

Progressive Education Society's
Modern College of Arts, Science and Commerce (Autonomous),
Shivajinagar, Pune 5

(An Autonomous College Affiliated to Savitribai Phule Pune University)

Framework of Syllabus

For

B.Sc. (Microbiology)

(Based on NEP 2020 framework)

(To be implemented from the Academic Year 2024-25)

Semester 1 (First Year)

Course Type	Course Code	Course	Course / Paper Title	Hours / Week	Credit	CIA	ES E	Total
Major Mandatory (2 + 2)	23ScMicU1101	Major Paper 1 (Theory) Section 1	Fundamentals of Microbiology	2	2	40	60	100
		Major Paper 1 (Theory) Section 2		2				
	23ScMicU1102	Major Paper 2 (Practical)	Lab course on 23ScMicU1101	4	2	20	30	50
Major Electives		-						
Minor		-						
OE (2 + 2)	23ScMicU1401		History of Microbiology	2	4	40	60	100
	23CpCopU1402		Democracy, Election and Governance	2				
VSC (2)	23ScMicU1501	Major Specific Practical I	Lab course on Biosafety and good laboratory practices	4	2	20	30	50
SEC (2)	23ScMicU1601	Skill Paper 1 (Practical)	Lab course on Basic Laboratory Practices	4	2	20	30	50
AEC(2),	23CpCopU1701 23CpCopU1702	MIL	MIL-I (Hindi) / MIL-I (Marathi)	2	2	20	30	50
VEC (2)	23CpCopU1801	EVS Theory	Environment Science I	2	2	20	30	50
IKS (2)	23ScMicU1901	IKS	Generic IKS	2	2	20	30	50
CC (2)	23CpCopU1001	CC-I Course	Online Course Based on Yoga	2	2	20	30	50
Total				28	22	220	330	550

Semester 2 (First Year)

Course Type	Course Code	Course	Course / Paper Title	Hours / Week	Credit	CIA	ES E	Total
Major Mandatory (4 + 2)	23ScMicU2101	Major Paper 3 (Theory) Section 1	Biochemistry and Microbiology	2	4	40	60	100
		Major Paper 3 (Theory) Section 2		2				
	23ScMicU2102	Major Paper 4 (Practical)	Lab course on 23ScMicU2101	4	2	20	30	50
Major Electives		-						
Minor	23ScMicU2301	Minor Paper I (Practical)	Aseptic technique and Sterilization	4	2	20	30	50
OE (2 + 2)	23ScMicU2401		Introduction to microbial world-1	2	4	40	60	100
	23CpCopU2402		Fundamentals of Music	2				
VSC (2)	23ScMicU2501	Major Specific Practical II	Lab course on Techniques in Microbiology	4	2	20	30	50
SEC (2)	23ScMicU2601	Skill Paper II (Practical)	Lab course on Introduction to Microscopy	4	2	20	30	50
AEC(2),	23CpCopU2703	English Theory	English Communication Skills II	2	2	20	30	50
VEC (2)	23CpCopU2801	EVS Theory	Environment Science II	2	2	20	30	50
IKS (2)	-							
CC (2)	23CpCopU2001	CC-II Course	Physical Education / Cultural Activities, NSS/NCC and Fine/ Applied/ Visual/ Performing Arts Course	2	2	20	30	50
Total				30	22	220	330	550

Semester 3 (Second Year)

Course Type	Course Code	Course	Course / Paper Title	Hours / Week	Credit	CIA	ES E	Total
Major Mandatory (4 + 2)	23ScMicU3101	Major Core Paper 5 (Theory) Section 1	Metabolism and Environmental Microbiology I	2	4	40	60	100
		Major Core Paper 5 (Theory) Section 2		2				
	23ScMicU3102	Major Paper 6 (Practical) on Section 1	Lab course based on 23ScMicU3101	4	2	20	30	50
IKS(2)	Code	Major specific IKS -	Vedic Microbiology	2	2	20	30	50
Minor (4)	23ScMicU3301	Minor Paper II (Theory) Section I	Soil and Agricultural Microbiology	2	4	40	60	100
		Minor Paper II (Practical) Section 2	Lab course on Soil and Agricultural Microbiology	4				
OE (2)	23ScMicU3401		Introduction to microbial world-2	2	2	20	30	50
VSC (2)	23ScMicU3501	Major Specific Practical III	Lab course on food Microbiology	4	2	20	30	50
SEC (2)		--	--	--	--	--	--	--
AEC(2),	23CpCopU3703	English Theory	English Communication Skills II	2	2	20	30	50
VEC (2)		--	--	--	--	--	--	--
IKS (2)		--	--	--	--	--	--	--
FP/CEP (2)	23ScMicU3002	FP –I	Major Specific Project	4	2	20	30	50
CC(2)	23CpCopU3001	CC III		2	2	20	30	50
Total				32	22	220	330	550

Semester 4 (Second Year)

Course Type	Course Code	Course	Course / Paper Title	Hours / Week	Credit	CIA	ESE	Total
Major Mandatory (4 + 4)	23ScMicU4101	Major Core Paper 7 (Theory) Section 1	Bacterial Genetics and Environmental Microbiology II	2	4	40	60	100
		Major Core Paper 7 (Theory) Section 2		2				
	23ScMicU4102	Major Paper 8 (Practical) on Section 1	Lab course based on 23ScMicU4101	4	4	40	60	100
		Major Paper 8 (Practical) on Section 2		4				
Major Electives		-						
Minor (4)	23ScMicU4301	Minor Paper III (Theory) Section 1	Air And Water Microbiology	2	4	40	60	100
		Minor Paper III (Practical) Section 2	Lab course Air And Water Microbiology	4				
OE (2)	23ScMicU4401		Community hygiene	2	2	20	30	50
VSC (2)		--	--	--	--	--	--	--
SEC (2)	23ScMicU4601	Skill Paper III (Practical)	Lab course on Dairy Microbiology	4	2	20	30	50
AEC(2),	23CpCopU4701	MIL	MIL-II (Hindi) / MIL-II (Marathi)	2	2	20	30	50
	23CpCopU4702							
VEC (2)		--	--	--	--	--	--	--
IKS (2)		--	--	--	--	--	--	--
FP / CEP(2)	23ScMicU4003	CEP –I	Community Engagement Project I	4	2	20	30	50
CC(2)	23CpCopU4001	CC-4		2	2	20	30	50
Total				32	22	220	330	550

Semester 5 (Third Year)

Course Type	Course Code	Course	Course / Paper Title	Hours / Week	Credit	CIA	ESE	Total
Major Mandatory (4 + 4 + 2)	23ScMicU5101	Major Core Paper 9 (Theory) Section 1	Medical Microbiology-I	2	4	40	60	100
		Major Core Paper 9 (Theory) Section 2	Immunology-1	2				
	23ScMicU5102	Major Paper 10 (Theory) Section 1	Biochemistry-I	2	4	40	60	100
		Major Paper 10 (Theory) Section 2	Molecular Biology-1	2				
	23ScMicU5103	Major Paper 11 (Practical)	Biochemistry and Molecular Biology	4	2	20	30	50
Major Electives	23ScMicU5201	Elective I (Theory)	Applied Microbiology -1	2	4	40	60	100
	23ScMicU5202	Elective I (Practical)	Practical based on Applied Microbiology -1	4				
	23ScMicU5203	Elective II (Theory)	Biostatistics and Biophysics-I	2	4	40	60	100
	23ScMicU5204	Elective II (Practical)	Practical based on Biostatistics and Biophysics	4				
Minor (4)	23ScMicU5301	Minor Paper IV (Theory) Section 1	Introduction to Fermentation	2	4	40	60	100
		Minor Paper IV (Practical) Section 2	Fermentation Technology	4				
OE (2)		--	--	--	--	--	--	--
VSC (2)	23ScMicU5501	Major Specific Practical IV	Clinical Microbiology	4	2	20	30	50
SEC (2)		--	--	--	--	--	--	--
AEC(2),		--	--	--	--	--	--	--
VEC (2)		--	--	--	--	--	--	--
IKS (2)		--	--	--	--	--	--	--

FP / CEP(2)	23ScMicU5002	FP –II	Field Project II	4	2	20	30	50
Total				38	22	220	330	550

Semester 6 (Third Year)

Course Type	Course Code	Course	Course / Paper Title	Hours / Week	Credit	CIA	ESE	Total
Major Mandatory (4 + 4 + 2)	23ScMicU6101	Major Core Paper 12 (Theory) Section 1	Medical Microbiology and Immunology-2	2	4	40	60	100
		Major Core Paper 12 (Theory) Section 2		2				
	23ScMicU6102	Major Paper 13 (Theory) Section 1	Biochemistry and Molecular Biology-2	2	4	40	60	100
		Major Paper 13 (Theory) Section 2		2				
	23ScMicU6103	Major Paper 14 (Practical)	Biochemistry/Molecular biology and Immunology	4	2	20	30	50
Major Electives	23ScMicU6201	Elective III (Theory)	Applied Microbiology -2	2	4	40	60	100
	23ScMicU6202	Elective III (Practical)	Practical based on Applied Microbiology	4				
	23ScMicU6203	Elective IV (Theory)	Biostatistics and Biophysics	2	4	40	60	100
	23ScMicU6204	Elective IV (Practical)	Practical based on Biostatistics and Biophysics	4				
Minor (4)	23ScMicU6301	Minor Paper V (Theory) Section 1	Ecology	2	4	40	60	100
		Minor Paper V (Practical) Section 2	Practical based on Ecology	4				
OE (2)		--	--	--	--	--	--	--
VSC (2)		--	--	--	--	--	--	--
SEC (2)		--	--	--	--	--	--	--
AEC(2),		--	--	--	--	--	--	--
VEC (2)		--	--	--	--	--	--	--
IKS (2)		--	--	--	--	--	--	--
FP / CEP(2)		--	--	--	--	--	--	--
OJT(4)	23ScMicU6004	OJT	On Job Training	8	4	40	60	100

Total				38	22	220	330	550
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OE : Open Elective

AEC: Ability Enhancement Course

VEC: value Education Courses

CC : Co-Curricular Courses

IKS : Indian Knowledge System

OJT : On Job Training

FP : Field Project

VSC : Vocational Skill Courses

CEP : Community Engagement Project

Progressive Education Society's
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Shivajinagar, Pune-5
Second Year of B.Sc.
(2023 Course under NEP2020)
Course Code: 23ScMicU3101
Course Name : Metabolism and Environmental Microbiology I

Teaching Scheme (TH): 4 Hours/Week

Credit: 04

Examination Scheme: CIA: 40 Marks

End Sem : 60 Marks

Prerequisite Courses: First Year B.Sc. Microbiology

Metabolism

Course Objectives:

- To learn and understand main metabolic pathways in prokaryotes.
- To provide a deeper insight into the fundamentals of enzyme structure and role in metabolism.
- To review and consolidate integrity between metabolism and the energy economy of a cell.

Course Outcomes:

On completion of the course, student will be able to–

- Discuss factors that affect enzymatic activity
- Apply bioenergetics principles in solving energy generation related problems.

Section II :**Course Objectives:**

- To introduce soil microflora.
- To enrich students with knowledge of how to use microorganisms in soil in agriculture.
- To develop an interest in the agricultural field.

Course Outcomes:

On completion of the course, student will–

- Become well versed with the microbial flora of soil and the interaction of those organisms with one another.
- Learn about the use of microorganisms as an application to control plant disease and enhance yield.
- Understand about eco-friendly agricultural techniques

Course Contents:

Unit	Topic	No. of Lectures
Unit 1	Biocatalysts	15
	A. Introduction to Enzymes Nature of active site, ribozymes, coenzymes, apoenzymes, prosthetic group and cofactors. Nomenclature & classification as per IUB (upto class level). Structure of active site; common amino acids at active site B. Models for catalysis • Lock and key • Induced fit	

	● Transition state. C. Specific catalytic groups involved in enzyme catalyzed reactions Acid-base catalysis, metal ion catalysis ,covalent catalysis. D. Effect of pH & temperature, substrate concentration & enzyme concentration, activators and inhibitors of enzyme	
Unit 2	Bacterial Metabolism	15
	A. Definitions of Metabolism, catabolism, anabolism, respiration and fermentation B. Metabolic pathways (with structures and regulation) EMP , HMP, ED, Phosphoketolase , TCA (emphasis on amphibolism), Glyoxylate Homofermentative and heterofermentative pathways, Interconnectivity of pathways. C. Bioenergetics High Energy Compounds Electron transport chain, Oxidative phosphorylation and Substrate level phosphorylation , Chemiosmotic hypothesis of ATP formation, Concept of Standard redox potential (Nernst equation)	

Course Contents :
Section II

Unit 3	Introduction to Soil Microbiology	15
	A. Introduction to Soil • Concept of Soil formation, Composition of soil, different types of soil (sand, loamy, clay, silt) • Soil microorganisms – Bacteria, algae, fungi, actinomycetes, protozoa and their proportion in the soil depending upon various conditions like environmental and competition. B. Introduction to Rhizosphere • Rhizosphere microflora and its role in rhizosphere C. Role of microorganisms in following elemental cycles in nature • Carbon, Nitrogen, Sulphur, Phosphorous cycles D. Degradation of organic matter • Source of organic matter, degradation of plant and animal matter, description of humus and humus formation steps • Degradation of cellulose, hemicelluloses, lignin and pectin	
Unit 4	Application of soil microflora in agriculture	15

	A. Development and large scale production of biofertilizers (Bacterial, Cyanobacterial, Fungal) with respect to • Nitrogen Fixation • Phosphate solubilization • Potassium mobilization • Iron chelation • Indole acetic acid production • Siderophore production B. Biocontrol agents: Bacterial, Viral, Fungal and their large scale production	
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References Section I :

1. Conn E., Stumpf P.K., Bruening G., Doi RH. (1987) Outlines of Biochemistry 5th Edition, John Wiley and Sons, New Delhi.
2. Nelson D. L. & Cox M. M. (2013) Lehninger's Principles of Biochemistry, 6th edition, W. H. Freeman & Co. NY
3. Voet D. & Voet J. G. (2015) Biochemistry, 4th edition. John Wiley & sons New York.
4. Bergey D. H. & Holt J. G. (1994) Bergey's Manual of Determinative Bacteriology. 9th Edition. Lippincott Williams & Wilkins.
5. Garrity G. M. (2005) Bergey's Manual of Systematic Bacteriology. 2nd Edition. (Vols. 1 – 4). Williams & Wilkins.
6. Madigan M. T., Martinko J. M. (2017) Brock's Biology of Microorganisms. 15th Edition. Pearson Education Inc.
7. Prescott L. M., Harley J. P. and Klein D. A. (2011) Microbiology, 8th Edition. MacGraw Hill Companies Inc.

References Section II :

1. Subba Rao N. S. (1977) Soil Microbiology, 4th Ed., Oxford & IBH Publishing Co. Pvt. Ltd.
2. Martin A. (1977) An Introduction to Soil Microbiology. 2nd edition. John Wiley & Sons Inc. New York & London.
3. Mexander M. (1977) Introduction to soil microbiology, John Wilery NY
4. Dube H.C. and Bilgrami. K.S.(1976) Text book of modern pathology. Vikas publishing house. New Delhi
5. Rangaswami G. (1979) Recent advances in biological nitrogen fixation. Oxford and IBH. New Delhi
6. John Postgate, (1998). Nitrogen Fixation. Cambridge University Press
7. Ajay Singh, Owen P. Ward, 2004 edition, Applied Bioremediation and Phytoremediation (Soil Biology). Springer
8. Ingraham J.L. and Ingraham C.A. (2004) Introduction to Microbiology. 3rd Edition. Thomson Brooks / Cole.
9. Madigan M.T, Martinko J.M. (2006) Brock's Biology of Microorganisms. 11th Edition. Pearson Education Inc.
10. Tortora G.J., Funke B.R., Case C.L. (2006) Microbiology: An Introduction. 8th Edition.
11. Stanier R.Y. (1985) General Microbiology. 4th and 5th Edn Macmillan Pub. Co. NY
12. Pelczar M. J., Chan E. C. S., Krieg N. R.(1986) Microbiology. 5th Edition, McGraw-Hill Publication
13. Prescott, Lancing M., John, P. Harley and Donald, A. Klein (2006) Microbiology, 6th Edition, McGraw Hill Higher Education
14. Hans G. Schlegel (1993) General Microbiology, 8th Edition, Cambridge University Press
15. Martin Frobisher (1937) Fundamentals of Microbiology, 8th Edition, Saunders, Michigan University press
16. Moshraffuddin Ahmed, SK Basumatary (2006) Applied Microbiology, MJP Publishers.

Progressive Education Society's
Modern College of Arts, Science and Commerce(Autonomous),
Shivajinagar, Pune - 5
Second Year of B.Sc. Microbiology (2020 Course)
Course Code: 23ScMicU3102
Course Name :Lab course based on 23ScMicU3101
Teaching Scheme: TH: 4 Hours/Week **Credit :**
2

Examination Scheme: CIA : 20 Marks

End-Sem : 30 Marks

Prerequisite Courses:

- FY B. Sc. Microbiology

Course Objectives:

1. To enrich students with the knowledge of biochemical characterization of bacteria.
2. To introduce the concept of bacterial growth kinetics.

Course Outcomes:

On completion of the course, student will be able to :

1. Identify organisms up to genus level based on biochemical characters.
2. Perceptive about bacterial growth curve.

Course Contents

Sr. No	Name of the practical	No. of practical's
1	Biochemical characterization of bacteria: a. Sugar utilization test (minimal medium + sugar) b. Sugar fermentation test c. Enzyme detection – Amylase, Gelatinase, Catalase, Oxidase d. Oxidative-fermentative test e. IMViC Test	8

2	Growth curve: - Absorbance measurement for bacterial culture - Calculation of growth rate, specific growth rate and generation time - Graph plotting by using computer software.	3
3	Enrichment, Isolation of plant growth promoting bacteria - Nitrogen fixing bacteria - Phosphate solubilizing bacteria - Development of biofertilizer	4

References:

1. Salle A.J. (2007). Fundamental Principles of Bacteriology. 7th Edition, Dodo Press.
2. Martin A. (1991). Introduction to Soil Microbiology 2nd Edition, John Wiley&Sons, New York and London publication.
3. Subba Rao N. S. (2017.) Soil Microbiology, 4th Edition, Oxford & IBH Publishing Co. Pvt. Ltd..
4. Sikyta, B. (1995). Techniques in applied microbiology (Vol. 31). Elsevier.
5. Sadasivam S. and Manickam A.(2004), "Biochemical Methods," 3rd Edition, New Age International (P) Limited Publishers, New Delhi
6. Plummer D.T.(2006). Introduction to practical biochemistry. 3rd Edition Tata McGraw Hill Education.

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Second Year B.Sc. Microbiology
(2024 course under NEP 2020)
Course Code: 23ScMicU3301
Course Name: Soil and Agricultural Microbiology

Teaching Scheme (TH): 2 Hours/Week (Section 1)
4 Hours/Week (Section 2)

Credit: 04

Examination Scheme: CIA : 40 Marks

End-Sem : 60 Marks

Section I and II:

Course Objectives:

- To introduce soil microflora.
- To enrich students with knowledge of how to use microorganisms in soil in agriculture.
- To develop an interest in the agricultural field.

Course Outcomes:

On completion of the course, student will–

- Become well versed with the microbial flora of soil and the interaction of those organisms with one another.
- Learn about the use of microorganisms as an application to control plant disease and enhance yield.
- Understand about eco-friendly agricultural techniques

Unit 1	Introduction to Soil Microbiology	15
	A. Introduction to Soil • Concept of Soil formation, Composition of soil, different types of soil (sand, loamy, clay, silt) • Soil microorganisms – Bacteria, algae, fungi, actinomycetes, protozoa and their proportion in the soil depending upon various conditions like environmental and competition. B. Introduction to Rhizosphere • Rhizosphere microflora and its role in rhizosphere C. Role of microorganisms in following elemental cycles in nature • Carbon, Nitrogen, Sulphur, Phosphorous cycles D. Degradation of organic matter • Source of organic matter, degradation of plant and animal matter, description of humus and humus formation steps • Degradation of cellulose, hemicelluloses, lignin and pectin	
Unit 2	Application of soil microflora in agriculture	15
	A. Development and large scale production of biofertilizers (Bacterial, Cyanobacterial, Fungal) with respect to • Nitrogen Fixation • Phosphate solubilization • Potassium mobilization • Iron chelation • Indole acetic acid production • Siderophore production B. Biocontrol agents: Bacterial, Viral, Fungal and their large scale production	

Section II :

Sr. No	Name of the practical	No. of practical's
1	Enumeration of microorganisms from soil sample using spread plate and pour plate technique	4
2	Enrichment, Isolation of plant growth promoting bacteria a. Nitrogen fixing bacteria b. Phosphate solubilizing bacteria c. Development of biofertilizer	10
3	Visit to Agriculture college/Experiential learning	1

References Section I and II :

1. Subba Rao N. S. (1977) Soil Microbiology, 4th Ed., Oxford & IBH Publishing Co. Pvt. Ltd.
2. Martin A. (1977) An Introduction to Soil Microbiology. 2nd edition. John Wiley & Sons Inc. New York & London.
3. Mexander M. (1977) Introduction to soil microbiology, John Wilery NY
4. Dube H.C. and Bilgrami. K.S.(1976) Text book of modern pathology. Vikas publishing house. New Delhi
5. Rangaswami G. (1979) Recent advances in biological nitrogen fixation. Oxford and IBH. New Delhi
6. Ajay Singh, Owen P. Ward, 2004 edition, Applied Bioremediation and Phytoremediation (Soil Biology). Springer
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8. Madigan M.T, Martinko J.M. (2006) Brock's Biology of Microorganisms. 11th Edition. Pearson Education Inc.

9. Tortora G.J., Funke B.R., Case C.L. (2006) Microbiology: An Introduction. 8th Edition.
10. Stanier R.Y. (1985) General Microbiology. 4th and 5th Edn Macmillan Pub. Co. NY
11. Pelczar M. J., Chan E. C. S., Krieg N. R.(1986) Microbiology. 5th Edition, McGraw-Hill Publication
12. Prescott, Lancing M., John, P. Harley and Donald, A. Klein (2006) Microbiology, 6th Edition, McGraw Hill Higher Education

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Second Year of B.Sc
(2024 Course under NEP 2020)
Course Code :23ScMicU3401
Course Name : Introduction to microbial world-II

Teaching Scheme: TH. 2 Hours/Week

Credit 02

Examination Scheme: CIA : 20 Marks

End-Sem : 30 Marks

Course objectives

- To Identify and differentiate between various types of microorganisms, including viruses, Virioids, and Prions
- To Analyze the ecological roles and significance of different microorganisms in various environments.
- To Investigate the diversity of viruses in different environments, including their roles in human health, agriculture, and ecosystems.
- To enrich students' knowledge about microorganisms
- To introduce the concepts related to cultivation, maintenance, and control of microorganisms

Course outcomes

On completion of the course, student will be able to–

- Students will be able to differentiate between various types of microorganisms, including viruses, Virioids, and Prions
- Students will be able to cultivation, maintenance, and control of microorganisms

Unit 1	Diversity of Microorganisms	No. of lectures
	A.Types of microorganisms and their differentiating characters • General characteristics including details of the morphology of different groups with emphasis on distribution and occurrence, morphology, mode of reproduction and economic importance. • Acellular microorganisms (Viruses, Viroids, and Prions) B..Principles of classification of viruses • Introduction to 9th edition Bergey's Manual of Determinative and Systematic Bacteriology viruses • Introduction to different groups of viruses	15

Unit 2	Cultivation of microorganisms	No. of lectures
	A. Nutritional requirements and their classification B. Design and preparation of media –Common ingredients of media and functional types of media. C. Methods for cultivating bacteria, algae, fungi, and protozoa, Viruses D. Concept of pure culture, enrichment, and isolation E. Maintenance of bacterial and fungal cultures by using various techniques	15

References:

1. Ingraham, J.L. , & Ingraham, C.A. (2013). Introduction to Microbiology. Wadsworth Publishing Company.
2. Madigan, M.T., & Martinko, J.M. (2019). Microorganisms and Microbiology. Brock Biology of microorganisms. 15th edition. New York: Pearson
3. Tortora, G. J. , Funke, B. R., Case, C. L. , & Johnson, T. R. (2016). Microbiology : an introduction. 12th edition, Pearson Education
4. Michael, J. P. (2009). Microbiology : An Application-Based Approach. Tata McGraw Hill Education Private Limited.
5. Willey, J. M., Sherwood, L., & Woolverton, C. J. (2013). Prescott, Harley, and Klein's microbiology. 8th edition, McGraw-Hill Higher Education.
6. Salle, A. J. (1971). Fundamental Principles of Bacteriology. 7th edition. Tata McGraw Hill Publishing Co.
7. Stanier, R. Y., Ingraham, J. L., Wheelis, M. L., & Painter, P. R. (1987). General Microbiology., 5th edition. Macmillan Press Ltd.
8. Nelson, D. L., & Cox, M. M. (2008). Leininger principles of Biochemistry. 7th edition. McMillan.
9. Brown, J. H. (1939). Bergey's manual of determinative bacteriology.
10. Holt, J. G., & Krieg, N. R. (1984). Bergey's manual of systematic bacteriology, vol.1. The Williams and Wilkins Co., Baltimore, 1-1388.

Progressive Education Society
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Second Year B.Sc. Microbiology
(2024 course under NEP 2020)
Course Code: 23ScMicU3501
Course Name: Lab course on Food Microbiology

Teaching Scheme (TH): 4 Hours/Week

Credit: 02

Examination Scheme: CIA: 20 Marks

Sem III term end: 30 Marks

Prerequisite Courses:

FY B. Sc. Microbiology

Course objective:

1. To understand the important developments in food and its scope.
2. To know about pathogenic, non-pathogenic and useful microorganisms in the food industry.
3. To become aware about the testing methods routinely used for testing food quality.
4. To understand the students about common causes of food spoilage.

Course outcomes:

On completion of the course, student will be able to–

1. Students will be able to describe the role of microorganisms in the production of food and its Spoilage
2. Students will develop experimental skills for testing different foods for the presence of microorganisms

Sr. No	Practicals on Food Microbiology	No. of practical's
1	a. Enumeration of microbial load in food samples by spread/pour plate technique.	2
2	a. Isolation and identification of any food borne pathogen from food products. b. Isolation and identification of microorganisms from spoiled vegetables/fruits. c. Isolation and identification of spoilage microorganisms from bread.	6
3	a. Isolation and identification of lactic culture upto genus level b. Antifungal activity of lactic acid bacteria c. Preparation of Yogurt/Dahi d. Determination of TDP and TDT	7

References

1. Banwart G. J. (1989). Basic Food Microbiology, 2nd Edn. Chapman and Hall, International Thompson Publishing.
2. Thomas J. Montville, Karl R. Matthews, and Kalmia E. Kniel (2017) Food Microbiology: An Introduction" 4th edition
3. Clarence Henry Eckles, Willes Barnes Combs, Harold Macy (1943). Milk and milk products, 4th Ed. McGraw-Hill Book Company, Incorporated.
4. James M. Jay, Martin J. Loessner, David A. Golden (2005). Modern Food Microbiology, 7th Edn. Springer Science & Business.
5. William C. Frazier, Dennis C. Westhoff, N. M. Vanitha (2013). Food Microbiology, 5th Edn. McGraw-Hill Education, India.
6. Leo M.L. Nollet and Fidel Toldrá .Handbook of Food Analysis, 3rd Edition - Volume 1: Physical Characterization and Nutrient Analysis"

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(2024 Course under NEP 2020)

Course Code: 23ScMicU4101

Course Name: Bacterial Genetics and Environmental Microbiology II

Credit: 04

End Sem: 60 Marks

Section 1 Bacterial genetics and systematics

Course Objectives:

- Discuss the most significant discoveries and theories through the historical progress of biological scientific discoveries in the development of molecular biology.
- Explain the fundamental structure, properties of nucleic acids.

Course Outcomes:

On completion of the course, student will be able to—

- Describe the central dogma of molecular biology.
- Differentiate the main types of prokaryotes through their grouping abilities and list their characteristic and differentiating properties.
- Apply the principles of bacterial systematics and taxonomy to design bacterial identification and classification experiments.

Section 2 Course name : Air And Water Microbiology

Course Objectives:

- Understand the varied air and water microflora.
- Understand the methods to determine the microorganisms present in air and water.
- To get versed with the techniques to treat and prevent air and water pollution.

Course Outcomes:

On completion of the course, student will be able to—

- Identify the microbes in air and water and the diseases associated with it.
- Get versed with the diversity of microbes present around us and will be able to determine them.
- Learn new ways to determine microbes from a raw sample.

Course Contents

Unit	Topic	No of lectures
Unit 1	Molecules of heredity	18
	A. Understanding molecules of heredity • RNA world and shift to DNA world with time • Discovery of transforming material (hereditary material): Griffith's experiment • Evidence for nucleic acid as genetic material -Avery and MacLeod experiment -Giererand Schramm / Fraenkel-Conrat& Singer experiment (TMV virus)-Hershay& Chase experiment • Prokaryotic genome organization • Concept of Gene, basic structure of B form of DNA • Properties of nucleotides related with DNA stability • Comparative account of different forms of DNA B. DNA REPLICATION • Messelson and Stahl's experiment (semiconservative) • Mechanisms of DNA replication: Theta model (semi-discontinuous), J Cairn's experiment, rolling circle model (plasmid DNA, λ phage DNA)	
Unit 2	MUTATIONS AND REVERSIONS	6
	a. Spontaneous mutations i. Occurrence and Mechanisms ii. Fluctuation test b. Mechanisms of induced mutations i. Base pair substitution (Transitions, Transversions), Base analogues (2amino purine, 5bromo uracil), HNO₂, Alkylating agents (ethyl methyl sulphonate) ii. Frame shift mutations (Insertions and deletions),	

	Intercalating agents (EtBr, acridine orange), Cross linking agents (Psorolin, mitomycin), UV rays, X rays, Biological mutagens (bacteriophage μ, transposomes) c. Types of mutations: Nonsense, Missense, Silent, Null, Conditional lethal temperature sensitive, amber, leaky & non leaky d. Isolation of Mutants: Replica plate technique 1 e. Reversion: i. True reversion ii. Suppression (intragenic and intergenic).	
Unit 3	Bacterial Systematics	6
	● Concept of species ● Chemotaxonomy ● Numerical taxonomy ● Genetic basis of taxonomy ○ G + C content ○ DNA hybridization ○ Base sequence similarity (Use of 16s rRNA databanks)	

	Section II	
Unit	Topic	No. of Lectures
Unit 4	Air Microbiology	15
	A. Air flora • Transient nature of air flora • Droplet, droplet nuclei, and aerosols B. Air pollution • Chemical pollutants, their sources in air and effects on human health C. Methods of Air sampling and types of air samplers • Impaction on solids • Impingement in liquid • Sedimentation • Centrifugation • Precipitation • Thermal Precipitation D. Air sanitation • Physical and chemical methods E. Air borne infections.	
Unit 5	Water Microbiology	15
	A. Types of water • Surface, ground, stored, distilled, mineral and de-mineralized water • Water purification methods, Bacteriological standards of potable water • Maharashtra pollution control board (MPCB), Central pollution control board(CPCB), Bureau of Indian standards (BIS),World health Organization (WHO) B. Water purification methods of drinking water C. Indicators of faecal pollution; <i>Escherichia coli, Bifidobacterium, Streptococcus faecalis, Clostridium perfringens;</i> New indicators: <i>Campylobacter</i> and <i>Pseudomonas</i> D. Bacteriological analysis of water for potability • Presumptive coliform count • Confirmed test • Completed test • Eijkman test • Hydrogen sulphide paper strip test • Membrane filter technique	

	E. Domestic Waste Water ● Analysis of wastewater i. Physicochemical parameters: pH, temperature, total solids, suspended solids, Chemical Oxygen Demand ii. Biological parameters: Biological Oxygen Demand, Toxicity (Fish bioassay) F. Industrial water pollutants, their ecological effects and health hazards ● Biomagnification and eutrophication G. Methods of effluent treatment ● Primary, secondary, tertiary treatment methods H. solid waste management ● Raw material, organism involved ● Biomethanation: Biochemical mechanisms, types of anaerobic digesters, applications of biogas	
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References Section I :

1. Benjamin Lewin (2017) Genes XII. Oxford University Press
2. Friefelder D. (1995) Molecular Biology, 2nd Edition. Narosa Publishing House.
3. Gardner E.J., Simmons M.J and Snustad D.P. (1991) Principles of Genetics. 8th Edition. John Wiley & Sons Inc.
4. Russel Peter. Essential Genetics. 2nd Edition, Blackwell Science Pub.
5. Stanier R.Y. (1985) General Microbiology. 4th and 5th Edition Macmillan Pub. Co. NY.
6. Stricberger M.W. (1985) Genetics. 3rd Edition Macmillan Pub. Co. NY.
7. Watson J.D. (1987) Molecular Biology of the Gene, 7th Edition. The Benjamin Cummings Publishing Company Inc.
8. Prescott L. M., Harley J. P. and Klein D. A. (2011) Microbiology, 8th Edition. MacGraw Hill Companies Inc.

References Section II :

1. Daniel Lim., Microbiology, 2nd Edition; McGraw-Hill Publication
2. Ingraham J.L. and Ingraham C.A. (2004) Introduction to Microbiology. 3rd Edition.
3. Thomson Brooks / Cole. Madigan M.T, Martinko J.M. (2006) Brock's Biology of Microorganisms. 11th Edition. Pearson Education Inc.
4. Salle A.J. (1971) Fundamental Principles of Bacteriology. 7th Edition. Tata MacGraw Publishing Co.
5. Tortora G.J., Funke B.R., Case C.L. (2006) Microbiology: An Introduction. 8th Edition.
6. Stanier R.Y. (1985) General Microbiology. 4th and 5th Edn Macmillan Pub. Co. NY
7. Pelzar M. J., Chan E. C. S., Krieg N. R. (1986) Microbiology. 5th Edition, McGraw-Hill Publication
8. Prescott, Lancing M., John, P. Harley and Donald, A. Klein (2006) Microbiology, 6th Edition, McGraw Hill Higher Education
9. Hans G. Schlegel (1993) General Microbiology, 8th Edition, Cambridge University Press
10. Martin Frobisher (1937) Fundamentals of Microbiology, 8th Edition, Saunders, Michigan University press.

11. Standard Methods for the Examination of Water and Wastewater (2005) 23rd Edition, Publication of the American Public Health Association (APHA), the American Water Works Association (AWWA), and the Water Environment Federation (WEF); edited by Andrew D. Eaton, Mary Ann H. Franson.

Progressive Education Society's
Modern College of Arts, Science and Commerce (Autonomous),
Shivajinagar, Pune - 5
Second Year of B.Sc. Microbiology (2020 Course)
Course Code: 23ScMicU4102
Course Name: Lab course based on 23ScMicU4101(Section 1)
Teaching Scheme: TH: 4 Hours/Week **Credit: 2**
Examination Scheme: CIA: 20 Marks **End-Sem : 30 Marks**

Prerequisite Courses:

- FY B. Sc. Microbiology

Course Objectives:

1. To accomplish the identification of microbes upto genus level.
2. To introduce the concept of measurement of microbial cell dimensions by micrometry

Course Outcomes: On completion of the course, student will be able to–

1. To identify microorganisms by using different biochemical tests
2. To measure microbial cell dimensions by micrometry

Section 1

Sr. No	Name of the practical	No.of practical's
1	Identification of bacterial isolates at least up to genus level from soil or air Using Bergey's manual of determinative bacteriology a. Introduction to Bergey's manual b. Aerobic bacteria c. Facultative anaerobic bacteria	09
2	Measurements of cell dimension by micrometry using all the objectives	2
3	a. Induction of mutations by using physical mutagen (e.g. UV rays) or chemical mutagen (e.g.HNO ₂) (demonstration) b. Isolation of mutants by any suitable method c. Demonstration of UV survival curve	4
4	Visits/Experiential learning	1

References:

1. Stanier R.Y. (1985) General Microbiology. 4th and 5th Edition Macmillan Pub. Co. NY.
2. Prescott, Lancing M., John, P. Harley and Donald, A. Klein (2006) Microbiology, 6th Edition,

McGraw Hill Higher Education

3. Holt, J. G., & Krieg, N. R. (1984). *Bergey's manual of systematic bacteriology*, vol.1. The Williams and Wilkins Co., Baltimore, 1-1388.

Progressive Education Society's
Modern College of Arts, Science and Commerce (Autonomous),
Shivajinagar, Pune - 5

Second Year of B.Sc. Microbiology (2020 Course)

Course Code: 23ScMicU4102

Course Name: Lab course based on 23ScMicU4101(Section 2)

Teaching Scheme: TH: 4 Hours/Week

Credit: 2

Examination Scheme: CIA: 20 Marks

End-Sem : 30 Marks

Course Objectives:

1. To enrich students with knowledge of microbial air diversity and air flora settling velocity.
2. To acquaint the students with different water quality analysis techniques

Course Outcomes: On completion of the course, student will be able to–

1. Determine microbial diversity of air
2. To analyze quality of water by performing different techniques

Section 2

Sr.No	Name of the practical	No.of practical's
1	AirFlora: 1. Diversity determination. 2. Simpson index 3. Settling velocity determination	4
2	Water Microbiology 1. Bacteriological tests of potability of water a. MPN, Confirmed and Completed test. b. Membrane filter technique (Demonstration) 2. Determination of B.O.D.of water sample 3. Determination of total solids and total suspended solids in sewage water 4. Water microflora	9
3	Visits/Experiential learning Sewage water treatment plant	1

References:

1. Standard Methods for the Examination of Water and Wastewater (2005) 23rd Edition, Publication of the American Public Health Association (APHA), the American Water Works Association (AWWA), and the Water Environment Federation (WEF); edited by Andrew D. Eaton, Mary Ann H Franson.
2. Tiwari R. P., Hoondal G. S., & Tewari R. (2009). 1st Edition, Laboratory techniques in Microbiology and Biotechnology. Abhishek Publications
3. Prescott, H. (2002). Laboratory exercises in Microbiology 5th edition.
4. Pelzar M. J., Chan E. C. S., Krieg N. R. (1986) Microbiology. 5th Edition, McGraw-Hill Publication.

Progressive Education Society**Modern College of Arts, Science, and Commerce (Autonomous),****Shivajinagar, Pune - 5****Second Year B.Sc. Microbiology****(2024 course under NEP 2020)****Course Code: 23ScMicU4301****Course Name: Air and Water Microbiology****Teaching Scheme (TH): 2 Hours/Week (Section 1)
4 Hours/Week (Section 2)****Credit: 04****Examination Scheme: CIA: 40 Marks****Sem IV term end: 60 Marks****Prerequisite Courses:**

- FY B. Sc. Microbiology

Course Objectives:

- Understand the varied air and water microflora.
- Understand the methods to determine the microorganisms present in air and water.
- To get versed with the techniques to treat and prevent air and water pollution.

Course Outcomes:

On completion of the course, student will be able to—

- Identify the microbes in air and water and the diseases associated with it.
- Get versed with the diversity of microbes present around us and will be able to determine them.
- Learn new ways to determine microbes from a raw sample.

Unit 1	Air Microbiology	15
	A. Air flora • Transient nature of air flora • Droplet, droplet nuclei, and aerosols B. Air pollution • Chemical pollutants, their sources in air and effects on human health C. Methods of Air sampling and types of air samplers • Impaction on solids • Impingement in liquid • Sedimentation • Centrifugation • Precipitation • Thermal Precipitation D. Air sanitation • Physical and chemical methods E. Air borne infections.	
Unit 2	Water Microbiology	15
	A. Types of water • Surface, ground, stored, distilled, mineral and de-mineralized water • Water purification methods, Bacteriological standards of potable water • Maharashtra pollution control board (MPCB), Central pollution control board(CPCB), Bureau of Indian standards (BIS),World health Organization (WHO) B. Water purification methods of drinking water C. Indicators of faecal pollution; <i>Escherichia coli</i>, <i>Bifidobacterium</i>, <i>Streptococcus faecalis</i>,<i>Clostridium perfringens</i>; New indicators: <i>Campylobacter</i> and <i>Pseudomonas</i> D. Bacteriological analysis of water for potability • Presumptive coliform count • Confirmed test • Completed test • Eijkman test • Hydrogen sulphide paper strip test • Membrane filter technique E. Domestic Waste Water • Analysis of wastewater	

	i. Physicochemical parameters: pH, temperature, total solids, suspended solids, Chemical Oxygen Demand ii. Biological parameters: Biological Oxygen Demand, Toxicity (Fish bioassay) F. Industrial water pollutants, their ecological effects and health hazards • Biomagnification and eutrophication G. Methods of effluent treatment • Primary, secondary, tertiary treatment methods H. solid waste management • Raw material, organism involved • Biomethanation: Biochemical mechanisms, types of anaerobic digesters, applications of biogas	
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References Section I :

1. Daniel Lim., Microbiology, 2nd Edition; McGraw-Hill Publication
2. Ingraham J.L. and Ingraham C.A. (2004) Introduction to Microbiology. 3rd Edition.
3. Thomson Brooks / Cole. Madigan M.T, Martinko J.M. (2006) Brock's Biology of Microorganisms. 11th Edition. Pearson Education Inc.
4. Salle A.J. (1971) Fundamental Principles of Bacteriology. 7th Edition. Tata MacGraw Publishing Co.
5. Tortora G.J., Funke B.R., Case C.L. (2006) Microbiology: An Introduction. 8th Edition.
6. Stanier R.Y. (1985) General Microbiology. 4th and 5th Edn Macmillan Pub. Co. NY
7. Pelzar M. J., Chan E. C. S., Krieg N. R. (1986) Microbiology. 5th Edition, McGraw-Hill Publication
8. Prescott, Lancing M., John, P. Harley and Donald, A. Klein (2006) Microbiology, 6th Edition, McGraw Hill Higher Education
9. Hans G. Schlegel (1993) General Microbiology, 8th Edition, Cambridge University Press
10. Martin Frobisher (1937) Fundamentals of Microbiology, 8th Edition, Saunders, Michigan University press.
11. Standard Methods for the Examination of Water and Wastewater (2005) 23rd Edition, Publication of the American Public Health Association (APHA), the American Water Works Association (AWWA), and the Water Environment Federation (WEF); edited by Andrew D. Eaton, Mary Ann H. Franson.

Section 2

Unit No.	Name of the practical	No. of practical's
3	AirFlora: 1. Diversity determination. 2. Simpson index 3. Settling velocity determination	4

4	Water Microbiology 1. Bacteriological tests of potability of water a. MPN, Confirmed and Completed test. b. Membrane filter technique (Demonstration) 2. Determination of B.O.D.of water sample 3. Determination of total solids and total suspended solids in sewage water 4. Water microflora	9
5	Visits/Experiential learning Sewage water treatment plant	1

References:

1. Standard Methods for the Examination of Water and Wastewater (2005) 23rd Edition, Publication of the American Public Health Association (APHA), the American Water Works Association (AWWA), and the Water Environment Federation (WEF); edited by Andrew D. Eaton, Mary Ann H Franson.
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4. Pelzar M. J., Chan E. C. S., Krieg N. R. (1986) Microbiology. 5th Edition, McGraw-Hill Publication.

Progressive Education Society's
Modern College of Arts, Science, and Commerce Shivajinagar, Pune-5
Second Year of B.Sc.
(2023 Course under NEP2020)
Course Code: 23ScMicU4401
Course Name : Community hygiene

Teaching Scheme (TH): 4 Hours/Week

Credit: 02

Examination Scheme: CIA: 20 Marks

End Sem :30 Marks

Prerequisite Courses: First Year B.Sc. Microbiology

Course Objectives:

- To understand the concepts of health, hygiene and pollution.
- To develop awareness and realise significance of good eco-friendly agricultural and health practices in the community

Course Outcomes:

On completion of the course, student will–

- Identify good and harmful environmental hygiene and sanitation practices in the community
- To spread awareness on health issues in community

Unit	Topic	No of lectures
Unit 1	Health and Hygeine	10
	A. Concept of health 1. What is health? 2. Classification of health ● Personal health ● Domestic or family health ● Community or public health ● Environmental health	

	B. Concept of hygiene 1. What is meant by hygiene 2. Classification of hygiene • Domestic hygiene • Community hygiene • Environmental hygiene C. Pollution • Types of pollution, their Causes and Effects D. Health Issues in the Community inadequate food, unsafe drinking water, lack of sanitation • Current Local and Global Health Concerns Determinants/Causes of ill health :CDC, WHO • Attitudinal and Behavioural changes • Giving guidance and counselling • Improving health literacy	
Unit 2	Environmental Hygiene	20
	A. Prevention and Control of environmental Pollution B. Waste Management • Biodegradable and Non-Biodegradable Waste • Waste Disposal Methods and challenges C. Water, Health and Sanitation.... • Water Quality and Health Risks • Water Conservation - Needs and Methods D. Eco-Friendly Agricultural Practices • Biopesticides and Biofertilisers	

References:

1. Joceline Pomerleau and Martin Mc Kee, (2006). Issues in public Health. Tata Mc Graw – Hill Publishing Company Limited, New Delhi
2. Megan Landon R. (2006). Environment, Health and Sustainable Development, Tata Mc Graw –Hill Publishing Company Limited, New Delhi.
3. Park, K. (2008). Essentials of community health nursing, Banarsidas Bhanot Publishers, Jabalpur

Progressive Education Society
Modern College of Arts, Science, and Commerce (Autonomous),
Shivajinagar, Pune - 5
Second Year B.Sc. Microbiology
(2024 course under NEP 2020)
Course Code: 23ScMicU4601
Course Name: Lab course on Dairy Microbiology

Teaching Scheme (TH): 4 Hours/Week

Credit: 02

Examination Scheme: CIA: 20 Marks

Sem IV term end: 30 Marks

Prerequisite Courses:

FY B. Sc. Microbiology

Course objective:-

- To develop practical skills through hands-on laboratory exercises, including microbial enumeration, isolation, identification, and interpretation of results, to reinforce theoretical concepts and enhance proficiency in milk microbiological analysis
- To know about pathogenic, non-pathogenic and useful microorganisms dairy industry.
- To become aware about the testing methods routinely used for testing milk quality.

Course outcomes:

- On completion of the course, student will be able to—
- Students will be able to describe the role of microorganisms in spoilage of milk.
 - Students will develop experimental skills for testing the milk for the presence of microorganisms

Sr. No	Name of the practical	No. of practical's
1	Tests for Milk and Dairy products a. Phosphatase test b. MBRT test and Resazurin test c. Test for mastitis d. Milk adulteration test- Urea, starch, detergent e. Direct microscopic count f. Somatic cell count g. Milk fat estimation (demonstration)	9
2	a. Standard Plate Count (compare pasteurized and unpasteurized milk) b. Isolation of bacteria from pasteurized milk and unpasteurized milk and identification of any one isolate upto genus level.	6

References

1. Banwart G. J. (1989). Basic Food Microbiology, 2nd Edn. Chapman and Hall, International Thompson Publishing.
2. Deeth, H.C., & Fitz-Gerald, C.H. (1994). Methylene blue reduction test for the estimation of bacterial numbers in milk. Australian Journal of Dairy Technology
3. Clarence Henry Eckles, Willes Barnes Combs, Harold Macy (1943). Milk and milk products, 4th Ed. McGraw-Hill Book Company, Incorporated.
4. James M. Jay, Martin J. Loessner, David A. Golden (2005). Modern Food Microbiology, 7th Edn. Springer Science & Business.
5. Sukumar De (2001). Outlines of Dairy Technology. 1st Ed. Oxford University Press, Delhi.
6. Marth, E.H., & Steele, J.L. (Eds.). (2001). Applied Dairy Microbiology ,2nd ed.. Marcel Dekker.