SOMAIYA VIDYAVIHAR

K J Somaiya College of Science & Commerce

Autonomous (Affiliated to University of Mumbai)

Somaiya TRUST

F. Y. B. Sc. Microbiology
Revised Syllabus
to be implemented
from the
Academic year 2021-2022

Preamble

Microbiology, to the common man, is the study of invisible mini wonders that only cause disease. In reality, the vast majority of microorganisms co-exist alongside us without causing any harm. On the contrary, many of them are required for our survival. Microbiology is a study of this microscopic world. It is a research-oriented subject and plays a pivotal role in our daily lives.

Microbiology is an indispensable part of our routine life. We are associated with the diverse world of microorganisms and depend on the different products produced by them. Microbiome is essential for the functioning of human development and immunity. Along with this the presence of microorganisms in air, soil and water substantiates their environmental significance. Basically, Microbiology is the branch of science which deals with study of microorganisms with emphasis on their morphology, biochemistry and industrial applications in diverse fields. Microbial cell-based technologies enhance our quality of life by providing new solutions to problems in health, environment and energy sector.

The syllabi for the three-year undergraduate programme are designed to enable the students to understand and select an area of their interest to pursue further studies for post-graduation.

Syllabus - F. Y. B.Sc. Microbiology

Course No.	Course Title	Course Code	Credits	Hr	Periods (50 min)	Module	Lectures per module (50 minutes)	Examination		
								Internal Marks	External Marks	Total Marks
SEMESTER I										
Core courses THEORY										
I	Basic Concepts of Microbiology	2IUSIMCCCIBCM	2	30	36	3	12	40	60	100
II	Applied Microbiology	2IUSIMBCC2APM	2	30	36	3	12	40	60	100
Core courses PRACTICAL										
		2IUSIMBP	2	75	90			40	60	100
SEMESTER II										
Core courses THEORY										
I	Fundamentals of Microbiology	2IUS2MBCCIFMI	2	30	36	3	12	40	60	100
II	Introduction to Environmental and Industrial Microbiology	2IUS2MBCC2EIM	2	30	36	3	12	40	60	100
Core courses PRACTICAL										
		2IUS2MBP	2	75	90			40	60	100

F.Y. B. Sc. (Microbiology) SEMESTER I

Core Course- I

COURSE TITLE: Basic Concepts of Microbiology

COURSE CODE: 21USIMBCC1BCM [CREDITS – 02]

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

Module 1	Introduction to Microbiology and Chemical basis of life	[12L]

Learning Objectives:

The module is intended to:

1. State the significant events in the ancient, golden and modern age of Microbiology.
2. Recognize the applications of microorganisms.
3. List the properties of different chemical bonds in biomolecules.
4. Describe the structure and role of water, carbohydrates, lipids, amino acids, proteins and nucleic acids.

Learning Outcome:

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. List the different types of chemical bonds in biomolecules. 4. Describe the structural attributes and significance of water, carbohydrates, lipids, amino acids, proteins and nucleic acids		
1.1	**History & Scope of Microbiology:**	[2L]
1.1.a.	**Brief History of Microbiology:** First observations Debate over spontaneous generation	
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.	
1.2	**Chemical basis of life:** Revision of basic chemical structure of an atom and different chemical bonds. **Types of chemical bonds and their relevance in biomolecules:** 1. Ionic 2. Covalent 3. Hydrogen	[1L]
1.3	**Definition, general characteristic & functions of biomolecules**	
1.3.a.	**Structure and Role of water:** Polar nature of water and its four characteristics	[1L]

1.3.b.	**Carbohydrates:** Description of structure and functions of: 1. Monosaccharides (Hexoses, pentoses) 2. Disaccharides (Lactose, Maltose, Sucrose) 3. Polysaccharides (Function of: Glycogen, Cellulose, Dextran, Chitin and Starch) 4. Significance of sugar derivatives: Inulin, Pectin, Mannitol, Inositol, Gluconic acid	[2L]
1.3.c.	**Amino- acids and Proteins:** 1. 20 standard amino acids and their classification. 2. Basic stereochemistry Peptide bond and its features 3. Levels of structure of proteins: Brief description of: a) Primary structure b) Secondary structure c) Tertiary structure d) Quaternary structure	[3L]
1.3.d.	**Lipids:** Structure and function of": a) Simple lipids b) Complex lipids	[3L]

Reference:

- Microbiology. (2001),5th Edition. Lansing M. Prescott, Harley and Klein. McGraw Hill Higher Education, New York.

- Microbiology-An Introduction. (1998) 6th Edition. Tortora Funke and Case. Addison Weseley Longman Inc.

Module 2	Prokaryotic Cell structure- functions	[12L]

Learning Objectives:

The module is intended to:

1. Describe the structure and function of different cellular organelles of a prokaryotic cell.
2. Draw and label parts of a typical prokaryotic cell.
3. Recognize the significance of cell-wall, plasma membrane in maintaining turgor pressure.
4. Describe the structure and role of bacterial endospores.

Learning Outcome:

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

1. Describe the structure and function of different components of a prokaryotic cell.
2. Compare the significance of various internal and external cellular structures of bacteria

2.1	Morphology of Prokaryotic cells: Size, Shape and Arrangement	[1L]
2.2	Plasma Membrane: The Fluid Mosaic model, Functions	[2L]
2.3	Cytoplasmic matrix – Inclusion bodies- types and significance of each, Ribosomes	[2L]
2.4	Bacterial chromosome (Nucleoid)	[1L]

2.5	Cell wall structure: Peptidoglycan Structure, Gram-Positive and Gram-Negative Cell Walls, Lipopolysaccharide layer, Functions of the cell wall	[2L]
2.6	Components external to cell wall- capsule, slime layer, flagella, fimbriae and pili Tactic Responses (Definitions)	[3L]
2.7	Bacterial endospores – structure and significance, stages in endospore formation.	[1L]

References:

- Microbiology. (2001),5th Edition. Lansing M. Prescott, Harley and Klein. McGraw Hill Higher Education, New York.
- General Microbiology. (2007) 5th Edition, R. Y. Stainier, J. Ingraham, M. Wheelis and P.R. Painter. Prentice Hall. New Jersey.
- Microbiology-An Introduction. (1998) 6th Edition. Tortora Funke and Case. Addison Weseley Longman Inc.
- Microbiology. (2001) 5th Edition, Michael Pelczar. Tata Mc Graw hill Education.

Module 3	Microbial Nutrition, Cultivation and Isolation	[12L]

Learning Objectives:

The module is intended to:

1. Categorize the nutrients required for growth of microorganisms.
2. Describe the utilization of growth factors.
3. Tabulate different nutritional types of microorganisms.
4. Prescribe culture media required for growth of different microorganisms.
5. Evaluate different methods of isolating microorganisms

Learning Outcome:

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, their features and significance. 5. Apply isolation methods to obtain a pure culture.		
3.1	**Nutritional requirements:** Macronutrients and Micronutrients	[1L]
3.2	**Utilization of Elements:** Nitrogen, Phosphorus and sulphur Growth Factors	[2L]
3.3	**Nutritional types of microorganisms:** **Characteristic features of:** **Photoautotrophs:** a) Photoorganoheterotrophs b) Photolithoautotrophs **Heterotrophs:** a) Chemoheterotrophs b) Chemo organoheterotrophs c) Chemo-lithoautotrophs d) Oligotrophs	[2L]
3.4	**Types of culture media with examples:** **Physical types of media:** Liquid, semi-solid and Solid media **Chemical types of media:** Defined and complex media	[5L]

	Functional types of media: General purpose media, Selective media, Differential media, Enriched media, Enrichment media, Transport media	
3.5	**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	[2L]

References:

- Microbiology. (2001),5th Edition. Lansing M. Prescott, Harley and Klein. McGraw Hill Higher Education, New York.
- General Microbiology. (2007) 5th Edition, R. Y. Stainier, J. Ingraham, M. Wheelis and P.R. Painter. Prentice Hall. New Jersey.
- Fundamentals of Microbiology. (1974) 9th Edition. M. Frobisher. W.B. Saunders Company.
- Industrial Microbiology (2000). L Casida. New Age International Publishers. New Delhi.
- Industrial Microbiology. (1984) A H Patel. MacMillan. New Delhi.
- Principles of Fermentation Technology. (1997) 2nd Edition. Stanbury P. F., Whitaker A. &Hall--S. J. Aditya Books Pvt. Ltd, New Delhi.
- Fermentation Microbiology and Biotechnology, (2012) E. L. Mansi,3rd Edition.

Question paper Template

F.Y. B. Sc. (Microbiology) SEMESTER I

Core Course- I

COURSE TITLE: Basic Concepts of Microbiology

COURSE CODE: 21USIMBCCIBCM [CREDITS – 02]

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	04	12	04	06	04	-	30
II	4	12	00	10	4	-	30
III	4	6	6	10	4	-	30
Total marks per objective	12	30	10	26	12	-	90
% Weightage	13	33	11	30	13	-	100

F.Y. B. Sc. (MICROBIOLOGY) SEMESTER I

Course- II

COURSE TITLE: Applied Microbiology

COURSE CODE: 21USIMBCC2APM

[CREDITS - 02]

Course Learning Outcome
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. Cultivate yeasts, fungi, molds and algae at laboratory level. 3. Recognize the economic significance of yeasts, fungi, molds and algae. 4. Control the growth of microorganisms by applying an appropriate physical or a chemical method.

Module 1	Microscopy	[12L]

Learning Objectives:

The module is intended to

1. Define basic terms related to Microscopy.
2. Explore parts of Bright-field Microscope and their functions.
3. Describe the significance of Resolution and Numerical aperture.
4. State the principle and brief working of Phase-contrast Microscope and Differential Interference Contrast Microscope.
5. Describe basic concepts of staining

Learning Outcome:

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. To recognize the significance of Resolution and numerical aperture in Microscopy. 4. Describe principle and working of Phase-contrast Microscope and Differential Interference Contrast Microscope. 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	[5L]
1.2	**Introduction to principle and brief working of:** 1. Dark Field Microscope 2. Phase Contrast Microscope; 3. Differential interference contrast Microscope	[2L]
1.3	**Staining of Specimen:** 1. Fixation. 2. Dyes and simple staining. 3. Differential staining	[5L]

References:

- Microbiology. (2001),5th Edition. Lansing M. Prescott, Harley and Klein. McGraw Hill Higher Education, New York.
- General Microbiology. (2007) 5th Edition, R. Y. Stainier, J. Ingraham, M. Wheelis and P.R. Painter. Prentice Hall. New Jersey.

- Microbiology. (2001) 5th Edition, Michael Pelczar. Tata Mc Graw hill Education.

Module 2	Eukaryotic Cell Structure and Function	[12L]

Learning Objectives:

The module is intended to:

1. Differentiate between prokaryotic and eukaryotic cells.
2. List the morphological characteristics of yeasts, fungi, molds and algae.
3. State the economic significance of yeasts, fungi, molds and algae.
4. Describe the cultivation of yeasts, fungi, molds and algae.
5. Obtain an introductory account of features of protozoa.

Learning Outcome:

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

1. List the morphological features of yeasts, fungi, molds and algae.
2. Compare and contrast between sexual and asexual methods of reproduction in fungi.
3. Explore the economic importance of yeasts, fungi, molds and algae.
4. Perform experiments to cultivate bacteria and fungi using suitable media at laboratory level.
5. Describe the characteristics of yeasts, fungi, molds, algae and protozoa.

2.1	Difference between Prokaryotes and Eukaryotes -Tabulation.	[1L]
2.2	Classification, Morphological characteristics, Cultivation, reproduction and economic significance of: a) Yeasts, fungi and Molds. b) Life cycle of *Saccharomyces cerevisiae, Schizosaccharomyces*and *Rhizopus stolonifer* Algae and life cycle of *Chlamydomonas*	[5L] [4L]

2.3	Introduction to Protozoa	[2L]

References:

- Microbiology. (2001),5th Edition. Lansing M. Prescott, Harley and Klein. McGraw Hill Higher Education, New York.
- Microbiology. (2001) 5th Edition, Michael Pelczar. Tata Mc Graw hill Education.

Module 3	Control of Microorganisms	[12L]

Learning Objectives:

The module is intended to:

1. Define basic terminology related to antimicrobial techniques.
2. Explore physical and chemical methods of controlling microbial growth.
3. Evaluate the effectiveness of the antimicrobial agent.

Learning Outcome:

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

1. Define the terms related to control of microbial growth.
2. Appreciate the importance 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	[1L]
3.2	**Physical methods of microbial control. Mode of action of:**	[5L]

	1. Heat: Moist & dry 2. Low temperature 3. Filtration 4. High pressure 5. Radiation 6. Desiccation 7. Osmotic Pressure	
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 7. Surface active agents 8. Aldehydes 9. Sterilizing Gases 10. Peroxygens	[5L]
3.4	**Evaluation of Effectiveness of Chemical Antimicrobial Agents:** Phenol co-efficient	[1L]
3.5	Self-study/ Case study/ sanitization measures for control of pandemic.	

References:

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

Question paper Template

F.Y. B. Sc. (MICROBIOLOGY) SEMESTER I

Course- II

COURSE TITLE: Applied Microbiology

COURSE CODE: 21USIMBCC2APM

[CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	04	10	06	06	04	-	30
II	10	20	-	-	-	-	30
III	16	10	-	04	-	-	30
Total marks per objective	30	40	06	10	04	-	90
% Weightage	33	45	7	11	4	-	100

F. Y. B. Sc. (MICROBIOLOGY)

SEMESTER I - Practical

COURSE CODE: 21USIMBCCP Credit- 02

Learning Objectives:

The Practical is intended to

1. Demonstrate basic aseptic techniques in Microbiology.
2. Describe the primary safety measures to be adopted while working with different microorganisms.
3. Describe the principle and working of different instruments in a Microbiology laboratory.

Learning Outcomes:

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

1. Implement basic aseptic techniques in practical related to microbial cultures and their characterization.
2. Apply primary qualitative biochemical tests to detect the presence of a biomolecule.

Core Course I	Basic Concepts of Microbiology

Experiment Sr. No.	Title and Number of credits	Number of hours
1	Safety Precautions in a Microbiology laboratory and disposal of biological waste	02
2	Qualitative test for carbohydrates- Demonstration	2.5

3	Qualitative test for proteins and amino acids	2.5
4	Qualitative tests for Nucleic acids: DNA and RNA	2.5
5	Study of cell structures	
	Monochrome staining	2.5
	b) Negative staining	2.5
6	Preparation of culture media	
	Liquid media (Nutrient broth)	O2
	Solid media (Nutrient agar, Sabouraud's agar)	O2
	Preparation of slants, butts and plates	2.5
7.	Inoculation techniques and study of growth	
	a) Liquid medium (Nutrient broth)	O2
	b) Solid media –slants, butts and plates	O2
	c) Study of colony characteristics of bacteria on Nutrient agar	2.5
	d) Use of differential (MacConkey agar), selective (Salt Mannitol Agar) and enriched media (Superimposed Blood agar Demonstration)	2.5

Core Course II	Applied Microbiology

Experiment Sr. No.	Title and Number of credits	Number of hours
1	Care of Microscope.	O1
2	Study of Compound Light Microscope	2.5
3	Differential staining-Gram staining	2.5
4	Physical methods of control of microorganisms	2.5

	a) Heat: Autoclaving Fractional sterilization, dry heat	O1
	b) Bacteria Proof Filtration (Demonstration of membrane filtration)	2.5
	c) Effect of UV rays (Demonstration)	2.5
	d) Effect of Desiccation	O1
5	Evaluation of a disinfectant by paper disc diffusion method (Phenolics as a representative example)	O1
6	Effect of soap as a disinfectant	O2
7	Study of oligodynamic action	O1
	Effect of storage of water in copper vessel group experiment)	1.5
8	Cultivation of yeasts and molds	O2
	a) Cultivation on Sabourauds agar	O2
	b) Fungal wet mounts and study of morphological characteristics	2.5
9	Cultivation and Permanent slides of	2.5
	i) Blue-green algae	O2
	ii) Protozoa	2.5

References:

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

- Fundamentals of Microbiology. (1974) 9th Edition. M. Frobisher. W.B. Saunders Company.
- Fundamental Principles of Bacteriology. (1984) A.J. Salle. Tata McGraw-Hill Education.
- Microbiology. (2001) 5th Edition, Michael Pelczar. Tata Mc Graw hill Education.
- Outlines of Biochemistry, (2006) 5th Edition. Conn P. Stumpf G Bruening and R Doi. John Wiley and Sons. New York. 1995.
- Industrial Microbiology (2000). L Casida. New Age International Publishers. New Delhi.
- Industrial Microbiology. (1984) A H Patel. MacMillan. New Delhi.
- Principles of Fermentation Technology. (1997) 2nd Edition. Stanbury P. F., Whitaker A. &Hall--S. J. Aditya Books Pvt. Ltd, New Delhi.
- Fermentation Microbiology and Biotechnology, (2012) E. L. Mansi,3rd Edition.

F.Y. B. Sc. (MICROBIOLOGY) SEMESTER II

Course- I

COURSE TITLE: Fundamentals of Microbiology

COURSE CODE: 21US2MBCC1FMI

[CREDITS - 02]

Course Learning Outcome
After the successful completion of the Course, the learner will be able to: 1. Evaluate the effect of different physical and chemical parameters on the growth of microorganisms. 2. Recall the principle and working of advanced microscopic techniques.

3. Demonstrate cellular structures by specific staining methods.
4. Investigate the general characteristics and significance of viruses, *Rickettsia, Chlamydia*, Actinomycetes and Archaebacteria.

Module 1	Microbial Growth	[12L]

Learning Objectives:

The module is intended to:

1. Define the concept of microbial growth.
2. State basic growth kinetics.
3. Measure the growth of microorganisms.
4. Regulate the growth of microorganisms by controlling different environmental factors.

Learning Outcome:

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. Appreciate the influence of different environmental factors on growth.

1.1	**Basic growth terminology:** Definition of growth, Prokaryotic cell cycle, give mathematical formulas.	[1L]
1.2	**Growth curve and phases of growth:** Lag, Log, Stationary and Death phase (VBNC)	[1L]
1.3	**Measurement of growth:** 1. Direct microscopic count, Haemocytometer. 2. Measurement of cell mass; growth yield.	[5L]

	3. Turbidity measurements-Nephelometric and Spectrophotometric techniques	
1.4	**Synchronous culture** Helmstetter Cumming technique	[1L]
1.5	**Influence of environmental factors on growth:** pH Temperature Aeration	[4L]

References:

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

Module 2	Specialized Microscopy and Special staining methods	[12L]

Learning Objectives:

The module is intended to:

1. cite different versions of Advanced Microscopy.
2. State the principle and describe working of Fluorescence microscopy, TEM and SEM.

3. Introduce the newer techniques such as Confocal Microscopy, Scanning Probe, Scanning Tunnelling and Atomic Force Microscopy techniques. 4. List the steps of specimen preparation for different microscopic methods. 5. State the principle and represent an outline of different staining methods for specific cellular structures.		
Learning Outcome: After the successful completion of the module, the learner will be able to: 1. Compare and contrast between different advanced microscopic methods. 2. Recognize the significance of the newer techniques such as Confocal Microscopy, Scanning Probe, Scanning Tunnelling and Atomic Force Microscopy techniques. 3. Implement the steps of specimen preparation for different microscopic methods. 4. Incorporate the methods of staining of specific cellular structures to study cytology.		
2.1	**Principle and working of:** Fluorescence Microscope.	[1L]
2.2	**The Electron Microscope:** Transmission Electron Microscope-TEM Scanning Electron Microscope- SEM	[2L]
2.3	**Specimen Preparation** in: Transmission Electron Microscope-TEM Scanning Electron Microscope- SEM Negative Staining, shadowing with metals, Freeze etching	[3L]
2.4	**Newer techniques in Microscopy**: Principle and working of Confocal Microscopy Introduction to:	[2L]

	Scanning probe Microscopy (Examples-The Scanning Tunnelling Microscope, The Atomic Force Microscope)	
2.5	**Staining specific structures:** Cell-wall, Capsule, Endospore, Metachromatic and Lipid granules, Flagella, Spirochete.	[4L]

References:

- Microbiology. (2001),5th Edition. Lansing M. Prescott, Harley and Klein. McGraw Hill Higher Education, New York.
- Microbiology-An Introduction. (1998) 6th Edition. Tortora Funke and Case. Addison Weseley Longman Inc.
- Microbiology. (2001) 5th Edition, Michael Pelczar. Tata Mc Graw hill Education.

Module 3	Study of Viruses, Rickettsia, Chlamydia, Actinomycetes and Archaebacteria	[12L]

Learning Objectives:

The module is intended to:

1. state the characteristics of structure of viruses.
2. recognize the difference between lytic and lysogeny modes of viral life-cycles.
3. escribe the methods for cultivation of viruses.
4. list the general characteristics and significance of Rickettsia, Chlamydia, Actinomycetes and Archaebacteria.

Learning Outcome:

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

1. Compare and contrast the structural features and growth characteristics of viruses with other life forms.

2. Differentiate between the concepts of lytic and lysogeny modes of viral life-cycle. 3. Describe the general characteristics and significance of Rickettsia and Chlamydia. 4. Explain the general characteristics of Actinomycetes with specific reference to their significance. 5. Discuss the general characteristics and habitats of Archaebacteria.		
3.1	**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	[7L]
3.2	**Rickettsia and Chlamydia:** General characteristics, diseases and vectors	[2L]
3.3	**Actinomycetes:** General Characteristics and Significance	[2L]
3.4	Introduction to Archaebacteria, Characteristics, examples	[1L]

References:

- Microbiology. (2001),5th Edition. Lansing M. Prescott, Harley and Klein. McGraw Hill Higher Education, New York.
- General Microbiology. (2007) 5th Edition, R. Y. Stainier, J. Ingraham, M. Wheelis and P.R. Painter. Prentice Hall. New Jersey.
- Microbiology-An Introduction. (1998) 6th Edition. Tortora Funke and Case. Addison Weseley Longman Inc.
- Fundamentals of Microbiology. (1974) 9th Edition. M. Frobisher. W.B. Saunders Company.

- Fundamental Principles of Bacteriology. (1984) A.J. Salle. Tata McGraw-Hill Education.
- Microbiology. (2001) 5th Edition, Michael Pelczar. Tata Mc Graw hill Education.

Question paper Template

F.Y. B. Sc. (MICROBIOLOGY) SEMESTER II

Course- I

COURSE TITLE: Fundamentals of Microbiology

COURSE CODE: 21US2MBCC1FM1

[CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	10	10	06	04	-	-	30
II	04	10	06	06	04	-	30
III	04	10	06	06	04	-	30
Total marks per objective	18	30	18	16	08	-	90
% Weightage	20	33	20	18	09	-	100

F.Y. B. Sc. (MICROBIOLOGY) SEMESTER II

Course- II

COURSE TITLE: Introduction to Environmental and Industrial Microbiology

COURSE CODE: 21US2MBCC2EIM

[CREDITS - 02]

Course Learning Outcome
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. Represent the methods for potable water quality analysis and treatment of wastewater. 3. Recall the basic design of a fermenter and the parts of a fermentation process. 4. Implement different methods for preservation of microorganisms.

Module 1	Microorganisms in Air and Soil	[12L]

Learning Objectives:

The module is intended to:

1. List and describe different techniques to enumerate microbes in air.
2. Describe the microenvironment of a soil.
3. Recognize different microbial interactions.
4. State the characteristics of different microbial associations with vascular plants.

Learning Outcome:

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) Techniques to enumerate air microflora	[2L]
1.2	**Microorganisms in the Terrestrial environment.** Soil as an environment and its diversity Microorganisms in the soil environment	[2L]
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 8. Human Microbiome	[3L]
1.4	**Microbial association with vascular plants:** Phyllosphere . Rhizosphere and Rhizoplane . Mycorrhizae . Fungal and bacterial endophytes . Root nodule formation by *Rhizobium*	[5L]
References:		

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

Module 2	Microbiology of potable water and wastewater	[12L]

Learning Objectives:

The module is intended to:

1. Describe the methods of treatment of potable water.
2. Analyse the bacteriological quality of water.
3. Evaluate the different methods of waste-water treatment.

Learning Outcome:

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

1. Recall the methods of treatment of potable water.
2. Interpret the results for tests performed to evaluate the bacteriological quality of potable water.
3. Summarize the wastewater treatment methods.

2.1	**Classes of natural waters** Atmospheric waters, surface waters stored waters and ground waters	[1L]
2.2	**Microbiology of potable water supplies** a) Preventive treatment b) Filter plants i. Sedimentation ii. Filtration iii. Disinfection	[2L]

2.3	**Bacteriological examination of potable water** a) Index organisms of fecal pollution (Coliform group, other index organisms, significance of index organisms) b) Routine bacteriological analysis i. Standard Place Count ii. Test for coliforms (Presumptive, confirmed and completed test) iii. Differentiation of fecal from non-fecal coliform groups iv. Membrane filter method	[5L]
2.4	**Wastewater treatment** a) Composition of sewage and microorganisms in sewage b) Treatment i. Physical or mechanical treatment ii. Biological stabilization of sewage (Aerobic and Anaerobic processes) iii. Chemical treatment (Chlorination) and final disposal	[3L]
2.5	Waterborne diseases (representation in a tabular form	[1L]

References:

- Fundamentals of Microbiology. (1974) 9th Edition. M. Frobisher. W.B. Saunders Company.

Module 3	Industrial Microbiology	[12L]
Learning Objectives: The module is intended to: 1. Describe different microbial products obtained from industrial productions. 2. Illustrate the steps of primary and secondary screening. 3. Sketch the basic design of a fermenter. 4. Elaborate the different methods of preservation of microorganisms.		
Learning Outcome: After the successful completion of the module, the learner will be able to: 1. State the significance of industrial processes and the different microbial industries based on products. 2. Recall the steps of primary and secondary screening. 3. Illustrate the components of a fermenter and their function. 4. Evaluate the different methods of preservation of microorganisms.		
3.1	**Types of microbial products** (Primary and secondary metabolites) **Industries based on Microbial products:** (Medical, agriculture, chemicals, Food and beverages, etc)	[1L]
3.2	**Prerequisites of an Industrial microbiological process:** Microorganism, Medium, Product	[1L]
3.3	**Parts of a typical fermentation Process:** Upstream processing, Fermentation Proper, Downstream Processing	[1L]
3.4	**Screening**: Primary and secondary screening	[3L]
3.5	**Basic Fermenter design:**	[3L]

	Criteria for designing the fermenter Fabrication materials for fermenters Components of a fermenter and their uses	
3.6	**Preservation of microorganisms:** Aim of preservation, Culture collection centres, Methods of preservation (Serial subculture, Mineral oil overlay, Storage under liquid Nitrogen, Lyophilisation, Soil stock method)	[3L]

References:

- Industrial Microbiology (2000). L Casida. New Age International Publishers. New Delhi.
- Industrial Microbiology. (1984) A H Patel. MacMillan. New Delhi.
- Principles of Fermentation Technology. (1997) 2nd Edition. Stanbury P. F., Whitaker A. & Hall--S. J. Aditya Books Pvt. Ltd, New Delhi.
- Fermentation Microbiology and Biotechnology, (2012) E. L. Mansi,3rd Edition.

Question paper Template

F.Y. B. Sc. (MICROBIOLOGY) SEMESTER II

Course- II

COURSE TITLE: Introduction to Environmental and Industrial Microbiology

COURSE CODE: 21US2MBCC2EIM

[CREDITS - 02].

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	04	10	06	06	04	-	30
II	04	10	06	06	04	-	30
III	-	04	10	10	06	-	30
Total marks per objective	08	24	22	22	14	-	90
% Weightage	09	27	24	24	16	-	100

F. Y. B. Sc. (MICROBIOLOGY)

SEMESTER I - Practical

COURSE CODE: 21US2MBCCP Credit- 02

Learning Objectives:

The Practical is intended to:

1. Demonstrate techniques for microbial growth and its measurement.
2. Present different special staining techniques.
3. Describe methods for water analysis.

4. Demonstrate enrichment and isolation of coliphage from sewage.
5. Describe different methods for preservation of cultures.

Learning Outcome:

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

1. Implement different techniques to enumerate microbial growth.
2. Apply methods to evaluate the quality of water sample.
3. Compare different methods for preservation of cultures.

Core Course I	Fundamentals of Microbiology	
Experiment Sr. No.	**Title**	**Number of hours**
1	Special Staining techniques	
	a) Cell wall staining	2.5
	b) Capsule staining	2.5
	c) Metachromatic staining	2.5
	d) Staining of lipid granules	2.5
	e) Staining of Endospore	2.5
	f) Flagella staining, (Demonstration)	2.5
2	Study of motility (Hanging drop preparation)	2.5
3	Determination of optimum growth conditions	
	a) Temperature	O2
	b) pH	2.5
4	Measurement of microbial growth	2.5
	a) Preparation of opacity tubes and determination of cell count	O1

	b) Growth curve of *E. coli* and determination of generation time (group experiment)	O2
5	Enrichment and isolation of coliphage from sewage. (Demonstration)	2.5
Core Course II	Introduction to Environmental and Industrial Microbiology	
Experiment Sr. No.	Title and Number of credits	Number of hours
1	Study of air microflora and determination of sedimentation rate.	5
2	Isolation of antibiotic producer by crowded plate technique.	5
3	Winogradsky Column.	5
4	Bacteriological analysis of water	5
5	Preservation of microorganisms	
	a) Preservation by mineral oil overlay	5
	b) Preservation by soil stock method	2.5
	c) Preservation by Glycerol stock method	2.5

References:

- Microbiology. (2001),5th Edition. Lansing M. Prescott, Harley and Klein. McGraw Hill Higher Education, New York.
- General Microbiology. (2007) 5th Edition, R. Y. Stainier, J. Ingraham, M. Wheelis and P.R. Painter. Prentice Hall. New Jersey.
- Microbiology-An Introduction. (1998) 6th Edition. Tortora Funke and Case. Addison Weseley Longman Inc.
- Fundamentals of Microbiology. (1974) 9th Edition. M. Frobisher. W.B. Saunders Company.

- Fundamental Principles of Bacteriology. (1984) A.J. Salle. Tata McGraw-Hill Education.
- Microbiology. (2001) 5th Edition, Michael Pelczar. Tata Mc Graw hill Education.
- Outlines of Biochemistry, (2006) 5th Edition. Conn P. Stumpf G Bruening and R Doi. John Wiley and Sons. New York. 1995.
- Industrial Microbiology (2000). L Casida. New Age International Publishers. New Delhi.
- Industrial Microbiology. (1984) A H Patel. MacMillan. New Delhi.
- Principles of Fermentation Technology. (1997) 2nd Edition. Stanbury P. F., Whitaker A. &Hall--S. J. Aditya Books Pvt. Ltd, New Delhi.
- Fermentation Microbiology and Biotechnology, (2012) E. L. Mansi,3rd Edition.

Assessment Methods

Evaluation Pattern: Theory

- Assessments are divided into two parts: Continuous Internal Assessment (CIA) & Semester End Examination.
- The Semester End Examination shall be conducted by the College at the end of each semester.
- Semester End Examination (external) (60 M)- Duration: 2 hours Paper Pattern

Question No	Module	Marks with Option	Marks without Option
1	I	30 M	20 M
2	II	30 M	20 M
3	III	30 M	20 M

For Course I and Course II each Internal Evaluation (40 M)

1. Continuous Evaluation 25 M
2. Workshop/Project/Industrial Visit/ Excursion/ Seminar/ Assignment/ Research paper review 15 M

or

1. Project (40 M)

Evaluation pattern: Practical

- Semester-end evaluation: 30 Marks practical examination for each Course at the end of semester.
- Continuous internal evaluation 20 marks as per the following rubrics

Semester I (ONLINE/OFFLINE MODE)

Semester I (ONLINE/OFFLINE MODE)

Category	Marks allotted (Practical I)	Marks allotted (Practical II)
Journal	05	05
Spots/Quiz	05	05
Any one experimental technique	10 PI: Monochrome/ Negative staining	10 PII: Fungal wet mounts
Total Marks	**20**	**20**

Semester II (ONLINE/OFFLINE MODE)

Semester II (ONLINE/OFFLINE MODE)

Category	Marks allotted (Practical I)	Marks allotted (Practical II)
Journal	05	05
Spots/Quiz	05	05
Any one experimental technique	10 PI: Growth Curve experiment	10 PII: Preservation of microorganisms
Total Marks	**20**	**20**