



Syllabus

Second Semester Courses in MICROBIOLOGY

2023-2024

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USMIC4502CR1 Elements of microbial nutrition, growth and control
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APPROVED SYLLABUS



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

F.Y.B.Sc. MICROBIOLOGY

Course code: USMIC4502CRI

Title: Elements of Microbial Nutrition, Growth and Control

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

Course Objectives:

1. Understand the basic concepts of microbial nutrition, growth and its measurement
2. Gain knowledge of the principles and basic methods involved in the study and control of microbes
3. Develop analytical and problem-solving skills

Number of lectures: 45

Course Outcomes (COs):

1. State nutritional requirements of microorganisms, give examples of nutritional types of microbes and give examples of microbes that fall in each type.
2. Compare various strategies for preservation of microbes.
3. Describe bacterial growth curve, explain and illustrate different methods of microbial growth measurement.
4. Explain and discern physical and chemical methods in microbial control and be able to distinguish between terms such as disinfection, sterilization and sanitation.
5. Choose a suitable method for control of microorganisms and justify its use.

Unit 1: Microbial Nutrition

(15 Lectures)

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| 1. | • Nutritional requirements- Carbon, Oxygen, Hydrogen, Nitrogen, Phosphorus, Sulphur and Growth factors | 2L |
| | • Chemical analysis of cell contents – chemical composition of a Gram positive and a Gram-negative organism | 1L |
| | • Nutritional types of microorganisms | 3L |
| | • Nutrient uptake mechanisms | 3L |
| | • Influence of environmental factors on growth | 3L |
| | • Preservation of microorganisms | 3L |

Unit 2: Microbial growth (15 Lectures)

1. • Definition of growth, Mathematical expression, Growth curve 3L
2. Measurement of Growth 6L
 - Direct Microscopic count- Breeds, Petroff-Hausser counting chamber, Haemocytometer
 - Viable count- Spread plate and Pour plate technique, Membrane filtration
 - Electronic Counting
 - Measurement of cell mass
 - Turbidity measurements- Nephelometer and spectrophotometer techniques
 - Measurements of cell constituents.
3. Synchronous growth, Continuous growth (chemostat and turbidostat), Diauxic growth, Growth Yield (definition of terms) 2L
4. Microbial growth in natural environments, and viable non-culturable organisms 2L
5. Quorum sensing 2L

Unit 3: Control of Microorganisms (15 Lectures)

1. Definitions of frequently used terms 1L
2. Pattern/Rate of Microbial Death 1L
3. Conditions influencing the effectiveness of antimicrobial agents 1L
4. Physical Methods of Microbial Control 5L
 - Heat: Moist and Dry
 - Low temperature
 - Filtration
 - High pressure
 - Desiccation
 - Osmotic pressure
 - Radiations
5. Chemical methods of Microbial Control 4L
 - Phenolics
 - Biguanides – chlorhexidine
 - Alcohols
 - Halogens
 - Heavy Metals

- Quaternary ammonium compounds
 - Surface active agents
 - Aldehydes
 - Sterilizing gases
 - Peroxygens
 - Chemotherapeutic agents
6. Biological control of microorganisms 1L
7. Evaluation of effectiveness of antimicrobial agent 2L

List of Recommended Reference Books:

1. Prescott, Harley, Klein's Microbiology, J.M. Willey, L.M. Sherwood, C.J. Woolverton, 12th International, edition 2023, McGraw Hill.
 2. Foundations in Microbiology, K. P. Talaro, 11th International edition 2020, McGraw Hill.
 3. Prescott's Microbiology, J.M. Willey, K. M. Sandman, D. H. Wood , 11th edition 2020, McGraw-Hill Education.
 4. Foundations in Microbiology, K. P. Talaro, 10th edition 2018, McGraw-Hill Education.
 5. Brock Biology of Microorganisms, M.T. Madigan, K. S. Bender, D. H. Buckley, W. Matthew Sattley, D. A. Stahl- 15th Edition, 2019, Pearson Benjamin Cummings.
 6. General Microbiology, Stanier, Ingraham et al, 4th and 5th edition 1987, Macmillan education limited.
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Practical

1. Determination of optimum growth conditions of bacteria
2. Design of bacterial growth media
3. Preservation of cultures
4. Enumeration of bacteria
 - Microscopic cell count (Haemocytometer, Breed's Count)
 - Brown's opacity tubes
 - Viable count (Pour plate and Surface spread)
5. Growth curve of *E. coli* and determination of generation time
6. Control of microorganisms
 - Physical methods: Heat, Filtration, UV-Rays, Desiccation, Osmotic pressure
 - Chemical methods: Dyes, Phenolics, cetrimide, chemotherapeutics, Oligodynamic action

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: Problem solving (Microbial growth) – 10 marks and Digital scrapbook (chemical control of microbes) – 10 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 Core course End Semester examination

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

F.Y.B.Sc. MICROBIOLOGY

Course code: USMIC4501VSI

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

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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