



Syllabus

First Semester Courses in MICROBIOLOGY

2023-2024

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USMIC4501CR1 Introduction to the world of Microbiology
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USMIC4501VS1 Basic techniques in molecular biology
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APPROVED SYLLABUS



PRINCIPAL
ST. XAVIER'S COLLEGE
AUTONOMOUS
MUMBAI - 400 001.

F.Y.B.Sc. MICROBIOLOGY

Course Code: USMIC4501CRI

Title: Introduction to the world of Microbiology

Credits 4: 3 (Total 45 hr) and Practical 1 (Total 30 hr)

Course Objectives:

1. Recognize members of microbial world.
2. Learn branches and fields of microbiology.
3. Learn the fundamental aspects of prokaryotic cell structure and function
4. Learn and understand the principles of working of the light microscope and other modified microscopes and to know the differences between them.
5. Learn basic methods of culturing bacteria and staining them.
6. Develop analytical skills

Number of lectures: 45

Course Outcomes (COs):

1. Recognize, name members of the microbial world and state their position on the Universal Phylogenetic tree. Describe milestones in the field of Microbiology
2. Describe prokaryotic cell structure; compare Bacteria with Archaea; relate structure with function of various cell components
3. Elucidate principles of light, dark field, phase contrast microscopy; identify various structural components of a light microscope and relate structure with function; solve problems on light microscopy
4. Compare different types of microscopes, draw, label their ray diagrams and choose appropriate microscopy for observing a particular specimen
5. Explain principles underlying cultivation and staining of bacteria and select an appropriate method

Unit 1: Introduction, history and scope of microbiology

(15 Lectures)

1.
 - Microorganisms – definition **3L**
 - Microbes are ubiquitous
 - Members of the microbial world - bacteria, fungi, protists, archaea, viruses, viroids, prions (satellites)
2. Evolution of microbes, the three domains of life, concept of species **2L**

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| 3. | Historical foundations of Microbiology - biogenesis, abiogenesis, Indian Knowledge System: Sukshmjeevanu in Vedas | 4L |
| 4. | Branches of Microbiology - Physiology, Genetics, Bacteriology, Mycology, Virology, Protozoology, Parasitology, Ecology, Phycology, Taxonomy | 2L |
| 5. | Major fields of Microbiology - Medical, Public health microbiology and epidemiology, Food and Dairy, Industrial, Environmental, Agricultural, Biotechnology, Immunology, Genetic engineering and recombinant DNA technology | 4L |

Unit 2: Structure and function of bacteria

(15 Lectures)

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| 1. | <ul style="list-style-type: none">• Bacterial and Archaeal functional anatomy• Prokaryotic groups• Diagram of Prokaryotic cell organization | 2L |
| 2. | Cell Wall Structure and Gram Stain: Bacterial and Archaeal <ul style="list-style-type: none">• Composition and characteristics• Gram stain mechanism | 4L |
| 3. | Structure External to Cell Wall of Bacteria and Archaea <ul style="list-style-type: none">• Glycocalyx - Capsule, Slime S-layer, Demonstration of capsule• Pili, Fimbriae• Flagella: Structure, Motility, Chemotaxis, Staining | 3L |
| 4. | Structures Internal to Cell Wall of Bacteria and Archaea <ul style="list-style-type: none">• Cell Membrane: Bacterial and Archaeal• Cytoplasmic Matrix of Bacteria and Archaea• Cytoskeleton, Nucleoid, Plasmids, Ribosome• Inclusion granules: Composition, Function and Staining• Bacterial Endospores: Formation and Germination, examples of spore forming organisms, habitats, function, staining | 6L |

Unit 3: Methods for studying microorganisms: microscopy and basic culture techniques

(15 Lectures)

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| 1. | <ul style="list-style-type: none">• History of the Microscope• Lenses and bending of Light | 1L |
|----|---|----|

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| 2. | <ul style="list-style-type: none">• Light Microscopy• Bright field Microscopy: Objectives, Eyepiece, Condenser• Characteristics of lenses: Resolution, Magnification, Numerical Aperture, Focal Length, Working distance, Depth of Focus.• Specimen Preparation and Principles of Bacterial cell staining• Micrometry | 5L |
| 3. | <ul style="list-style-type: none">• Dark Field Microscopy | 1L |
| 4. | <ul style="list-style-type: none">• Phase Contrast and Differential Interference Contrast Microscopy | 1L |
| 5. | <ul style="list-style-type: none">• Methods of culturing microorganisms• Laboratory techniques for growing bacteria - an overview (collecting samples, inoculation, isolation, incubation, identification)• Categories of media based on physical state, chemical composition, functional type | 7L |

List of Recommended Reference Books:

1. Prescott's Microbiology, J.M. Willey, L.M. Sherwood, C.J. Woolverton, 12th International, edition 2023, McGraw Hill.
2. Kuhad U, Goel G, Maurya PK, Kuhad RC. Sukshmjeevanu in Vedas: The Forgotten Past of Microbiology in Indian Vedic Knowledge. Indian J Microbiol. 2021 Mar;61(1):108-110.
doi: 10.1007/s12088-020-00911-5. Epub 2020 Oct 19. PMID: 33505101; PMCID: PMC7810802
3. Prescott's Microbiology, J.M. Willey, L.M. Sherwood, C.J. Woolverton, 11th International, edition 2020, McGraw Hill.
4. Foundations in Microbiology, K. P. Talaro, 11th International edition 2020, McGraw Hill.
5. Foundations in Microbiology, K. P. Talaro, 10th International edition 2017, McGraw Hill.
6. Sachidananda Padhy (2016) Vedic Indians were Aware of the Microbial Biodiversity, Demanding 'Kannva' as the Father of Microbiology, Journal of Biodiversity, 7:2, 101-103, DOI: 10.1080/09766901.2016.11884762)

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
 12. Study of autoclave
 13. Staining of cell components – cell wall, capsule, metachromatic granules, lipid granules, flagella and endospores
 14. Staining of spirochaetes
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Evaluation (Core Theory): Total marks per course - 100.

- I. Formative Assessment 'for' Learning (continuous internal assessment - CIA to improve learning).
CIA – 40 marks
CIA 1: Written test – 20 marks
CIA 2: Model making – 20 marks
- II. 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.

Evaluation of (Practical) Total marks Practical course – 50.

CIA – 20 marks including journal marks

End Semester Practical Examination – 30 marks.

Template for the End Semester examination for the Core course

UNITS	KNOWLEDGE	UNDERSTANDING	APPLICATION and ANALYSES	TOTAL MARKS- Per unit
1	8	8	4	20
2	7	7	6	20
3	6	6	8	20
-TOTAL - Per objective	21	21	18	60
% WEIGHTAGE	35%	35%	30%	100%

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F.Y.B.Sc. MICROBIOLOGY

Course code: USMIC4501VS1

Title: Basic techniques in molecular biology

Credits 2 - Theory 1 (Total 15 hr) and Practical 1 (Total 30 hr)

Course Objectives:

1. To familiarize students with the basic laboratory tools used in molecular biology
2. To introduce basic methods in genomic and plasmid DNA isolation

Number of lectures: 45

Course Outcomes (COs):

1. Isolate genomic DNA and plasmid DNA from various biological sources
2. Perform restriction digestion of DNA
3. Demonstrate the presence of DNA and the restriction digests using agarose gel electrophoresis and quantitate using a spectrophotometer.
4. Demonstrate basic expertise in handling laboratory equipment used in molecular biology

Basic techniques in molecular biology

(15 Lectures)

1. Introduction to the structure of chromosomal DNA (gDNA) and their isolation **5L**
 - Principle, method and significance of gDNA isolation from plant cells
 - Principle, method and significance of gDNA isolation from animal cells
 - Principle, method and significance of gDNA isolation from bacterial cells
 - Differences between the methods of isolation from eukaryotic and prokaryotic cells
2. Introduction to the structure of plasmid DNA and their isolation **5L**
 - Principle, method and significance of isolation of plasmid vectors – (such as pUC18/19 and pGLO)
 - Restriction enzymes and significance of restriction digestion.
3. Detection and analysis of gDNA and plasmid DNA **5L**
 - Use of spectrophotometer in detection and quantification of macromolecules
 - Principle, method and significance of Agarose gel electrophoresis
 - Serum electrophoresis – a variation of agarose gel electrophoresis

List of Recommended Reference Books:

1. iGenetics – a molecular approach, Peter Russell, 3rd edition, 2020, Pearson Publications
 2. Biochemical Calculations, Irwin H. Segel, 2nd Edition, 2010, John Wiley & Sons
 3. Molecular Cloning: A Laboratory Manual (3 Volume Set), J. Sambrook, E. F. Fritsch, T. Maniatis, 2nd ed., 1989, Cold Spring Harbor Laboratory Pr.
 4. Methods in Microbiology, Norris & Ribbons Volume VB, 1971, Academic Press
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Practical

1. Use of Micropipettes and their calibration.
 2. Isolation of genomic DNA from bacteria, plant source and animal source
 3. Determination of lambda max and study of Beer-Lambert's law using colorimeter and spectrophotometer
 4. Estimations of DNA by chemical method using colorimeter
 5. Estimation of DNA samples using UV-Vis spectrophotometer.
 6. Plasmid Isolation and restriction digestion
 7. Visualization of DNA using Horizontal gel electrophoresis - agarose gel electrophoresis
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Evaluation (Vocational Skill Course): Total marks per course – 50

- I. Formative Assessment 'for' Learning (continuous internal assessment - CIA to improve learning) – Journal Report
CIA 1 – 20 marks
- II. Summative Assessment 'of' Learning (focus on outcomes, quantitative data for outcomes of instruction).
End Semester Examination – 30 marks

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Template for End Semester examination for Vocational Skill Course

UNITS	KNOWLEDGE	UNDERSTANDING	APPLICATION and ANALYSES	TOTAL MARKS- Per unit
Theory	5	5	10	20
Practical	5	5	20	30
TOTAL	10	10	30	50
% WEIGHTAGE	20	20	60	100%

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