SOMAIYA VIDYAVIHAR
K J Somaiya College of Science & Commerce
Autonomous (Affiliated to University of Mumbai)

Somaiya TRUST

NEP Syllabus

Of

MICROBIOLOGY

For
Bachelor of Science

Undergraduate Programme
And

Master of Science

Undergraduate Programme

From
Academic year
2023-24

F. Y. B.Sc. Syllabus with effect from the Academic year 2023–2024

Course No.	CourseTitle	CourseCode	Credits	Hr	Period (60 min)	Module	Lectures per module (60 minutes)	Examination		
								Internal Marks	External Marks	Total Marks
SEMESTER I										
Core courses THEORY										
I	Fundamentals of Microbiology	23USIMBCCIFMI	2	30	15	2	15	20	30	50
II	Basic Concepts of Microbiology	23USIMBCC2BCM	2	30	15	2	15	20	30	50
Core courses Practical										
		23USIMBP1 and 23US1MBP2	2	60	30			25	25	50
SEMESTER II										
Core courses THEORY										
I	Microbial Diversity and Growth	23US2MBCC1MDG	2	30	15	2	15	20	30	50
II	Applied Microbiology	23US2MBCC2AMI	2	30	15	2	15	20	30	50
Core courses Practical										
		23US2MBP1 and 23US2MBP2	2	60	30			25	25	50

F.Y. B. Sc. (Microbiology) SEMESTER I Core Course- I

COURSE TITLE: Fundamentals of Microbiology

COURSE CODE: 23US1MBCC1FMI [CREDITS – 02]

Course Learning Outcomes
After the successful completion of the Course, the learner will be able to: 1. State the significant historical events in Microbiology. 2. Describe structure and function of parts of a prokaryotic cell. 3. Classify microorganisms on the basis of nutrition. 4. Evaluate the different methods and nutrient media for cultivation and isolation of microorganisms. 5. Implement the different methods for preservation of microbial cultures.

Module 1	History of Microbiology and prokaryotic cell structure	[15 L]

Learning Objectives:

1. To state the significant events in the ancient, golden and modern age of Microbiology.
2. To recognize the applications of microorganisms.
3. To describe the structure and function of different cellular organelles of a prokaryotic cell.
4. To draw and label parts of a typical prokaryotic cell.
5. To recognize the significance of cell-wall, plasma membrane in maintaining turgorpressure.
6. To describe the structure and role of bacterial endospores.

Learning Outcomes:

After the successful completion of the module, the learner will be able to:

1. Cite the contributions of different scientists and discoveries in Microbiology.
2. State the role of microorganisms in environment, medicine and industrial fields.
3. Describe the structure and function of different components of a prokaryotic cell.
4. Compare the significance of various internal and external cellular structures of bacteria.

1.1	History & Scope of Microbiology	1 L
1.1.a.	Brief History of Microbiology: First observations Debate over spontaneous generation	1 L
1.1.b.	Golden age of Microbiology: The Birth of Modern Chemotherapy	
1.1.c.	Modern Developments in Microbiology: 1. Microbes and human welfare (in brief) 2. Only names of few emerging infections and their causative agents.	1 L
1.2	Morphology of Prokaryotic cells: Size, Shape and Arrangement	1 L

1.2. a	Plasma Membrane: The Fluid Mosaic model, Functions	2 L
1.2. b.	Cytoplasmic matrix – Inclusion bodies- types and significance of each, Ribosomes	2 L
1.2. c.	Bacterial chromosome (Nucleoid)	1 L
1.2.d.	Cell wall structure: Peptidoglycan Structure, Gram-Positive and Gram-Negative Cell Walls, Lipopolysaccharide layer, Functions of the cell wall	2 L
1.3.e.	Components external to cell wall- capsule, slime layer, flagella, fimbriae and pili Tactic Responses (Definitions)	3 L
1.2.f.	Bacterial endospores – structure and significance, stages in endospore formation.	1 L

References:

1. Tortora Funke and Case. (1998) Microbiology-An Introduction6th Edition. Addison Weseley Longman Inc.
2. Lansing M. Prescott, Harley and Klein. 2001. Microbiology. 5th Edition. McGraw Hill Higher Education, New York.
3. R. Y. Stanier, J. Ingraham, M. Wheelis and P.R. Painter. 2007. General Microbiology. 5th Edition, Prentice Hall. New Jersey.
4. Michael Pelczar. 2001. Microbiology. 5th Edition. Tata Mc Graw hill Education.

Module 2	**Nutrition, classification, isolation and preservation of microorganisms**	**[15 L]**

Learning Objectives:

1. To categorize the nutrients required for growth of microorganisms.
2. To describe the utilization of growth factors.
3. To tabulate the different nutritional types of microorganisms.
4. To prescribe culture media required for growth of different microorganisms.
5. To evaluate different methods of isolating and preserving microorganisms.

Learning Outcomes:

After the successful completion of the module, the learner will be able to:

1. Describe Macronutrients and Micronutrients required for microbial growth.
2. Explain the utilization of different growth factors.
3. Present an outline in a tabulation to represent different nutritional types of microorganisms.
4. State different types of culture media and their significance.
5. Apply isolation methods to obtain a pure culture.
6. Elaborate different methods of preserving microorganisms.

2.1	Nutritional requirements: Macronutrients and Micronutrients	1 L
2.2	Utilization of Elements: Nitrogen, Phosphorus and sulphur Growth Factors	2 L
2.3	Nutritional types of microorganisms: a) a) Photoorganoheterotrophs	3 L

	b) b) Photolithoautotrophs c) a) Chemoheterotrophs d) b) Chemo organoheterotrophs e) c) Chemo-lithoautotrophs f) d) Oligotrophs	
2.4	Types of culture media with examples: Physical types of media: Liquid, semi-solid and Solid media Chemical types of media: Defined and complex media Functional types of media: General purpose media, Selective media, Differential media, Enriched media, Enrichment media, Transport media	4 L
2.5	Isolation of microorganisms & pure culture techniques: 1. Isolation on solid media by streak plate methods- T-streak, Quadrant method 2. Viable count methods: a) Pour plate b) Spread plate	2 L
2.6	Preservation of microorganisms: Aim of preservation, Culture collection centres, methods of preservation (Serial subculture, mineral oil overlay, storage under liquid Nitrogen, Lyophilization, Soil stock method)	3 L

References:

1. Lansing M. Prescott, Harley and Klein. 2001. Microbiology. 5th Edition. McGraw Hill Higher Education, New York.
2. R. Y. Stanier, J. Ingraham, M. Wheelis and P.R. Painter. 2007. General Microbiology. 5th Edition. Prentice Hall. New Jersey.
3. M. Frobisher. 1974. Fundamentals of Microbiology. 9th Edition. W.B. Saunders Company.
4. 4. A H Patel. 1984. Industrial Microbiology. MacMillan. New Delhi.

Question paper Template
F.Y. B. Sc. (Microbiology) SEMESTER I
Core Course- I
COURSE TITLE: Fundamentals of Microbiology
COURSE CODE: 23US1MBCC1FMI [CREDITS – 02]

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	08	08	04	06	-	-	26
II	04	06	06	06	04	--	26
Total marks	12	14	10	12	04	--	52
% Weightage	23	27	19	23	8	--	100

F.Y. B. Sc. (MICROBIOLOGY) SEMESTER I Course- II
COURSE TITLE: Basic concepts of Microbiology
COURSE CODE:23US1MBCC2BCM
[CREDITS - 02]

Course Learning Outcomes		
After the successful completion of the Course, the learner will be able to: 1. Apply the basic principles of Microscopy and staining to observe bacterial cells. 2. Control the growth of microorganisms by applying an appropriate physical or a chemical method		
Module 1	**Microscopy**	**[15 L]**
Learning Objectives: 1. To define basic terms related to Microscopy. 2. To explore parts of Bright-field Microscope and their functions. 3. To describe the significance of Resolution and Numerical aperture. 4. To state the principle and brief working of advanced microscopic techniques. 5. To describe basic concepts of staining		
Learning Outcomes: After the successful completion of the module, the learner will be able to: 1. Define the basic terms related to Microscopy 2. Draw and label the parts of Bright-field Microscope. 3. Recognize the significance of resolution and numerical aperture in Microscopy. 4. Describe principle and working of advanced microscopic techniques. 5. Apply the principles of staining in experiments to study cytology of a bacterial cell.		
1.1	Basic terminology of Microscopy: 1. Focal length 2. Refraction, Reflection and magnification 3. The Light Microscope: Components; their features and functions. 4. Descriptions of Resolution and numerical aperture	3 L
1.2	Introduction to principle and brief working of: 1. Dark Field microscope 2. Phase Contrast microscope 3. Differential interference contrast Microscope 4. Fluorescence microscope 5. Transmission Electron Microscope-TEM 6. Scanning Electron Microscope- SEM	7 L
1.3	Staining of Specimen: 1. Fixation. 2. Dyes and simple staining. 3. Differential staining	5 L

	4. Special staining techniques (Cell wall, capsule, endospore, lipid granule, metachromatic granule staining, flagella, spirochaete)	

References:

1. Lansing M. Prescott, Harley and Klein. 2001. Microbiology. 5th Edition. McGraw Hill Higher Education, New York.
2. R. Y. Stanier, J. Ingraham, M. Wheelis and P.R. Painter. 2007. General Microbiology. 5th Edition, Prentice Hall. New Jersey.
3. Michael Pelczar. 2001. Microbiology. 5th Edition, Tata Mc Graw hill Education.
4. M. Frobisher. 1974. Fundamentals of Microbiology. 9th Edition. W.B. Saunders Company.
5. A.J. Salle. 1984. Fundamental Principles of Bacteriology. Tata McGraw-Hill Education.

Module 2	**Control of Microorganisms**	**[15 L]**

Learning Objectives:

1. To explore physical and chemical methods of controlling microbial growth.
2. To evaluate the effectiveness of the antimicrobial agent.

Learning Outcomes:

After the successful completion of the module, the learner will be able to:
1. Define the terms related to control of microbial growth.
2. Justify the significance of methods to control microbial growth.
3. Differentiate between the concepts of bacteriostatic and bactericidal agents.
4. Implement the different physical and chemical methods at laboratory level and domestic level to control microbial growth.
5. Evaluate the effectiveness of the antimicrobial agent by a suitable laboratory technique.

3.1	Basic Terminology: Definition; conditions influencing the effectiveness of antimicrobial agents	2 L
3.2	Physical methods of microbial control. Mode of action of: 1. Heat: Moist & dry 2. Low temperature 3. Filtration 4. High pressure 5. Radiation 6. Desiccation 7. Osmotic Pressure	8 L
3.3	Chemical methods of microbial control: Mode of action of: 1. Phenolics 2. Biguanides (Chlorhexidine) 3. Alcohols 4. Halogens 5. Heavy metals 6. Quaternary ammonium compounds	4 L

	7. Surface active agents 8. Aldehydes 9. Sterilizing Gases 10. Peroxygens	
3.4.	Evaluation of effectiveness of chemical antimicrobial agents: phenol co-efficient	1 L
3.5	Self-study/ case study/ sanitization measures for control of pandemic. practical	

References:

1. Lansing M. Prescott, Harley and Klein. 2001. Microbiology. 5th Edition. McGraw Hill Higher Education, New York.
2. R. Y. Stanier, J. Ingraham, M. Wheelis and P.R. Painter. 2007. General Microbiology. 5th Edition, Prentice Hall. New Jersey.
3. Tortora Funke and Case. 1998. Microbiology-An Introduction. 6th Edition. Addison Weseley Longman Inc.

Question paper Template
F.Y. B. Sc. (MICROBIOLOGY) SEMESTER I Course-II
COURSE TITLE: Basic concepts of Microbiology
COURSE CODE: 23US1MBCC2BCM
[CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	04	06	06	06	04	-	26
II	10	10	-	04	02	-	26
Total marks	14	16	06	10	06		52
% Weightage	26	31	12	19	12	--	100

F. Y. B. Sc. (MICROBIOLOGY)SEMESTER I - Practical
COURSE based on 23US1MBCCP1 and 23USMBCCP2 Credit- 02

Course outcomes

After the successful completion of the practical, the learner will be able to:

1. Mention the primary safety measures to be adopted while working with different microorganisms.
2. Describe the principle and working of different instruments in a Microbiology laboratory.
3. Prepare and sterilize media for cultivation of microorganisms.
4. Apply aseptic techniques of media inoculation in Microbiology.
5. Cultivate microorganisms in controlled environment.

Practical Course

Experiment Sr. No.	Title	Number of hours 60
1	Introduction to the laboratory, safety precautions in a Microbiology laboratory and disposal of biological waste	03
2	Study of cell structures	
	a) Monochrome staining	02
	b) Negative staining	02
3	Preparation of culture media	
	Liquid media (Nutrient broth) Solid media (Nutrient agar)	03
4	Preparation of slants, butts and plates	02
5	Inoculation techniques and study of growth	
	a) Liquid medium (Nutrient broth)	02
	b) Solid media –slants, butts and plates	02

	c) Study of colony characteristics of bacteria on Nutrient agar	03
	d) Use of differential (MacConkey agar)	02
6	Preservation of microorganisms	
	a) Preservation by mineral oil overlay	05
	b) Preservation by soil stock method	03
7	Care of Microscope	
8	Study of Compound Light Microscope	02
9	Differential staining-Gram staining	02
10	Special staining- a) Cell wall staining	02
	b) Lipid granule staining	02
	c) Endospore staining	02
11	Demonstration 1. Flagella staining 2. Spirochaete staining	02
12	Physical methods of control of microorganisms	
	a) Heat: Autoclaving Fractional sterilization, dry heat	03
	b) Bacteria Proof Filtration (Demonstration of membrane filtration)	03
	c) Effect of UV rays	04
	d) Effect of Desiccation	03
13	Evaluation of a disinfectant by paper disc diffusion method (Phenolics as a representative example)	04
14	Study of oligodynamic action	02

References:

1. Laboratory Manual in Microbiology by P. Gunasekaran, New Age International Publishers.
2. Laboratory manual in General Microbiology by N. Kannan, Palani Paramount publications.

F.Y. B. Sc. (MICROBIOLOGY) SEMESTER II
Course- I
COURSE TITLE: Microbial diversity and growth COURSE CODE: 23US2MBCC1MDG
[CREDITS - 02]

Course Learning Outcomes
After the successful completion of the Course, the learner will be able to: 1. Investigate the general characteristics and significance of diverse groups ofmicroorganisms 2. Evaluate the effect of different physical and chemical parameters on the growth of microorganisms.

Module 1	Study of microbial diversity	[15 L]

Learning Objectives:

1. To state the characteristics of structure of viruses.
2. To recognize the difference between lytic and lysogeny modes of viral life-cycles.
3. To describe the methods for cultivation of viruses.
4. To list the general characteristics and significance of diverse groups of microorganisms

Learning Outcomes:

After the successful completion of the module, the learner will be able to:

1. Explain the classification, morphological characteristics, cultivation and economic significance of yeasts, fungi molds and algae.
2. Compare and contrast the structural features and growth characteristics of viruses with other life forms.
3. Differentiate between the concepts of lytic and lysogeny modes of viral life-cycle.
4. Describe the general characteristics and significance of Rickettsia and Chlamydia.
5. Explain the general characteristics of Actinomycetes with specific reference to their significance.
6. Discuss the general characteristics and habitats of Archaebacteria.

1.1	Classification, morphological characteristics, cultivation and economic significance of: Yeasts, fungi molds and algae	5 L
1.2	Viruses: General characteristics and structure with emphasis on T even structure, medical significance of viruses (with special reference to Corona viruses) Viruses causing pandemic (only tabulation) Introduction to viral cultivation- animal viruses Lytic cycle-details, Lysogeny- definition Enumeration of phages	5 L
1.3	Rickettsia and Chlamydia: General characteristics, diseases and vectors	2 L

1.4	Actinomycetes: General Characteristics and Significance	2 L
1.5	Introduction to Archaebacteria, Characteristics, examples	1 L

References:

1. Lansing M. Prescott, Harley and Klein. 2001. Microbiology. 5th Edition. McGrawHill
Higher Education, New York.
2. R. Y. Stanier, J. Ingraham, M. Wheelis and P.R. Painter. 2007. General Microbiology.5th Edition. Prentice Hall. New Jersey.
3. Tortora Funke and Case. 1998. Microbiology-An Introduction. 6th Edition. Addison Weseley Longman Inc.
4. M. Frobisher. 1974. Fundamentals of Microbiology. 9th Edition. W.B. Saunders Company.
5. A.J. Salle. 1984. Fundamental Principles of Bacteriology. Tata McGraw-Hill Education.
6. Michael Pelczar. 2001. Microbiology. 5th Edition, Tata Mc Graw hill Education.

Module 2	Microbial growth	15 L

Learning Objectives:

1. To define the concept of microbial growth.
2. To state basic growth kinetics.
3. To measure the growth of microorganisms.
4. To summarize the effect of different environmental factors on microbial growth.

Learning Outcomes:

After the successful completion of the module, the learner will be able to:

1. Determine the growth rate of microorganisms.
2. Analyse the microbial growth by direct and indirect methods.
3. Differentiate between viable and non-viable count methods.
4. Justify the influence of different environmental factors on growth.

1.1	Basic growth terminology: Definition of growth, Prokaryotic cell cycle, give mathematical formulas.	1 L
1.2	Growth curve and phases of growth: Lag, Log, Stationary and Death phase	2 L
1.3	Measurement of growth: 1. Direct microscopic count, Haemocytometer. 2. Measurement of cell mass; growth yield. 3. Turbidity measurements-Nephelometric and Spectrophotometric techniques	3 L
1.4	Synchronous culture: Helmstetter Cumming technique Introduction to continuous culture (Chemostat and Turbidostat)	3 L
1.5	Influence of environmental factors on growth: pH Temperature Aeration Salinity Radiation	6 L

References:

1. Lansing M. Prescott, Harley and Klein. 2001. Microbiology. 5th Edition. McGraw Hill Higher Education, New York.
2. R. Y. Stanier, J. Ingraham, M. Wheelis and P.R. Painter. 2007. General Microbiology.5th Edition. Prentice Hall. New Jersey.
3. M. Frobisher. 1974. Fundamentals of Microbiology. 9th Edition. W.B. Saunders Company.
4. A.J. Salle. 1984. Fundamental Principles of Bacteriology. Tata McGraw-Hill Education.
5. Michael Pelczar. 2001. Microbiology. 5th Edition, Tata Mc Graw hill Education.

Question paper Template
F.Y. B. Sc. (MICROBIOLOGY) SEMESTER II
Course- I
COURSE TITLE: Microbial diversity and growth
COURSE CODE: 23US2MBCC1MDG
[CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	06	10	04	06	-	-	26
II	06	06	04	06	04	-	26
Total marks	12	16	08	12	04	-	52
% Weightage	23	31	15	23	8		100

F.Y. B. Sc. (MICROBIOLOGY) SEMESTER II
Course- II
COURSE TITLE: Applied Microbiology
COURSE CODE: 23US2MBCC2AMI
[CREDITS - 02]

Course Learning Outcomes		
After the successful completion of the Course, the learner will be able to: 1. Evaluate the role of microorganisms in air and soil habitats. 2. Describe the different water-borne, food-borne diseases. 3. Adopt appropriate prophylactic measure		
Module 1	**Microorganisms in Air and Soil**	**[15 L]**
Learning Objectives: 1. To list and describe different techniques to enumerate microbes in air. 2. To describe the microenvironment of a soil. 3. To recognize different microbial interactions. 4. To state the characteristics of different microbial associations with vascular plants.		
Learning Outcomes: After the successful completion of the module, the learner will be able to: 1. Quantify the microbial content of air. 2. Differentiate between different microorganisms in soil. 3. Appreciate the ecological significance of different microbial interactions. 4. Describe the salient features of the associations of microbes with vascular plants.		
1.1	Air Microbiology: a) Types and significance of organisms b) Transient nature of air microflora c) Air samplers and methods for enumeration of microbes in air.	3 L
1.2	Microorganisms in the Terrestrial environment. Soil as an environment and its diversity Microorganisms in the soil environment	2 L
1.3	Types of Microbial interactions (concept and one example of each): 1. Mutualism 2. Co-operation 3. Commensalism 4. Predation 5. Parasitism 6. Amensalism 7. Competition Human Microbiome: Concept, significance and associated different microorganisms	5 L
1.4	Microbial association with vascular plants:	5 L

	1. Phyllosphere 2. Rhizosphere and Rhizoplane 3. Mycorrhizae and its types 4. Fungal and bacterial endophytes 5. Mechanism of root nodule formation by *Rhizobium*	

References:

1. Microbiology. (2001),5th Edition. Lansing M. Prescott, Harley and Klein. McGraw Hill Higher Education, New York.
2. Fundamental Principles of Bacteriology. (1984) A.J. Salle. Tata McGraw-Hill Education

Module 2	Water Microbiology	15 L

Learning Objectives:

1. To describe different water-borne infections.
2. To implement prophylactic measures to avoid infections due to water contamination.

Learning Outcomes:

After the successful completion of the module, the learner will be able to:

1. Summarize different water-borne infections.
2. Apply suitable Microbiological tests to assess sanitary quality of water.
   Incorporate prophylactic measures to avoid infections due to water contamination.

2.1	General Account of water-borne infections: Surveillance of microbial infections: Recognition of an infectious disease in a population	3 L
2.1	Water borne infections: Symptoms and preventive measures for: Cholera, Amoebiasis and Giardiasis	2 L
2. 2	Determining sanitary quality of water: Bacteriological evidence of fecal pollution, indicators of fecal pollution. Biological indicators of fecal pollution. Microbiological analysis of water: SPC, Tests for coliform, MPN, IMViC reactions, membrane filter technique. Water purification in municipal water supply Source, mode of transmission, symptoms	7 L
2.4	Prevention and control: General preventive measures, Importance of personal hygiene, environmental sanitation and methods to prevent the spread of infectious agents transmitted by water.	3 L

References:

1. Microbiology. (2001),5th Edition. Lansing M. Prescott, Harley and Klein. McGraw HillHigher Education, New York.
2. Fundamental Principles of Bacteriology. (1984) A.J. Salle. Tata McGraw-Hill Education.
3. Textbook of Microbiology-Frobisher.

Question paper Template
F.Y. B. Sc. (MICROBIOLOGY) SEMESTER II
Course- II
COURSE TITLE: Applied Microbiology
COURSE CODE: 23US2MBCC2AMI
[CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	04	06	06	06	04	-	26
II	04	06	06	06	04	-	26
Total marks	08	12	12	12	08	-	52
% Weightage	15	23	23	23	16	--	100

F. Y. B. Sc. (MICROBIOLOGY)
SEMESTER II - Practical
COURSE based on 23US2MBCCP1 and 23US2MBCCP2 Credit- 02

Course Outcomes:

After the successful completion of the practical, the learner will be able to:
1. Implement different techniques to enumerate microbial growth.
2. Monitor microbial growth under controlled conditions.
3. Cultivate different types of microorganisms.

List of experiments

Experiment Sr. No.	Title	Number of hours 60
1	Study of motility (Hanging drop preparation)	02
2	Determination of optimum growth conditions a) Temperature b) pH c) Salinity d) Aeration	06
3	Measurement of microbial growth a) Preparation of opacity tubes and determination of cell count b) Enumeration of cells using Haemocytometer b) Growth curve of *E. coli* and determination of generation time (group experiment)	10
4	Enrichment and isolation of coliphage from sewage. (Demonstration)	02
5	Cultivation of yeasts and molds	04
	a) Cultivation on Sabourauds agar	03
	b) Fungal wet mounts and study of morphological characteristics	03
	c)Slide culture technique	03
6	Cultivation and Permanent slides of	
	i) Blue-green algae	02
	ii) Protozoa	02
7	Study of air microflora and determination of sedimentation rate.	04
8	Winogradsky column	06
9	Bacteriological analysis of water MPN, presumptive, confirmed and completed	10
10	IMViC test	03

References:

1. Laboratory Manual in Microbiology by P. Gunasekaran, New Age International Publishers.
2. Laboratory manual in General Microbiology by N. Kannan, Palani Paramount publications.