

**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)**

**Implemented from
Academic Year 2023-24**

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
4.	Ms. Shinde Ashwini A.	Member
5.	Ms. Mehetre Vidya S.	Member
6.	Ms. Shinde Supriya D.	Member
7.	Dr. Gahile Yogesh R.	Member
8.	Mr. Wani Ashish S.	Member
9.	Dr. Patil Ulhas K	Member (Co-Opt)
10.	Dr. Dixit Prashant P.	Academic Council Nominee
11.	Dr. Naphade Bhushan S.	Academic Council Nominee
12.	Mr. Choure Rajendra G.	Vice-Chancellor Nominee
13.	Mr. Yewatkar Saikiran	Alumni
14.	Mr. Dube Chandrakant G.	Industry Expert

1. Prologue/ Introduction of the programme: At least one page

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 of microorganisms with their environments as well as how these organisms are harnessed in human 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 each other 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, 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 of humanity.

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

2. 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-MR102T	Techniques in Microbiology	03
3.	II	III	5.0	MNR-3	BS-MR201T	Environmental Microbiology	03
4.	II	IV	5.0	MNR-4	BS-MR202T	Bacterial Genetics	03
5.	III	V	5.5	MNR-5	BS-MR301T	Medical Microbiology	04
6.	III	VI	5.5	MNR-6	BS-MR302T	Industrial Microbiology	04
							20

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's
New Arts, Commerce and Science College, Ahmednagar
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Syllabus
B.Sc. Microbiology (Minor)

Title of the Course: Basic Microbiology								
Year: I					Semester: I			
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
MNR-1	BS-MR101 T	02	01	03	60	30	70	100

Learning Objectives: The objective of this course of is to introduce the student the Microbiology, different disciplines of microbiology, history and development of microbiology and bacterial cytology.

Course Outcomes (Cos)

1. Students will understand the applications of different branches of microbiology and their scope.
2. Students will understand the concept of abiogenesis vs biogenesis through historical experiments
3. Students will come to know the contribution of different scientist for the development of microbiology.
4. Student will learn the types of bacteria and bacterial cytology in detail.

Detailed Syllabus:

Unit No.	Topic	Allotted Lectures
Unit I	Introduction to Microbiology Beneficial and Harmful effects of microorganisms: <ol style="list-style-type: none"> 1. Medical Microbiology (Enlist diseases caused by various microorganisms, vaccines and antibiotics) 2. Environmental Microbiology (Eutrophication, red tide, Sewage treatment, bioremediation) 	5

3. Food and Dairy Microbiology (Food spoilage, food borne diseases, Probiotics and fermented food)
4. Agriculture Microbiology (Plant diseases and Biofertilizers and Bio-control agents)
5. Industrial Microbiology (Production of antibiotics, enzymes, solvents and contaminants-bacteria and phages)
6. Immunology (Normal flora, Three lines of defense)
7. Scope and application of Microbiology

Unit II

A. Development of Microbiology as a discipline

15

1. Discovery of microscope and Microorganisms (Anton von Leeuwenhoek and Robert Hooke),
2. Abiogenesis v/s biogenesis (Aristotle's notion about
3. spontaneous generation, Francesco Redi's experiment,
4. Schulze and Shawn Experiment, Louis Pasteur's & Tyndall's experiments)

B. Golden Era of Microbiology

Contributions of –

1. Louis Pasteur (Fermentation, Rabies, Pasteurization and Cholera vaccine-fowl cholera experiment)
2. Robert Koch (Koch's Postulates, Germ theory of disease,
3. Discovery of viruses (TMV and Bacteriophages),
4. River's Postulates
5. Contribution of Joseph Lister (antiseptic surgery), Paul Ehrlich (Chemotherapy), Edward Jenner (Vaccination) and Alexander Fleming (Penicillin) in establishment of fields of medical microbiology and immunology, Discovery of Streptomycin by Waksman

Unit III Bacterial Cytology

10

1. Microbial cell size, shape and arrangements
2. Structure, chemical composition and functions of the following components in bacterial cell:
 - a. Cell wall (Gram positive, Gram negative)
 - b. Cell membrane
 - c. Endospore (spore formation and stages of sporulation)
 - d. Capsule

- e. Flagella
- f. Fimbriae and Pili
- g. Ribosomes
- h. Chromosomal & extra-chromosomal material
- i. Cell inclusions

Practicals

30

Unit IV

1. Safety measures and Good Laboratory Practices in microbiology laboratory
2. Introduction, working principle, operation, precautions and use of common microbiology laboratory instruments: Analytical balance, Incubator, Hot air oven, Autoclave, Colorimeter/spectrophotometer, Laminar air flow hood/biosafety cabinet, centrifuge, Distillation unit, pH meter
3. Construction (mechanical and optical), working and care of compound microscope.
4. Wet mount slide preparation and its observation for: Bacteria, Algae, Fungi and Protozoa.
5. Introduction and use of common laboratory wares: Test tubes, culture tubes, suspension tubes, screw capped tubes, Petri plates, pipettes (Mohr and serological) micropipettes, Pasteur pipettes, Erlenmeyer flask, volumetric flask, glass spreader, Durham's tube, Cragie's tube and inoculating needles (wire loop, stab needles), dessicator, anaerobic jar
6. Learning basic techniques in Microbiology: Wrapping of glassware, cotton plugging, cleaning and washing of glassware, biological waste disposal.
7. Observation of motility in bacteria using: Hanging drop method and swarming growth method.
8. (soap and disinfectant)
9. Simple staining
10. Negative staining

Suggested Readings/Material:

1. Prescott, Lancing. M., John, P. Harley and Donald, A. Klein (2006). Microbiology, 6th Edition, McGraw Hill Higher Education.
2. Willey J. M., Sherwood L. M. and Woolverton C. J. (2013). Prescott's Microbiology, 8th Edition, McGraw-Hill Higher Education.
3. Salle A.J. (1971). Fundamental Principles of Bacteriology. 7th Edition, Tata McGraw Hill Publishing Co.
4. Stanier R.Y., Adelberg E.A. and Ingraham J.L. (1987). General Microbiology, 5th Edition, Macmillan Press Ltd.
5. Tortora G.J., Funke B.R., Case C.L. (2006). Microbiology: An Introduction. 8th Edition, Pearson Education Inc.
6. Daniel L., (1998). Microbiology, 2nd Edition, McGraw-Hill Publication.
7. Madigan M.T., Martinko J.M. (2006). Brock's Biology of Microorganisms. 11th Edition. Pearson Education Inc.
8. Pelczar M.J., Chan JR. E.C.S., Noel R. K. (1993). Microbiology, 5th Edition, Tata McGraw Hill Press.
9. Prescott L.M., Harley J.P., and Klein D.A. (2005). Microbiology, 6th Edition. McGraw Hill Companies Inc.

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Syllabus
B.Sc. Microbiology (Minor)

Title of the Course: Techniques in Microbiology								
Year: I				Semester: II				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
MNR-2	BS-MR102 T	02	01	03	60	30	70	100

Learning Objectives:

The objectives of this course is (i)to provide knowledge to students about the types of microscopy and staining methods to observe microorganisms (ii) to know about the types of culture media employed to isolate the microorganisms and (iii) to appreciate various methods of sterilization and disinfection employed to ensure aseptic conditions in microbiology works

Course Outcomes (Cos)

1. Students will understand the principles and applications of the different microscopes and staining methods.
2. Students will have gained knowledge about the Bacterial growth
3. Students will be acquainted with different methods of isolation and preservation of pure cultures.
4. Students will understand the different types of media used for the cultivation of microbes.

Detailed Syllabus:

Unit No.	Title	Allotted Lectures
Unit I	Microscopy and Staining Method	15
	A. Microscopy: Principle, mechanism and application of different types of Microscopes:	

Bright Field Microscope, Dark Field Microscope, Phase Contrast Microscope, Fluorescence Microscopy, Scanning and Transmission Electron Microscopy.

B. Staining Methods:

- a. Definition and types of stains (acidic and basic stains),
- b. Simple staining and negative staining,
- c. Differential staining- Gram staining, and acid-fast staining.
- d. Special staining-Endospore staining, capsule staining

Unit II Microbial Growth and Control 15

A. Microbial cultivation and growth

1. Nutritional requirements in bacteria and nutritional categories.
2. Culture media: components of media, Types of media
3. Pure culture isolation: Streak plate, spread plate and pour plate methods; cultivation, maintenance and preservation of pure cultures.
4. Asexual methods of reproduction, Bacterial growth curve, calculation of generation time and specific growth rate.

B. Control of Microbial Growth

1. Physical methods of microbial control: heat, radiation, filtration
2. Chemical methods of microbial control: disinfectants, types and mode of action.

Unit III Practicals 30

1. Preparation and sterilization of different media: Nutrient agar, MacConkey agar
2. Gram staining
3. Capsule staining
4. Endospore staining.
5. Isolation of pure cultures of bacteria by streak plate method.

6. Estimation of CFU count by spread plate method/pour plate method.
7. Aseptic transfer technique (Aseptic Behavior in the clean room or in the LAF (while working)
8. Study of effect of washing on skin microflora
9. Observation of microorganisms - bacteria, cyanobacteria protozoa, fungi, yeasts, and algae from natural habitats.

Suggested Readings/Material:

1. Prescott, M.J., Harley, J.P. and Klein, D.A. Microbiology. 5th Edition WCB Mc Graw Hill, New York, (2002).
3. Tortora, G.J., Funke, B.R. and Case, C.L. Microbiology : An Introduction. Pearson Education, Singapore, (2004).
5. Alamo, I.E. Fundamentals of Microbiology. VI Edition, Jones and Bartlett Publishers. Sudbury. Massachusetts, (2001).
7. Black J.G. Microbiology-Principles and Explorations. John Wiley & Sons Inc. New York, (2002).
9. Pelczar, M.J. Chan ECS and Krieg NR, Microbiology McGraw-Hill.