbiology (Total Credits 2)

### Learning Objectives:

1. To know the principle, working and applications of Basic techniques in microbiology
2. To create awareness in learners about the use of these techniques in modern era.

### Course Outcome:

1. Students will acquire the skills of handling different microscope, staining techniques, sterilization and cultivation.
2. Students will know how to cultivate microorganisms.

<b>SEC 2 Basic techniques in Microbiology (Total Credits 2)</b>		
<b>THEORY COURSE (02credits)</b>		
		<b>Total Lectures 30L</b>
		<b>Total Marks 30+20</b>
<b>Unit No.</b>	<b>Content of Unit</b>	<b>Lectures Allotted</b>
<b>I</b>	<p><b>Microscopic and Staining techniques</b></p> <p><b>A) Microscopy</b></p> <p>i) Basic concept and types of Microscopes : Simple, Compound, Electron, Bright field, Dark field, phase contrast, Fluorescent Microscope</p> <p>ii) Magnification, numerical aperture and resolving power.</p> <p>iii) Parts and functions of compound microscope with ray diagram.</p> <p>iv) Introduction, types, working, principle and applications of Electron microscope</p> <p><b>B) Staining techniques –</b></p> <p>i) Definition, types of stains, mechanism of staining</p> <p>ii) Different methods of staining: Simple- monochrome and negative, Differential- Gram and Acid Fast staining</p> <p>iii) Special staining- Cell wall staining (Chance's method) and capsule staining (Maneval's method)</p>	<b>15 L</b>
<b>II</b>	<p><b>Sterilization of Media and Microbial Cultivation:</b></p> <p><b>A) Sterilization</b></p> <p>i) Definitions of-sterilization, disinfection, antiseptic, germicide, microbiostasis, Microbicidal, and sanitization</p> <p>ii) Sterilization by Physical agents-Temperature (dry heat and moist heat), and Membrane Filtration.</p> <p>iii) Sterilization by chemical agents</p> <p>Phenol and phenolic compounds, Ethyl alcohol, Halogens- chlorine and iodine and Gaseous agents- Ethylene oxide, <math>\beta</math>-propiolactone, formaldehyde.</p> <p><b>B) Microbial Cultivation</b></p> <p><b>1) Culture Media:</b></p> <p>i) Common components of culture media</p> <p>ii) Definitions with example- Living media and Non-living media- (Natural, Synthetic, Semi synthetic, Differential, Enriched, Enrichment, Selective).</p> <p>3) Cultivation of anaerobic bacteria / Microorganisms</p> <p><b>2) Methods of Pure culture:</b></p> <p>i) Serial dilution</p> <p>ii) Streak Plate, Spread Plate and Pour Plate technique.</p>	<b>15 L</b>

## References:

1. Outline of Biochemistry – Cohn and Stump
2. Biochemistry – Lehninger
3. Enzymes – Dixon and Web
4. Text book of Medical Microbiology – Ananthnarayan
5. Review of Medical Microbiology – Jawetz et al
6. Microbiology – Zinsser
7. Medical Microbiology – Cruickshank
8. Medical Microbiology - Davis and Dulbecco
9. Medical Bacteriology – Dey and Dey
10. Biology of Microorganisms – Brock, Parker, Madigen, 9th edition
11. Microbiology – Prescott and Harley, 5th edition
12. General microbiology – Stanier
13. General microbiology – Pawar and Dagainawala Vol I and II
14. Advances in Biotechnology – S.W. Jogdand.
15. Textbook of Biotechnology – R.C. Dubey,
16. Biotechnology – B.D. Singh
17. Fundamentals of Bacteriology by A.J. Salle
18. Textbook of Microbiology by Pelczar, Tata McGraw Hill Publication.



