

BHARATHIDASAN UNIVERSITY, TIRUCHIRAPPALLI -24**(For B.Sc. Biochemistry)****(For the candidates admitted from the academic year 2026 – 2027 onwards)****SEMESTER –I****MICROBIOLOGY I – BASICS AND APPLIED MICROBIOLOGY**

Course Code	MC - I	Course Type	Core	L	T	P	C	Syllabus version	2026-2027
				4	-	-	4		
Pre-requisite	Foundational knowledge of biological sciences, cell structure, and a basic understanding of how environmental factors and chemical agents influence the survival and growth of living organisms								

Course Objectives:

✓ Remember: Introduce students to the fundamental biology, classification, and diversity of microorganisms (bacteria, fungi, viruses, and archaea).
✓ Understand: Microbial growth and factors affecting it
✓ Apply and Analyze: Equip students with technical laboratory skills to culture, enumerate, and control microbes safely. Connect theoretical concepts to real-world industrial, environmental, and medical applications.
✓ Evaluate: Foster critical thinking to solve contemporary global challenges in food and milk spoilage and preservation,
✓ Create process for microbial production of antibiotics, enzymes alcoholic beverages and dairy products

Expected Course Outcomes:**On the completion of the course the student will be able to**

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	Define and describe the cellular structure, classification and properties of diverse microorganisms.	K1, K2
CO2	Apply microbiological principles to evaluate the quality of food, water, and pharmaceuticals.	K1 – K2
CO3	Distinguish between pathogenic and beneficial microorganisms based on their functional and physiological characteristics.	K1 – K3
CO4	Analyze data from growth kinetics	K1 -K4
CO5	Assess the impact of microbes on the environment (e.g., biogeochemical cycles) and human health (e.g., pathogenesis and immunity).	K1 – k5

CO6	Design an experimental protocol or a bio-based product (e.g., biofuels, fermented foods, enzymes) to address a specific industrial or environmental problem.	K5, K6
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit-I: Bacteriology	Definition, scope and brief history of microbiology. Differences between prokaryotic and eukaryotic microorganisms. Bacterial Structure: Size, shape, and arrangement. Brief study of Flagella, Pili, Capsule, Cell wall, Cytoplasmic membrane, and Endospores. Types of bacteria: chlamydia, rickettsia, mycoplasma, actinomycetes, cyanobacteria and eubacteria. Brief overview of Archea.
Unit-II: Viruses and fungi	Classification and types of viruses: Baltimore classification. Structure (bacteriophages, plant and animal viruses) and general properties of viruses. General characteristics of major groups of fungi: Oomycota, Zygomycota, Ascomycota and Basidiomycota.
Unit-III: Protozoa and Algae	Properties and classification of protozoa: Mastigophora, Sarcodina, Sporozoa and Ciliophora. General characteristics of major groups of algae: Chlorophyta, Phaeophyta, Rhodophyta, Pyrrophyta, Chrysophyta and Euglenophyta.
Unit-IV: Microbial growth and pure culture techniques	Microbial growth, growth rate, doubling time and exponential growth phases. Factors affecting microbial growth: nutrient factors (C, H, N, O, P, S and trace elements) and non-nutrients (temperature, hydrostatic pressure, pH, osmotic strength). Types of nutrient media and special nutrient media. Differential media, and examples to distinguish between different groups of bacteria using differential media. Streak plate, pour plate, Antibiotic sensitivity test.
Unit – V: Food and industrial microbiology (12 hours)	Food and industrial microbiology: Food spoilage and preservation. fermented foods and probiotics. Quality control of drinking water: total coliform count. Microorganisms in milk and milk products, and the preservation of milk. Role of microbes in industrial production of antibiotics, enzymes, alcoholic beverages and dairy products. Preservation of wine. Single-cell proteins, microbial biofuel and biofertilizers.

Unit-VI: Current Contours (For Continuous Internal Assessment only):	Review of daily news on fundamental microbiology discoveries (e.g., new bacterial species, antibiotic resistance trends). Public Awareness: Creating awareness of the importance of microbes in daily life, hygiene, and fermented foods for human and animal health. Scientific Models: Developing physical or digital scientific models explaining bacterial ultra-structure, growth curves, or mechanisms of sterilization.
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Recommended References:

1. Prescott's Microbiology (12th Ed, 2023) – Authors: Joanne Willey, Kathleen Sandman, Dorothy Wood.
2. Microbiology: An Introduction (14th Global Ed, 2024) – Authors: Gerard J. Tortora, Berdell R. Funke, Christine L. Case.
3. Brock Biology of Microorganisms (16th Ed, 2021) – Authors: Michael T. Madigan, Kelly S. Bender, Daniel H. Buckley.
4. Alcamo's Fundamentals of Microbiology (12th Ed, 2022) – Author: Jeffrey C. Pommerville.
5. Foundations in Microbiology (11th Ed, 2021) – Authors: Kathleen Park Talaro, Barry Chess.
6. Microbiology: Principles and Explorations (11th Ed, 2023) – Author: Jacquelyn G. Black.
7. Microbiology: Laboratory Theory & Application (4th Ed, 2020) – Authors: Michael J. Leboffe, Burton E. Pierce.
8. Lippincott Illustrated Reviews: Microbiology (4th South Asian Ed, 2022) – Authors: Cynthia Nau Cornelissen, Marcia Metzgar Gleason.

Related Online Contents:

1. nptel.ac.in (NPTEL - Intro to Microbiology)
2. coursera.org (Coursera - The Microbial World)
3. nih.gov (NCBI - Microbial Genomes)
4. microbenotes.com (MicrobeNotes - Study Notes)
5. qiime2.org (QIIME 2 - Computational Analysis)
6. biorender.com (BioRender - Microbial Models)

MICROBIOLOGY I – BASICS AND APPLIED MICROBIOLOGY(P)

Course Code	CP - 1	Course Type	Core	L	T	P	C	Syllabus version	2026-2027
				-	-	4	4		
Pre-requisite	Basic knowledge of laboratory safety, cell biology concepts, and a fundamental understanding of aseptic handling to perform microbial staining, cultivation, and control experiments.								

Course Objectives:

✓ Master the technical skills of operating microscopes and mastery in differential staining techniques for microbial identification.
✓ Addresses challenges in aseptic techniques by mastering sterilization protocols using Autoclave and Hot Air Oven.
✓ Creative problem solver of microbial isolation from diverse samples using streak, pour, and spread plate methods.
✓ Understand the physiological dynamics of bacterial growth curves and the impact of environmental factors on microbial populations.
✓ Demonstrate proficiency in antimicrobial assays to evaluate the efficacy of disinfectants and antibiotic sensitivity patterns.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	Demonstrate proficiency in operating microscopes and applying staining techniques for microbial visualization.	K3
CO2	To execute various sterilization protocols and handle laboratory instruments safely to maintain aseptic conditions.	K3
CO3	To formulate culture media and isolate pure cultures using streak, pour, and spread plate techniques.	K3, K4
CO4	To quantify microbial growth and analyze the influence of environmental factors like temperature and pH.	K3, K4
CO5	To evaluate the efficacy of antimicrobial agents and disinfectants using standardized sensitivity testing methods.	K5
CO6	To analyze microbial data from web resources and maintain precise laboratory records with sample metadata and OTU mapping.	K4, K5
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

1. Safety practices in Microbiological Laboratory

Microscopic Techniques

- Principles and parts of a compound Light Microscope.
- Calibration of Microscope using Ocular and Stage Micrometers.

2. Staining Methods

- Preparation of Bacterial Smear.
- Simple Staining: Using Methylene blue/Crystal violet.
- Differential Staining: Gram Staining (to differentiate Gram +ve and -ve bacteria).
- Special Staining: Acid-fast staining (Ziehl-Neelsen method).
- Structural Staining: Capsule staining and Spore staining (Schaffer-Fulton method).

3. Sterilization and Disinfection

- Introduction to Autoclave, Hot Air Oven, and Laminar Air Flow (LAF).
- Cleaning and sterilization of glassware.

4. Culture Media Preparation

- Preparation of Basal media (Nutrient Broth and Nutrient Agar).
- Preparation of Selective and Differential media (e.g., MacConkey Agar, MSA).

5. Pure Culture Techniques

- Isolation of Bacteria: Streak plate, Pour plate, and Spread plate methods.
- Maintenance and preservation of cultures (Slant and Stab cultures).

6. Microbial Growth and Enumeration

- Measuring bacterial growth by Turbidometry (Spectrophotometer).

7. Motility Testing

- Hanging drop method to observe bacterial motility.

8. Control of Microorganisms

- Testing the efficacy of disinfectants (Phenol coefficient).
- Antibiotic Sensitivity Test (Kirby-Bauer Disk Diffusion method).

9. Microbial quality of milk and water

- Methylene Blue Reductase Test (Milk)
- Coliform count by MPN method

Recommended References:

1. Microbiology: Laboratory Theory & Application (4th Edition, 2020) – Authors: Michael J. Leboffe, Burton E. Pierce.
2. Laboratory Manual in General Microbiology (2nd Edition, 2023) – Author: N. Kannan.
3. Benson's Microbiological Applications: Laboratory Manual in General Microbiology (15th Edition, 2022) – Authors: Heidi Smith, Alfred Brown.
4. Practical Microbiology (Revised Edition, 2022) – Authors: Dr. R.C. Dubey and Dr. D.K. Maheshwari.
5. Microbiology: A Laboratory Manual (12th Global Edition, 2020) – Authors: James G. Cappuccino, Chad T. Welsh.

Related Online Contents:

1. <https://www.jove.com/education/core/microbiologyamrita.edu>
2. <https://vlab.amrita.edu/?sub=3&brch=76>
3. <https://learn.chm.msu.edu/vibl/>
4. <https://pmc.ncbi.nlm.nih.gov/articles/PMC3577210/microbenotes.com>
5. <https://microbenotes.com/>

SEMESTER –II**MICROBIOLOGY II – MEDICAL MICROBIOLOGY**

Course Code	CC - 1	Course Type	Core	L 2	T -	P -	C 4	Syllabus version	2026-2027
Pre-requisite	Foundational knowledge of biological sciences, cell structure, and a basic understanding of how environmental factors and chemical agents influence the survival and growth of living organisms								

Course Objectives:

✓ To provide fundamental knowledge on the history, classification, and basic concepts of medical microbiology including host-pathogen interactions.
✓ To understand the etiology, pathogenesis, transmission, prevention, and treatment of major bacterial diseases affecting different organ systems.
✓ To develop knowledge on viral diseases, their mechanisms of infection, clinical manifestations, and control strategies.
✓ To impart understanding of medically important fungi, protozoa, and helminths, along with their role in human diseases.
✓ To familiarize students with clinical diagnostic methods, including specimen collection, isolation, and identification of pathogens.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	Acquire knowledge on the Normal flora of human body and infectious diseases	K1, K2
CO2	Understand the concepts about bacterial diseases	K2
CO3	Distinguish various types of viral diseases and their diagnosis	K4
CO4	Diagnose protozoan and fungal infections	K5
CO5	Expertise on various laboratory Procedures and Diagnostic Methods.	K6
CO6	Demonstrate comprehensive understanding of microbial growth, metabolism, and their applications in biotechnology, environmental sustainability, and disease control.	K5, K6
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit-I:Host pathogen interaction	Microflora of the human body and host pathogen interaction: Normal microflora of the human body: Importance of normal microflora, normal microflora of skin, throat, gastrointestinal tract, urogenital tract Host pathogen interaction: Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Carriers and their types, Opportunistic infections, Nosocomial infections.
Unit-II:Bacterial and fungal diseases	Bacterial disease and Fungal diseases: Bacteria:. The following diseases in detail with Symptoms, mode of transmission, prophylaxis and control Respiratory Diseases: <i>M.tuberculosis</i> . Gastrointestinal Diseases: <i>S.typhi</i> , <i>Vibrio cholerae</i> , <i>S. aureus</i> , , <i>Clostridium tetani</i> , botulinum. Fungi: following types of mycoses and one representative disease to be studied with respect to transmission, symptoms and prevention Cutaneous mycoses: Tineapedis (Athlete's foot) Systemic mycoses: Histoplasmosis Opportunistic mycoses: Candidiasis.
Unit-III: Viral and Protozoal diseases	Viral diseases and Protozoan diseases: The following diseases in detail with Symptoms, mode of transmission, control Polio, Rabies, Dengue, AIDS, with brief description of swine flu, Ebola, Chikungunya. Protozoan diseases. Symptoms, mode of transmission, prophylaxis and control Malaria, Kala-azar.
Unit-IV:Antimicrobial agents	Antimicrobial agents: General characteristics and mode of action, Antibacterial agents: Five modes of action with one example each: Inhibitor of nucleic acid synthesis; Inhibitor of cell wall synthesis; Inhibitor of cell membrane function; Inhibitor of protein synthesis; Antifungal agents: Mechanism of action of Amphotericin B, Griseofulvin. Antiviral agents: Mechanism of action of Amantadine, Acyclovir, Remdesvir, gancyclovir. Antibiotic resistance.
Unit – V:Diagnostic Microbiology	Sample collection, transport and diagnosis: Collection, transport and culturing of clinical samples, principles of different diagnostic tests, Diagnostic kits. (ELISA, Immunofluorescence, Agglutination based tests, Complement fixation, PCR, DNA probes).
Unit-VI: Current Contours (For Continuous Internal Assessment only):	UNIT – VI CURRENT CONTOURS (For continuous internal assessment only): Chalk and talk about SARS, coronavirus, monkeypox, and black fungus. Preventive measures and treatment strategies.

Recommended References:

1. Alexopoulos, C.J., Mims, C.W. and Blackwell, M. 2014. Introductory Mycology. 4th Edition, John Wiley & sons, New Delhi.
2. Collee JC, Duguid JP, Fraser AC, Marimon BP. Mackie and Mc Carteny, 1989. Practical Medical Microbiology, 13th edition, Churchill Livingstone, London.
3. David Greenwood, Mike Barer, Richard Slack and Will Irving. 2012. Medical Microbiology. A Guide to Microbial Infections: Pathogenesis, immunity, Laboratory investigation and Control, 18th edition, Churchill Livingstone. London.
4. Dimmock, N.J., Easton, A.J. and Lippard, K.N. 2009. Introduction to Modern Virology. Wiley Blackwell, USA
5. Hugo W.B and Russell A.D. 1989. Pharmaceutical Microbiology, 4th edition, Blackwell Scientific Publications, Oxford, United Kingdom.
6. Errol Reiss, Jean Shadomy, H. and Marshall Lyon, G. 2011. Fundamental Medical Mycology. 1st edition, Wiley Blackwell. United States.
7. Flint, S.J., Enquist L.W., Racaniello, V.R. and Skalka, A.M. 2009. Principles of Virology : Molecular Biology, 3rd edition. ASM Press, Washington.
8. Stefan Riedal, Stephan A. Morse, Timothy Mietzner and Steve Miller, 2001. Jawetz, Melnick and Adelberg's Medical Microbiology, 28th edition, McGraw Hill Medical Publication division, New York
9. Joan Stokes E, Ridgway G.L and Wren M.W.D. 1993. Clinical Microbiology 7th edition, Edward Arnold (A division of Hodder and Stoughton), London
10. Morag, C. and Timbury, M.C. 1994. Medical Virology, 10th edition. Churchill Livingstone, London.
11. Cary Engleberg, N, Victor, J, Di Rita, Michale J. Imperiale, Schaechter's Mechanisms of Microbial Disease, 6th edition, Williams and Wilkins., Baltimore.
12. Topley and Wilson 1995. Principles of Bacteriology, Virology and Immunity, 9th edition. Edward Arnold, London..
13. Vinay Kumar, Abul K. Abbas and Jon C Aster. Robbins and Cotran, 2014. Pathologic Basis of Disease: South Asia Edition.
14. Ananthanarayan and Paniker (2013) Textbook of Microbiology. 9th Edition, Universities Press Publisher, Hyderabad,

Related Online Contents:

1. <http://www.mednotes.net/notes/microbiology/>
2. <http://dmoz.org/Science/Biology/Microbiology/>
3. <http://microbiology.mtsinai.on.ca/manual/default.asp>
4. http://fdjpkc.fudan.edu.cn/_upload/article/files/4d/8a/0337d0b94956b709eaed117489c9/2e232f50-d708-4783-a40d-5e970d1142f0.pdf
5. <https://www.aacc.org/store/books/8300/lecture-notes-medical-microbiology-and-infection-5th-edition>
6. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2158889/>

