

**Punyashlok Ahilyadevi Holkar Solapur University, Solapur**



NAAC Accredited-2022

'B<sup>++</sup>' Grade (CGPA 2.96)

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

**CHOICE BASED CREDIT SYSTEM**

**Syllabus: Microbiology**

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

**(Syllabus to be implemented from June 2022)**



**Punyashlok Ahilyadevi Holkar Solapur University, Solapur**

**B. Sc. First Year (Liberal Science) Sem.-I**

**Core Course: MICROBIOLOGY (Paper-I)**

**Teaching Scheme:**

**Lectures – 3 Hours/week, 2 Credits**

**Practical – 4 Hours/week, 4 Credit**

**Examination Scheme:**

**UA – 40 Marks**

**CIE – 10 Marks**

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About Course: 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 vast range of industries and institutes like research and development laboratories of government and private hospitals, research organizations, pharmaceutical, food, beverage and chemical industries.

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**Course Prerequisite:**

Student shall have knowledge of Biology which includes Botany and Zoology and know about microorganisms.

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**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 syllabi of microbiology for undergraduate course, 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.

The systematic and planned curricula for first year students shall motivate and encourage them for pursuing higher studies in Microbiology and for becoming an entrepreneur.

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**Course Objectives:**

The objectives of B. Sc. Microbiology course are:

- 1) To impart knowledge with respect to the subject and its practicable applicability.
- 2) To enhance understanding of basic and advanced concepts in microbiology.
- 3) To develop the awareness of various emerging areas of Microbiology.
- 4) To train students for further studies helping in their bright career in the subject
- 5) To expose the students to different processes used in industries and in research field
- 6) To develop their ability to apply the knowledge of microbiology in day to day life.
- 7) To prepare the students to accept the challenges in life sciences.
- 8) To make students skillful to work in various industries, research labs and health sector

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**Course Outcomes:**

After completing the course students will be familiarized the with necessary laboratory techniques and tools of microbiology and provide an exposure in research, analytical and presentational skills. Microbiology has tremendous job potential. The successful students will be able well trained to get various microbiology related job.

**B. Sc. First Year (Liberal Science) Semester-I  
Core Course: MICROBIOLOGY (Paper-I)**

**Introduction to Microbiology and Microbial Diversity  
THEORY COURSE (02 credits)**

**Total Lectures 30L**

**UNIT I: History and Scope of Microbiology**

**15 L**

- A. Historical Background:** a) Contribution of Robert Hook, Antony Van Leuwenhoek, Ernst Ruska  
b) Theory of spontaneous generation: Francisco Redii, John Needham, Friedrich Schroder and Van Dusch, Louis Pasteur (Swan neck flask experiment) and John Tyndall.  
c) Golden era of Microbiology (1857-1914) - i) Germ theory of fermentation ii) Germ theory of disease  
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.
- B. a) Branches of Microbiology**  
b) **National Institutes related to microbiology in India –**  
NIV, NARI, NCCS, CCMB, Serum Institute of India, Vasantdada Sugar Institute.

**UNIT II: Microbial Diversity**

**15 L**

- A. General Characteristics, occurrence and economic importance of microorganisms –**  
a) Acellular – Viruses (definition and example of Phytophage, Zoophage and Bacteriophage), Viroid, Prions  
b) Cellular – i) Bacteria (Size, Shape and Arrangement)  
c) ii) Mycoplasma  
iii) Rickettsia iv) Actinomycetes v) Archaeobacteria vi) Algae vii) Fungi viii) Protozoa
- B. Differences between prokaryotic and eukaryotic cell**
- C. Bacterial Taxonomy -** a) Basic principles of nomenclature b) Criteria for bacterial classification and identification – Morphological, cultural, Biochemical and molecular by 16S rRNA gene sequencing, % G + C (Introductory concept),

**Core Course: MICROBIOLOGY (Paper-II)**  
**Paper II: Cell cytology and Microbial Techniques**

THEORY COURSE (02 credits)

**Total Lectures 30L**

**UNIT I: Cellular organization of Bacteria**

**15 L**

**A) Structure, composition and Functions of :**

- i) Cell wall-Gram-positive and Gram-negative bacteria
- ii) Definitions of sphaeroplast and protoplast
- iii) Cell membrane -fluid mosaic model
- iv) Cytoplasm- Ribosome, mesosome and nucleoid
- v) Ultrastructure of endospore
- vi) Capsule and slime layer
- vii) Flagella and Pili

**UNIT II: Basic techniques in Microbiology**

**15 L**

**A) Microscopy :**

- i) Basic concept - Magnification, numerical aperture and resolving power.
- ii) Principle, working and application of compound microscope and electron microscope (Scanning electron microscope (SEM), Transmission electron microscope (TEM)).

**B) Staining techniques:**

- i) Definition, types of stain – Acidic Basic and Neutral with example
- ii) Different methods of staining- monochrome, negative, Differential- Gram and acid fast
- iii) Special staining - Cell wall staining (by Chance's method) and capsule staining (by Maneval's method)

**C) Sterilization techniques:**

- i) Definitions of- sterilization, disinfection, antiseptic, germicide, microbiostasis and sanitization.
- ii) Sterilization by Physical agents-Temperature (dry heat and moist heat), Radiation -U.V rays and  $\gamma$ -rays and Membrane Filtration.

**iii) Sterilization by chemical agents**

Phenol and phenolic compounds, Ethyl alcohol, Halogens- chlorine and iodide, Heavy Metals–Copper and Mercury and Gaseous agents- Ethylene oxide,  $\beta$ -propiolactone, formaldehyde.

**SEMESTER II**  
**Core Course: MICROBIOLOGY (Paper-III)**  
**Microbial Metabolism and Cultivation**  
**THEORY COURSE (02 credits)**

**Total Lectures 30L**  
**15 L**

**UNIT I : Biomolecules and Bioenergetics:**

**A) Biomolecules: Structure and function of**

a) Carbohydrates b) Proteins c) Lipids d) Nucleic acids- i) DNA ii) RNA

**B) Bioenergetics:**

First and Second law of Thermodynamics, Definition of Gibbs free energy, enthalpy and entropy, High energy compounds and structure of ATP, definition of Metabolism, Anabolism and Catabolism.

**C) Enzymes and metabolic pathways:**

- i) Definition -apoenzyme, coenzymes, cofactors, prosthetic group and active site.
- ii) Types of enzymes - extracellular and intracellular, constitutive and induced enzyme.
- iii) Mechanism of enzyme action: Lock and key hypothesis and induced fit hypothesis.

**iv) Catabolism of glucose-**

EMP pathway, Fate of Pyruvate- i) Aerobic ii) Anaerobic (Ethanol) iii) Microaerophilic (Lactic acid)

**UNIT II: Microbial Nutrition and Cultivation Technique**

**15 L**

**A) Microbial Nutrition:**

- i) Nutritional requirements of microorganisms
- ii) Nutritional types of Microorganisms based on Carbon and Energy source.

**B) Cultivation techniques of Microorganisms**

**1) Culture Media:**

i) Definitions with example- Living media and Non-living media- (Natural, Synthetic, Semi synthetic, Differential, Enriched and Selective).

**2) Methods of Pure culture:**

- i) Serial dilution
- ii) Streak Plate, Spread Plate and Pour Plate technique.

**SEMESTER II**  
**Core Course: MICROBIOLOGY (Paper-IV)**  
**APPLIED MICROBIOLOGY**  
**THEORY COURSE (02 credits)**

**Total Lectures 30L**

**UNIT I: Water and sewage Microbiology**

- A. Water Microbiology:** a) Sources of Microorganisms in water  
b) fecal pollution of water and its indicator  
c) Routine bacteriological analysis of water for detection and differentiation of coliforms –  
i) Qualitative (presumptive, confirmed and completed) and IMViC and Eijkman test ii)  
Quantitative Test – MPN  
d) Municipal water purification process: Sedimentation, Filtration and Disinfection
- B. Sewage Microbiology:** a) Definition, Types and Microflora of sewage  
b) Definition of DO, BOD and COD, c) Treatment of Sewage –  
Primary (Physical), Secondary (Chemical) and Tertiary (Biological) method

**UNIT II: Medical Microbiology**

**15 L**

- A. Definitions:-** Infection, etiology, etiological agents, disease, pathogen, incubation period, fomite, pathogenicity, virulence, morbidity rate, mortality rate, opportunistic pathogen, carriers, host, epidemiology, prophylaxis.
- B. Types of diseases:-** Epidemic, endemic, pandemic & sporadic
- C. Types of infections:** Primary, Secondary, acute, chronic, reinfection, cross infection, Mixed infection, congenital, local, systemic and generalized
- D. Mode of transmission of diseases:** 1) Inoculation 2) Ingestion 3) Contact 4) Inhalation
- E. Preventive and control measures for:** 1) Water and food borne diseases 2) Air borne diseases 3) Vector borne diseases 4) Diseases transmitted through physical contact

**PRACTICAL COURSE**  
**B. Sc. First Year (Liberal Science) Semester-I & II**  
**Practical – I : MICROBIOLOGY**

<b>Examination Scheme:</b>	<b>UA – 80 Marks</b>
<b>Practical – 4 Hours/week, 4 Credit</b>	<b>CIE – 20 Marks</b>

**LIST OF PRACTICALS:**

1. Good microbiology laboratory practices and Biosafety
2. Principle, working and applications of Common laboratory instruments
  - a) Autoclave
  - b) Hot Air Oven
  - c) Incubator
  - d) Colony Counter
  - e) PH Meter
  - f) Laminar Air flow
3. Handling and Care of compound Microscope
4. Monochrome staining
5. Negative staining
6. Gram staining
7. Special Staining Procedures - Cell Wall (Chance's Method)
8. Special staining Procedures - Capsule (Maneval's Method)
9. 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
10. Demonstration of inoculation techniques – Broth, Slant, Stab, Spot, Spread, Streak and Pour plate
11. Determination of CFU by Serial Dilution Technique using sewage / food / soil/ water sample
12. Study of colony characteristics of bacterial isolates.
13. study of bacterial motility by Hanging drop technique



14. Isolation and identification of *E.coli* by four quadrant method using MacConkeys Agar.
15. Isolation and identification of *Bacillus sp.* by four quadrant method using Nutrient Agar.
16. Mounting of Fungi (a) *Aspergillus* (b) *Rhizopus* (c) *Penicillium* (d) *Mucor*
17. Study of coliforms by IMViC test.
18. Study of sugar fermentation - Glucose, Lactose,
19. Detection of Amylase activity
20. Detection of Caseinase activity

Students should perform minimum 20 practical during Semester I & II

• **Continuous Internal Evaluation (CIE):**

CIE will consist of Home Assignment/Tutorials/Tests/Seminars, etc.

**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 – Powar and Dagainawala Vol I and II
14. Textbook of Biotechnology – R.C. Dubey,
15. Biotechnology – B.D. Singh
16. Fundamentals of Bacteriology by A.J. Salle
17. Textbook of Microbiology by Pelczar, Tata McGraw Hill Publication.

Students should perform minimum 20 practical during Semester I & II