



# Syllabus

## First Semester Courses in BSc Microbiology (June 2024 onwards)

- **Core Courses:**
  - USMIC4501CR1 Introduction to the World of Microbiology
  - USMIC4501CR1PR Introduction to the World of Microbiology Practical
- **Vocational Skill Course:**
  - USMIC4502VS1 Bacterial Staining Techniques
- **Evaluation and Assessment guidelines**



**APPROVED SYLLABUS**

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<b>BSc in Microbiology</b>		
<b>Course Title: Introduction to the World of Microbiology</b>		
<b>Course Code: USMIC4501CR1</b>		
Credits 4: Theory (3) = 45 hr Number of lectures: 45		
<b>No.</b>	<b>Course Objectives</b>	
1.	Familiarize students with diversity of microorganisms	
2.	Introduction to the branches and fields of microbiology	
3.	Facilitate understanding of the fundamental aspects of prokaryotic cell structure and function	
4.	Explain the principles of working of the light microscope and other modified microscopes and the differences between them	
5.	Equip students with a good understanding of the basic principles of bacterial cultivation	
<b>CO</b>	<b>Course Outcomes</b> <b>On completing the course, the learner will be able to</b>	<b>Bloom's Taxonomy Level (BT level)</b>
1.	Recognize, name members of the microbial world and state their position on the Universal Phylogenetic tree. Describe milestones in the field of Microbiology.	Remember
2.	Describe prokaryotic cell structure; compare Bacteria with Archaea; relate structure with function of various cell components.	Understand, Apply
3.	Elucidate principles of light, dark field, phase contrast; identify various structural components of a light microscope and relate structure with function; solve problems on light microscopy.	Apply
4.	Compare different types of microscopes, draw, label their ray diagrams and choose appropriate microscopy for observing a particular specimen	Analyze
5.	Explain principles underlying cultivation of bacteria and select an appropriate method	Apply



<b>UNIT I</b>	<b>INTRODUCTION, HISTORY AND SCOPE OF MICROBIOLOGY</b>	<b>(15)</b>
<b>A.</b>	1. Microorganisms – definition 2. Microbes are ubiquitous 3. Members of the microbial world - bacteria, fungi, protists, archaea, viruses, viroids, prions-(satellites)	<b>(3)</b>
<b>B.</b>	<b>Evolution of microbes, the three domains of life, concept of species</b>	<b>(2)</b>
<b>C.</b>	<b>Historical foundations of Microbiology</b> - biogenesis, abiogenesis, Indian Knowledge System: Sukshmjeevanu in Vedas	<b>(4)</b>
<b>D.</b>	<b>Branches of Microbiology</b> - Physiology, Genetics, Bacteriology, Mycology, Virology, Protozoology, Parasitology, Ecology, Phycology, Taxonomy	<b>(2)</b>
<b>E.</b>	<b>Major fields of Microbiology</b> - Medical, Public health microbiology and epidemiology, Food and Dairy, Industrial, Environmental, Agricultural, Biotechnology, Immunology, Genetic engineering and recombinant DNA technology	<b>(4)</b>
<b>UNIT II</b>	<b>STRUCTURE AND FUNCTION OF BACTERIA</b>	<b>(15)</b>
<b>A.</b>	1. Bacterial and Archaeal functional anatomy 2. Prokaryotic groups 3. Diagram of Prokaryotic cell organization	<b>(2)</b>
<b>B.</b>	<b>Cell Wall Structure and Gram Stain: Bacterial and Archaeal</b> 1. Composition and characteristics 2. Gram stain mechanism	<b>(4)</b>
<b>C.</b>	<b>Structure External to Cell Wall of Bacteria and Archaea</b> 1. Glycocalyx - Capsule, Slime S-layer 2. Pili, Fimbriae 3. Flagella: Structure, Motility, Chemotaxis	<b>(3)</b>
<b>D.</b>	<b>Structures Internal to Cell Wall of Bacteria and Archaea</b> 1. Cell Membrane: Bacterial and Archaeal 2. Cytoplasmic Matrix of Bacteria and Archaea	<b>(6)</b>



3. Cytoskeleton, Nucleoid, Plasmids, Ribosome
4. Inclusion granules: Composition, Function
5. Bacterial Endospores: Formation and Germination, examples of spore forming organisms, habitats, function

<b>UNIT III</b>	<b>METHODS FOR STUDYING MICROORGANISMS: MICROSCOPY AND BASIC CULTURE TECHNIQUES</b>	<b>(15)</b>
<b>A.</b>	1. History of the Microscope	<b>(1)</b>
	2. Lenses and bending of Light	
<b>B.</b>	1. Light microscopy	<b>(5)</b>
	2. Bright field Microscopy: Objectives, Eyepiece, Condenser	
	3. Characteristics of lenses: Resolution, Magnification, Numerical Aperture, Focal Length, Working distance, Depth of Focus.	
	4. Micrometry	
<b>C.</b>	Dark Field Microscopy	<b>(1)</b>
<b>D.</b>	Phase Contrast and Differential Interference Contrast Microscopy	<b>(1)</b>
<b>F.</b>	1. Methods of culturing microorganisms	<b>(7)</b>
	2. Laboratory techniques for growing bacteria - an overview (collecting samples, inoculation, isolation, incubation, identification)	
	3. Categories of media based on physical state, chemical composition, functional type	

**References:**

1. Chess, B. (2024). *Talaro's foundations in microbiology* (12th edition). McGraw Hill LLC.
2. Chess, B., & Talaro, K. P. (2021). *Talaro's Foundations in microbiology* (11th edition). McGraw.
3. Kuhad, U., Goel, G., Maurya, P. K., & Kuhad, R. C. (2021). Sukshmjeevanu in Vedas: The forgotten past of microbiology in Indian Vedic knowledge. *Indian Journal of Microbiology*, 61(1), 108–110. <https://doi.org/10.1007/s12088-020-00911-5>
4. Padhy, S. (2016). Vedic Indians were aware of the microbial biodiversity, demanding 'Kannva' as the father of microbiology. *Journal of Biodiversity*, 7(2), 101–103. <https://doi.org/10.1080/09766901.2016.11884762>
5. Willey, J. M., Prescott, L. M., Sandman, K. M., & Wood, D. H. (2020). *Prescott's microbiology* (11th edition). McGraw-Hill Education.
6. Willey, J. M., Sandman, K., Wood, D. H., & Prescott, L. M. (2023). *Prescott's microbiology* (12th edition, international student edition). McGraw Hill.



**Evaluation (Theory, USMIC4501CR1): Total marks per course - 100.**

Formative Assessment for Learning

(continuous internal assessment - CIA to improve learning).

**CIA – 40 marks**

CIA 1: Written test – 20 marks

CIA 2: Written assignment – 20 marks

Summative Assessment of Learning (focus on outcomes, quantitative data for outcomes of instruction).

**End Semester Examination – 60 marks**

One question from each unit for 20 marks, with internal choice. Total marks per question with choice – 25 to 30.

**Distribution of Bloom's Taxonomy levels for the course assessment**

Learning Levels	Remember	Understand	Apply	Analyze	Evaluate	Create
Percentage	15-25%	25-35%	20-25%	20-25%	-	-

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<b>BSc in Microbiology</b>		
<b>Course Title: Introduction to the World of Microbiology Practical</b>		
<b>Course Code: USMIC4501CR1PR</b>		
Credits: 1      Practical (1) Number of hours: 30		
<b>No.</b>	<b>Course Objectives</b>	
1.	Familiarize students with essential microbiology laboratory safety protocols and use and functions of the light microscope	
2.	Equip students with the skills to perform basic microbiological staining techniques such as monochrome, Gram, and negative staining	
3.	Train students to be proficient in inoculation and isolation techniques for culturing microorganisms, observing bacterial growth patterns in liquid media	
4.	Provide training to prepare culture media using appropriate aseptic techniques and to operate an autoclave	
<b>CO</b>	<b>Course Outcomes</b> <b>On completing the course, the learner will be able to</b>	<b>Bloom's Taxonomy Level (BT level)</b>
1.	Demonstrate safe handling of microbial cultures and follow standard laboratory safety procedures; operate and maintain a light microscope for microbial observation.	Apply
2.	Perform Gram stain to differentiate and identify bacterial species; perform negative staining and measure dimensions of microorganisms using micrometry	Apply, Analyze
3.	Culture and isolate bacteria using the streak, spread, stab, and pour plate techniques	Apply
4.	Differentiate bacterial colonies based on their growth patterns on Nutrient agar, MacConkey's agar, and Salt Mannitol agar	Analyze
5.	Prepare and sterilize culture media using standard microbiological procedures; use the autoclave in microbial laboratory work	Apply



S. No.	Name of the Practical
1.	Laboratory safety practices
2.	The light microscope: parts and function
3.	Monochrome staining of bacteria
4.	Gram staining of bacteria
5.	Negative staining and micrometry
6.	Inoculation techniques - streak, spread, stab, pour
7.	Isolation and study of colony characteristics on Nutrient agar
8.	Isolation and study of colony characteristics on MacConkey's agar
9.	Isolation and study of colony characteristics on Salt mannitol agar
10.	Study of bacterial growth in nutrient broth
11.	Preparation of nutrient broth and nutrient agar
12.	Study of autoclave

**References:**

1. Cappuccino, J. G., & Sherman, N. (2014). *Microbiology: A laboratory manual* (10th edition). Pearson.
2. Chess, B. (2024). *Talaro's foundations in microbiology* (12th edition). McGraw Hill LLC.
3. Willey, J. M., Sherwood, L. M., & Woolverton, C. J. (2020). *Prescott's microbiology* (11th ed.). McGraw-Hill.
4. Willey, J. M., Sherwood, L. M., & Woolverton, C. J. (2023). *Prescott, Harley, and Klein's microbiology* (12th edition). McGraw-Hill.

**Evaluation (Practical, USMIC4501CR1PR): Total marks practical course - 50**

**CIA - 20 marks**

**End Semester Practical Examination - 30 marks**

Continuous practical evaluation will be done based on the completion of the hands-on practical sessions.

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**Distribution of Bloom's Taxonomy levels for the practical assessment**

<b>Learning Levels</b>	<b>Remember</b>	<b>Understand</b>	<b>Apply</b>	<b>Analyze</b>	<b>Evaluate</b>	<b>Create</b>
Percentage	-	-	45-60%	40-60%	-	-

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<b>BSc in Microbiology</b>		
<b>Course Title: Bacterial staining techniques</b>		
<b>Course Code: USMIC4502VS1</b>		
Credits 4:      Theory (1) = 15 hr Practical (1) = 30 hr		
<b>No.</b>	<b>Course Objectives</b>	
1.	Facilitate understanding of the principles of bacterial staining methods	
2.	Equip students with skills in preparing bacterial samples for staining	
3.	Identification of different bacterial structures and characteristics under the microscope	
4.	Develop skills in interpreting and analysing stained bacterial slides	
<b>CO</b>	<b>Course Outcomes</b> <b>On completing the course, the learner will be able to</b>	<b>Bloom's Taxonomy Level (BT level)</b>
1	Describe the principles of bacterial staining methods	Understand
2	Explain the differences between various staining techniques	Apply
3	Interpret the results of bacterial staining procedures as well as compare and contrast different bacterial structures observed under the microscope	Apply
4	Analyze stained bacterial slides to identify specific structures and characteristics.	Analyze



<b>UNIT I</b>	<b>STAINING TECHNIQUES FOR BACTERIA</b>	<b>(15)</b>
A.	Introduction to bacterial staining methods	(2)
B.	Preparation of bacterial samples for staining	(1)
C.	Dyes and stains used to stain bacteria	(2)
D.	Principle and procedure of -	(9)
	1. Monochrome staining technique	
	2. Acid-fast staining technique	
	3. Endospore staining technique	
	4. Capsule staining technique	
	5. Cell wall staining technique	
	6. Lipid granule staining technique	
	7. Volutin granule staining technique	
	8. Flagella staining technique	
	9. Spirochaete staining	
E.	Interpretation of stained bacterial slides	(1)

**References:**

1. Cappuccino, J. G., & Sherman, N. (2014). *Microbiology: A laboratory manual* (10th edition). Pearson.
2. Chess, B. (2024). *Talaro's foundations in microbiology* (12th edition). McGraw Hill LLC.
3. Willey, J. M., Sherwood, L. M., & Woolverton, C. J. (2023). *Prescott, Harley, and Klein's microbiology* (12th edition). McGraw-Hill.

**S. No. Name of the Practical**

1. Monochrome staining
2. Acid-fast staining technique (*M. smegmatis*)
3. Endospore staining technique
4. Capsule staining technique
5. Cell wall staining technique



6. Lipid granule staining technique
7. Volutin granule staining technique
8. Flagella staining technique
9. Spirochaete staining from tooth tartar

**Evaluation (USMIC4502VS1): Total marks per course – 50**

Formative Assessment 'for' Learning

(continuous internal assessment - CIA to improve learning).

**CIA - 20 marks**

Summative Assessment 'of' Learning

(focus on outcomes, quantitative data for outcomes of instruction)

**End Semester Examination - 30 marks**

**Distribution of Bloom's Taxonomy levels for the assessment**

Learning Levels	Remember	Understand	Apply	Analyze	Evaluate	Create
Percentage	-	20%	35-45%	35-45%	-	-

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