Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce, and Science College, Ahmednagar (Autonomous)

(Affiliated to Savitribai Phule Pune University, Pune)

National Education Policy (NEP)
Choice Based Credit System (CBCS)

Programme Skeleton and Syllabus of

Microbiology (Minor)-II Year

Implemented from

Academic Year 2024-25

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar (Autonomous)

Board of Studies in Microbiology

Sr. No.	Name	Designation
1.	Ms. Giramkar Dipali D.	Chairman
2.	Mr.Shaikh Sajid H.	Member
3.	Ms.Pansare Ragini P.	Member
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6.	Ms.Sarode Dhanashree S.	Member
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8.	Dr. Gahile Yogesh R.	Member
9.	Mr.Wani Ashish S.	Member
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11.	Dr. Dixit Prashant P.	Academic Council Nominee
12.	Dr. Naphade Bhushan S.	Academic Council Nominee
13.	Mr.Choure Rajendra G.	Vice-Chancellor Nominee
14.	Mr. Yewatkar Saikiran	Alumni
15.	Mr. Dube Chandrakant G.	Industry Expert

1. Prologue/ Introduction of the programme:

Microbiology is a broad discipline of Biology which encompasses five groups of microorganisms i.e. bacteria, protozoa, algae, fungi and viruses. It studies the interaction ofmicroorganisms with their environments as well as how these organisms are harnessed inhuman endeavor and their impact on society. The study has its extensions in various other conventional and advanced fields of biology by employing microbes as study models. Since inception of Microbiology as a branch of Science, it has remained an ever-expanding field of active research, broadly categorized as Pure and Applied Science. Different branches of Pure Microbiology based on taxonomy are Bacteriology, Mycology, Protozoology and Parasitology, Phycology and Virology; with considerable overlap between these specific branches over eachother and also with other disciplines of Life Sciences, like Botany, Zoology, Cell Biology, Biochemistry, Biotechnology, Nanotechnology, Bioinformatics, etc. Areas in the applied Microbial Sciences can be identified as: Medical, Pharmaceutical, And Industrial (Fermentation, Pollution Control), Air, Water, Food and Dairy, Agriculture (Plant Pathology and Soil Microbiology), Veterinary, Environmental (Ecology, Geomicrobiology); and the technological aspects of these areas. Knowledge of different aspects of Microbiology has become crucial and indispensable to the society. Study of microbes has become an integral part of education and human progress. The science of Microbiology has an important role to play in health, agriculture, environment and industry. Several discoveries in the last two to three decades, which significantly impact these areas, have put Microbiology on the center stage of teaching, research and development all over the world. There is a continuous demand for microbiologists as work force – education, industry and research. Career opportunities for the graduate students are available in industry and research equally. In the post globalization world higher education has to play a significant role in creation of skilled human resources for the well-being ofhumanity.

The NEP-2020 offers an opportunity to effect paradigm shift from a teacher-centric to student-centric higher education system in India. It caters skill based education where the graduate attributes are first kept in mind to reverse-design the programs, courses and supplementary activities to attain the graduate attributes and learning attributes. The learning outcomes-based curriculum framework for a degree in B.Sc. (Honours) Microbiology is intended to provide a comprehensive foundation to the subject and to help students develop the ability to successfully continue with further studies and research in the subject while they are equipped with required skills at various stages. Effort has been made to integrate use of recent technology to assist

teaching-learning process among students. The framework is designed to equip students with valuable cognitive abilities and skills so that they are successful in meeting diverse needs of professional careers in a developing and knowledge-based society. The curriculum framework takes into account the need to maintain globally competitive standards of achievement in terms of knowledge and skills in Microbiology and allied courses, as well develop scientific orientation, spirit of enquiry, problem solving skills, human and professional values which foster rational and critical thinking in the students. This course serves a plethora of opportunities in different fields right from classical to applied aspects in Microbiology. Some of the characteristic attributes a graduate in Microbiology should possess are:

• Disciplinary knowledge and skills • Skilled communication
• Critical thinking and problem solving capacity • Logical thinking and reasoning
• Team Spirit & Leadership Quality • Digital efficiency • Ethical awareness / reasoning
• National and international perspective • Lifelong learning

1. Programme Outcomes (POs)

Students enrolled in the program will complete a curriculum that exposes and trains students in a full range of essential skills and abilities. Theory supplemented with extensive practical skill sets will help a graduate student to avail the opportunities in the applied fields (research, industry or institutions), without any additional training. They will have the opportunity to master the following objectives.

1. To enrich students' knowledge and train them in the pure microbial sciences
2. To Acquire knowledge and understanding of the microbiology concepts as applicable to diverse areas such as medical, industrial, environment, genetics, agriculture, food etc.
3. To introduce the concepts of application and research in Microbiology
4. To inculcate sense of scientific responsibilities and social and environment awareness
5. To help students build-up a progressive and successful career

Credit Distribution: B.Sc. Microbiology including Minor and OE and other courses.

	Type of Courses	III Yr	IV Yrs (Honours)	IV Yrs Research
Major Marathi	Discipline-Specific Courses (DSC)	46	74	66
	Discipline Specific Elective (DSE)	08	16	16
	Skill Enhancement Courses (SEC)	06	06	06
	Vocational Skill Courses (VSC)	08	08	08
	On-Job Training (OJT)	04	08	04
	Field Project (FP)	04	04	04
	Community Engagement and Service (CEP)	02	02	02
	Research project	00	00	12
	Research Methodology	00	04	04
	Indian Knowledge System	02	02	02
	Total (I, II and III Year)	80	124	124
Minor	Minor	20	20	20
Other Courses	Open Elective (OE)/ Multidisciplinary Courses	12	12	12
	Co-Curricular Courses	08	08	08
	Ability Enhancement Courses	08	08	08
	Value Education Courses	04	04	04
	Total	132	176	176

Programme Framework (Courses and Credits): B.Sc. Microbiology (Minor)

Sr. No.	Year	Semester	Level	Course Type	Course Code	Title	Credits
1.	I	I	4.5	MNR-1	BS-MR101T	Basic Microbiology	03
2.	I	II	4.5	MNR-2	BS-MR201T	Techniques in Microbiology	03
3.	II	III	5.0	MNR-3	BS-MR301T	Environmental Microbiology	03
4.	II	IV	5.0	MNR-4	BS-MR401T	Bacterial Genetics	03
5.	III	V	5.5	MNR-5	BS-MR501T	Medical Microbiology	04
6.	III	VI	5.5	MNR-6	BS-MR601T	Industrial Microbiology	04
							20

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar
(Autonomous)
Syllabus
B.Sc. Microbiology (Minor)

Title of the Course: Environmental Microbiology								
Year: II				**Semester: III**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
MNR-3	BS-MR301T	02	01	03	60	30	70	100

Learning Objectives: The course has been organized to cover most of the important aspects related to Environmental Microbiology. The course will provide a brief overview of air microbiology, water microbiology. This course also explains the role of microorganisms in soil and physicochemical characteristics of waste water.

Course Outcomes (Cos)

1. Students will understand the transient air flora, methods of air sampling and air sanitation and air borne infections
2. Students will understand the types of water, Recommended Bacteriological standards of Water Quality, methods for Bacteriological analysis of water for portability, water purification methods, indicators of fecal pollution and water borne infections.
3. Students will understand role of the rhizosphere microflora, large scale production of bio fertilizer and biocontrol agents, microbial interactions in soil and role of microorganisms in humus and compost formation and in carbon, nitrogen cycle.
4. Students will also learn physicochemical characteristics of waste water.

Detailed Syllabus:

Unit No.	Topic	Allotted lectures
Unit I	**Air Microbiology**	**06**

1. Air flora
    a. Transient nature of air flora
    b. Droplet, droplet nuclei, and aerosols
2. Methods of Air sampling and types of air samplers
    a. Impaction on solids
    b. Impingement in liquid
3. Air sanitation: Physical and chemical methods
4. Air borne infections

Unit II	**Soil Microbiology**	**09**

1. Rhizosphere microflora and its role in the rhizosphere
2. Bio fertilizers, Biocontrol agents
3. Brief account of microbial interactions:
   Symbiosis, Neutralism, Commensalism, Competition, Ammensalism, Synergism, Parasitism, and Predation
4. Role of microorganisms in elemental cycles in nature: Carbon, Nitrogen

Unit III	**Water Microbiology**	**15**

1. Types of water: surface, ground, stored, distilled, mineral and de- mineralized water
2. Recommended Bacteriological standards of Water Quality of Maharashtra Pollution Control Board (MPCB) and Central Pollution Control Board(CPCB):
3. Main Functions
4. Water quality standards for best designated usages
5. Water purification methods
6. Water borne Infections
7. Indicators of faecal pollution

*(Escherichia coli,Bifidobacterium,Streptococcus faecalis Clostridium perfringens,*New indicators: *Campylobacter and*

Pseudomonas)

8. Bacteriological analysis of water for potability

a. Bacteriological standards of potable water: Bureau of Indian standards (BIS),World health Organization (WHO)

b. Presumptive coliform count

c. Confirmed test

d. Completed test

e. Eijkman test

f. Membrane filter technique

9. Analysis of waste water

i. Physico chemical parameters: pH, temperature, total solids, suspended solids, Chemical Oxygen Demand(C.O.D.)

ii. Biological parameters: B.O.D., Toxicity (Fish bioassay)

Unit IV **Practical:-** **30**

1. Air Flora:
    a. Diversity determination.
    b. Simpson index and settling velocity determination

2. Bacteriological tests for potability of water:
    a. MPN, Confirmed and Completed test.
    b. Membrane filtration technique (Demonstration)
3. Enumeration of bacteria from rhizosphere soil
4. Determination of B.O.D., total solids and total suspended solids, total dissolved solids of water.

Suggested Readings:

1. Subba Rao N. S. (1977) Soil Microbiology, 4th Ed., Oxford & IBH Publishing Co. Pvt. Ltd.
2. Dubey R.C., and Maheswari, D. K. Textbook of Microbiology, S. Chand & Co.
3. Martin A. (1977) An Introduction to Soil Microbiology. 2nd edition. John Wiley & Sons Inc. New York & London.

4. Dube H.C. and Bilgrami. K.S. (1976) Text book of modern pathology. Vikas publishing house. New Delhi.
5. Daniel Lim., Microbiology, 2nd Edition; McGraw-Hill Publication
6. Ingraham J.L. and Ingraham C.A. (2004) Introduction to Microbiology. 3rd Edition. Thomson Brooks / Cole.
7. Madigan M.T, Martinko J.M. (2006) Brock's Biology of Microorganisms. 11th Edition. Pearson Education Inc.
8. Salle A.J. (1971) Fundamental Principles of Bacteriology. 7th Edition. Tata MacGraw Publishing Co.
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. Pelzar 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
13. Hans G. Schlegel (1993) General Microbiology, 8th Edition, Cambridge University Press
14. Martin Frobisher (1937) Fundamentals of Microbiology, 8th Edition, Saunders, Michigan University press
15. WHO guidelines for drinking water quality Volume I
16. https://www.mpcb.gov.in/water-quality/standards-protocols/water-quality-standards
17. https://cpcb.nic.in/wqstandards/
18. Standard Methods for the Examination of Water and Wastewater (2005) 21st 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 AnnH.

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(Autonomous)

Syllabus

B.Sc. Microbiology (Minor)

Title of the Course: Bacterial Genetics								
Year: II				**Semester: IV**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
MNR-4	BS-MR401T	02	01	03	60	30	70	100

Learning Objectives: The course has been organized to cover most of the important aspects related to bacterial genetics. The course will provide a brief overview of understanding the structure of DNA, DNA replication, Gene expression. This course provides the knowledge of mutation and its types. It also provides information about concept of plasmid.

Course Outcomes (COs):

1. Students will understand the different experiments proving nucleic acid as genetic material and learn the basic structure, properties and types of nucleic acid and Mechanism and modes of prokaryotic DNA replication
2. Students will understand concept of gene and gene expression like transcription and translation
3. Students will learn spontaneous mutation and induced mutations due to different mutagenic agents
4. Student will be able to understand plasmid genetics

Detailed Syllabus:

Unit No.	Topic	Allotted lectures
Unit I	**Understanding DNA** 1. Experimental evidences for nucleic acid as genetic material: a. Discovery of transforming material (hereditary material):Griffith's experiment b. Avery and MacLeod experiment c. Gierer and Schramm d. Fraenkel-Conrat & Singer experiment (TMV virus) e. Hershay & Chase experiment 2. Types of nucleic acids (DNA and RNAs) 3. Structure of DNA a. Structure of Nitrogen bases, Nucleoside, Nucleotide and polynucleotide chain b. Bonds involved in DNA structure c. Different forms of DNA	**08**
Unit II	**Prokaryotic DNA replication** 1. Models of DNA replication. (Conservative, semiconservative, and Dispersive) 2. Meselson and Stahl's experiment (semiconservative) 3. Enzymes, proteins and other factors involved in semi discontinuous DNA replication. 4. Modes of DNA replication- Rolling circle mechanism, theta and linear DNA replication	**07**
Unit III	**Gene expression and mutations** **1.Gene expression** a. Concept of Genetic code and its properties b .Concept of transcription and translation **2.Mutations** a. Concept of Mutation and Types of mutations:	**10**

Nonsense, Missense, Silent, frame shift mutation

3.Spontaneous Mutation

a. Discovery of spontaneous mutation (Fluctuation test)

a. Mechanism of spontaneous mutation

b. Isolation of Mutants: Replica plate technique

4.Concept of Induced Mutations

a. Base pair substitution (Transitions, Transversions), Insertions and deletions- Frame /Phase shift mutations

b. Physical Mutagenic agents: UV and X ray

c. Chemical mutagenic agents:

- Base analogues (2amino purine, 5bromo uracil),
- HNO2, Alkylating agents

d. Intercalating agents (EtBr, acridine orange)

Unit IV **Plasmid genetics** **05**

1. Types of plasmids
2. Properties of Plasmid
3. Plasmid replication
4. Plasmid incompatibility
5. Plasmid curing

Unit V **Practical:-** **30**

1. Demonstrated isolation of genomic DNA from bacteria and Estimation of DNA by the DPA method
2. Study of bacterial growth curve
3. Induction of mutations by using physical mutagen (e.g. UV rays)
4. Isolation of mutants by any suitable method
5. Demonstration of UV survival curve

Suggested Readings:

1. Bruce A. (2008), Molecular Biology of the Cell, 5th Edn. Publisher: Garland Science, New York.
2. David Freidfelder, (1987). Molecular Biology, 2nd Edn. Jones & Bartlett Pub.

3. .James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Losick, (2013), Molecular Biology of the Gene, 7th Edn. Pearson Publishers.
4. Jocelyn E. Krebs, Elliott S. Goldstein, Stephen T. Kilpatrick, (2012) Lewin's GENES XI , 11th Edn. Jones &Bartlett Learning
5. Lodish H. et al. (2012), Molecular Cell Biology, 7th Edn. W. H. Freeman & Company. New York.
6. Primrose, S. B. (2002). Principles of Gene Manipulation6th Edn. Oxford: Blackwell Scientific Publications
7. Russel Peter. (2009), Genetics: A Molecular Approach, 3rd Edn. Publisher Benjamin Cummings
8. Russel, Peter, (1990), Essential Genetics, 7thEdn. Blackwell Science Pub.
9. Stanier, R. Y. (1987), General Microbiology, 5th Edition, Macmillan Pub. Co. NY