

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
B.Sc. Microbiology (Major) - II Year

Implemented from

Academic Year 2024-25

Credit Distribution: B.Sc. Microbiology (Major) 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

B. Sc. Programme Framework: Credit Distribution

Y e a r	Se m e s t e r	L e v e l	Major										M i n o r	O E	C C	A E C	V E C	T o t a l	
			D S C		D S E		S E C		V S C		F P/ O J T / I N / C E P								I K S
I	I	4.5	T	P	T	P	T	P	T	P	T	P		T/P	-	-	-	-	
I	II	4.5	4	2	-	-	-	2	-	-	-	-	2	03	3	2	2	2	22
			6	-	-	-	-	2	-	2	-	-		03	3	2	2	2	22
Exit Option: Award of UG Certificate in Major with 44 credits and an additional 4 credit core NSQF course /Internship or Continue with Major and Minor																			
II	III	5.0	6	2	-	-	-	2	-	-	-	2		03	3	2	2	-	22
II	IV	5.0	6	2	-	-	-	-	-	2	-	2		03	3	2	2	-	22
Exit Option: Award of UG Diploma in Major with 88 credits and an additional 4 credit core NSQF course /Internship or Continue with major and minor																			
III	V	5.5	8	2	2	2	-	-	-	2		2		04	-	-	-	-	22
III	VI	5.5	6	2	2	2	-	-	-	2		4		04	-	-	-	-	22
Exit Option: Award of UG Degree in Major and Minor with 132 credits or continue with Major for a 4-year Degree																			
IV	VII	6.0	8	6	2	2	RM-	-	-	-	-			-	-	-	-	-	22

Programme Framework (Course Distribution): B.Sc. Microbiology (Major)

Year	Semester	Level	Major											Total	
			DSC		DSE		SEC		VSC		FP/OJT /IN/CEP/PR		IKS	T	P/PR
			T	P	T	P	T	P	T	P	T	P	T		
I	I	4.5	2	1	-	-	-	1	-	-	-	-	01	03	02
I	II	4.5	2	-	-	-	1	-	1	-	-	-	-	02	02
II	III	5.0	2	1	-	-	1	-	-	-	1	-	02	03	
II	IV	5.0	2	1	-	-	-	-	1	-	1	-	02	03	
III	V	5.5	2	1	1	1	-	-	-	1	-	1	03	04	
III	VI	5.5	2	1	1	1	-	-	-	1	-	1	03	04	
B.Sc. Honours															
IV	VII	6.0	3	3	1	1	RM-1	-	-	-	-	-	05	04	
IV	VIII	6.0	3	3	1	1	-	-	-	-	1	-	04	05	
B.Sc. Honours with Research															
IV	VII	6.0	2	2	1	1	RM-1	-	-	-	1	-	04	04	
IV	VIII	6.0	2	2	1	1	-	-	-	-	1	-	03	04	

Programme Framework (Credit Distribution): B.Sc. Microbiology (Major)

Year	Semester	Level	Major											Total
			DSC		DSE		SEC		VSC		FP/OJT /IN/CEP/R P		IKS	
			T	P	T	P	T	P	T	P	T	P	T	
I	I	4.5	4	2	-	-	-	2	-	-	-	-	02	10
I	II	4.5	6	-	-	-	2	-	2	-	-	-	-	10
II	III	5.0	6	2	-	-	2	-	-	-	2	-	12	
II	IV	5.0	6	2	-	-	-	-	2	-	2	-	12	
III	V	5.5	8	2	2	2	-	-	-	2	-	2	18	
III	VI	5.5	6	2	2	2	-	-	-	2	-	4	18	
IV	VII	6.0	8	6	2	2	RM-4	-	-	-	-	-	22	
IV	VIII	6.0	8	6	2	2	-	-	-	-	-	4	22	
IV	VII	6.0	6	4	2	2	RM-4	-	-	-	-	4	22	
IV	VIII	6.0	6	4	2	2	-	-	-	-	-	8	22	

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

Sr. No.	Year	Semester	Level	Course Type	Course Code	Title	Credits
1.	I	I	4.5	DSC-1	BS-MR111T	Introduction to Microbiology	02
2.	I	I	4.5	DSC-2	BS-MR112T	Basic Techniques in Microbiology	02
3.	I	I	4.5	DSC-3	BS-MR113P	Practical Course based on Theory Paper I and II	02
4.	I	I	4.5	SEC-1	BS-MR114P	Computer Applications	02
5.	I	I	4.5	IKS-1	BS-MR115T	Vedic Microbiology	02
6.	I	II	4.5	DSC-4	BS-MR121T	Cell Biology of Microorganisms	03
7.	I	II	4.5	DSC-5	BS-MR122T	Bacteriology and Virology	03
8.	I	II	4.5	SEC-2	BS-MR123P	Microbiology Methods	02
9.	I	II	4.5	VSC-1	BS-MR124P	Basic Laboratory Practices In Microbiology	02
10.	II	III	5.0	DSC-6	BS-MR231T	Immunology	03
11.	II	III	5.0	DSC-7	BS-MR232T	Environmental Microbiology	03
12.	II	III	5.0	DSC-8	BS-MR233P	Practical Course based On Theory Paper I and II	02
13.	II	III	5.0	SEC-3	BS-MR234P	Biochemical Techniques and Instrumentation	02
14.	II	III	5.0	FP-01	BS-MR235P	Field Project	02
15.	II	IV	5.0	DSC-9	BS-MR241T	Bacterial Genetics	03
16.	II	IV	5.0	DSC-10	BS-MR242T	Bacterial Physiology and Enzymology	03
17.	II	IV	5.0	DSC-11	BS-MR243P	Practical Course based On Theory Paper I and II	02
18.	II	IV	5.0	VSC-2	BS-MR244P	Clinical Pathology and Biochemistry	02
19.	II	IV	5.0	CEP-01	BS-MR245P	Community engagement and Service	02

20.	III	V	5.5	DSC-12	BS-MR351T	Medical Microbiology	04
21.	III	V	5.5	DSC-13	BS-MR352T	Molecular Biology	04
22.	III	V	5.5	DSC-14	BS-MR353P	Practical Course based On Theory Paper I and II	02
23.	III	V	5.5	DSE-01	BS-MR355T	Enzymology	02
24.	III	V	5.5	DSE-02	BS-MR356P	Practical Course based On Enzymology	02
25.	III	V	5.5	VSC-3	BS-MR357P	Food and Dairy Microbiology	02
26.	III	V	5.5	FP-02	BS-MR358P	Field Project	02
27.	III	VI	5.5	DSC-15	BS-MR361T	Fermentation Technology	03
28.	III	VI	5.5	DSC-16	BS-MR362T	Applied Microbiology	03
29.	III	VI	5.5	DSC-17	BS-MR363P	Practical Course based On Theory Paper I and II	02
30.	III	VI	5.5	DSE-03	BS-MR364T	Immunology	02
31.	III	VI	5.5	DSE-04	BS-MR365P	Practical course based on immunology	02
32.	III	VI	5.5	VSC-4	BS-MR366P	Industrial Microbiology	02
33.	III	VI	5.5	OJT-01	BS-MR367P	On Job Training	04

B.Sc. Microbiology (Major with Honors)

34.	IV	VII	6.0	DSC-18	BS-MR471T	Microbial Cell Organization And Biochemistry	03
35.	IV	VII	6.0	DSC-19	BS-MR472T	Quantitative Biology	03
36.	IV	VII	6.0	DSC-20	BS-MR473Y	Microbial Systematics	02
37.	IV	VII	6.0	DSC-21	BS-MR474P	Practical Course Based On Biochemical Techniques	02
38.	IV	VII	6.0	DSC-22	BS-MR475P	Practical Course Based On Biostatistics And Bioinformatics	02

39.	IV	VII	6.0	DSC-23	BS-MR476P	Practical Course Based On Developmental Biology And Microbial Diversity	02
40.	IV	VII	6.0	DSE-05	BS-MR477T	Virology	02
41.	IV	VII	6.0	DSE-06	BS-MR478P	Practical Course Based On Virology	02
42.	IV	VII	6.0	RM-01	BS- MR479T/P	Research Methodology	04
43.	IV	VIII	6.0	DSC-24	BS-MR481T	Instrumentation And Molecular Biophysics	03
44.	IV	VIII	6.0	DSC-25	BS-MR482T	Molecular Biology	03
45.	IV	VIII	6.0	DSC-26	BS-MR482T	Nitrogen Metabolism And Photosynthesis	02
46.	IV	VIII	6.0	DSC-27	BS-MR482P	Practical Course Based On Instrumentation Techniques	02
47.	IV	VIII	6.0	DSC-28	BS-MR482P	Practical Course Based On Molecular Biology	02
48.	IV	VIII	6.0	DSC-29	BS-MR482P	Practical Course Based On Nitrogen Metabolism And Photosynthesis	02
49.	IV	VIII	6.0	DSE-07	BS-MR485T	Enzymology And Bioenergetics	02
50.	IV	VIII	6.0	DSE-08	BS-MR486P	Practical Course Based On Enzymology	02
51.	IV	VIII	6.0	OJT-02	BS-MR487P	On Job Training	04

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's
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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. Sarode Dhanashree S.	Member
7.	Ms. Suryawanshi Amruta P.	Member
8.	Dr. Gahile Yogesh R.	Member
9.	Mr. Wani Ashish S.	Member
10.	Dr. Patil Ulhas K.	Member(Co-Opt)
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 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 and use of MOOCs 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

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

Title of the Course: Immunology								
Year: II				Semester: III				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-6	BS-MR 231T	03	00	03	45	30	70	100

Learning Objectives: The objective of this course is to introduce the student the basic concept of immunity and its working. The concepts of antigen, antibody, MHC, organs of immune system and their interdependence will be explained in detail. The course will also focus on the applied immunology discussing the techniques like hybridoma technology, hematology and vaccination.

Course Outcomes (Cos)

1. Students will understand the working of various molecular, cellular components as well as organs involved in the immune system.
2. Students will acquire the knowledge about antigens, antibodies and MHC molecules.
3. Students will understand the various strategies for diagnosis of diseases based on antigen and antibody reactions.

Detailed Syllabus:

Unit No.	Topic	Allotted Lectures
Unit I	A. Introduction to immune system 1. Three lines of defenses, Innate vs acquired Immunity, Humoral Immunity and cell mediated Immunity 2. Primary and secondary immune response (Humoral) 3. Formation of blood cells (hematopoiesis) B. Organs of immune system: a. Primary lymphoid organs (Thymus and Bone Marrow): Thymus – structure, thymic education (positive and negative selection) b. Secondary lymphoid organs – structure and function of spleen and lymph node	8
Unit II	Innate immunity: Non-specific mechanisms of defense: Second line of defense: a. Humoral components, pattern recognition proteins (PRP) and pathogen associated molecular patterns (PAMPs), complement. b. Phagocytosis (oxygen dependent and independent systems), Complement activation (Classical, Alternative and lectin pathway), Inflammation	7

Unit III

A. Antigen:

15

Basic concept of antigen.

- a. Factors affecting immunogenicity
- b. Antigenic determinants, haptens and cross-reactivity, Carrier, Adjuvants
- c. Types of antigens: Thymus-dependent and thymus-independent antigens, Synthetic antigens, Soluble and particulate antigens, Autoantigens, Isoantigens

B. Immunoglobulins

- a. Basic structure of antibody molecule
- b. antigenic nature of immunoglobulin molecules
- c. Molecular basis of antibody diversity (kappa, lambda and heavy chain)

C. Major Histocompatibility Complex:

- a. Structure of MHC in man and mouse
- b. Structure and functions of MHC class-I and class-II molecules
- c. MHC antigen typing (microcytotoxicity and mixed lymphocyte reaction)

A. Immunohematology

Unit IV

- a. ABO and Rh blood group systems
- b. Bombay blood group
- c. Biochemistry of blood group substances
- e. Medico legal applications of blood groups

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B. Active and Passive Immunization

- a. Active Immunization Whole organism vaccines
 - i. Attenuated vaccines
 - ii. Inactivated Vaccines
- b. Passive Immunization

Transfer of preformed antibodies

**New Arts, Commerce and Science College, Ahmednagar
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Syllabus

B.Sc. Microbiology (Major)

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
DSC-7	BS-MR 232T	03	00	03	45	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 bioremediation.

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 potability, water purification methods, indicators of fecal pollution and water borne infections.
3. Students will understand the role of the rhizosphere microflora, large scale production of biofertilizer and biocontrol agents, microbial interactions in soil and role of microorganisms in humus and compost formation and in carbon, nitrogen, and Sulphur cycle.
4. Students will understand the role of microorganisms in bioremediation.

Detailed Syllabus:

Unit No.	Topic	Allotted lectures
Unit I	Air Microbiology	05
	1. Air flora <ul style="list-style-type: none">a. Transient nature of air florab. Droplet, droplet nuclei, and aerosols	
	2. Methods of Air sampling and types of air samplers <ul style="list-style-type: none">a. Impaction on solidsb. Impingement in liquidc. Sedimentationd. Centrifugation	
	3. Air sanitation: Physical and chemical methods	
	4. Air borne infections	
Unit II	Water Microbiology	10
	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 method	
	6. Water borne Infections	
	7. Indicators of faecal contamination	

(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), National Primary Drinking Water Regulation (NPDWR) by USEPA
 - b. Presumptive coliform count
 - c. Confirmed test
 - d. Completed test
 - e. Eijkman test
 - f. Membrane filter technique

Unit III Soil Microbiology

15

1. Rhizosphere microflora and its role in the rhizosphere
2. Role of microorganisms in composting and humus formation
3. Biofertilizers: Bacterial, Cyanobacterial, fungal and their large-scale production
4. Biocontrol agents: Bacterial, Viral, Fungal and their large-scale production
5. Brief account of microbial interactions:
Symbiosis, Neutralism, Commensalism, Competition, Ammensalism, Synergism, Parasitism, and Predation
6. Role of microorganisms in elemental cycles in nature:

Carbon, Nitrogen

- Unit IV** **1. Bioremediation:** Definition, advantages, bioremediation techniques, Phytoremediation, Genetically Modified Microorganisms in Bioremediation, Bioaugmentation, Biosorption, eutrophication. **15**
- 2. Bioleaching:** Microorganisms used, Bioleaching process, Bioleaching of Copper, Advantages of Bioleaching
- 3. Synthesis of Nanoparticles using microorganisms and its' applications**
- 4. Microbial Biosensors and Biochips in Environmental Monitoring**
- 5. Biofuel cells and Biodegradable plastic**

Suggested Readings/Material:

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. Martin Alexander (1999). Biodegradation and Bioremediation. Academic Press
19. R. Barry King, John K. Sheldon, Gilbert M. Long, 1997 Practical Environmental Bioremediation: The Field Guide, 2nd Edn. CRC Press

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Syllabus
B.Sc. Microbiology (Major)

Title of the Course: Practical based on theory paper I and theory paper II								
Year: II				Semester: III				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-8	BS-MR 233P	00	02	02	60	15	35	50

Learning Objectives: The course has been organized to cover most of the important aspects related to diversity and calculate the diversity index. The course will provide a brief overview of understanding the Bacteriological tests for potability of water and also learn the blood grouping; hematology tests. This course provides the knowledge of bioinoculant and enumeration of rhizospheric bacteria.

Course Outcomes (Cos)

1. Students will understand the concept of diversity and be able to calculate the diversity index.
2. Students will be able to analyze water samples and know the quality of drinking water or to know the potability of water by detecting the presence of indicator organisms, i.e. coliforms.
3. Students will perform the various hematology tests and blood grouping.
4. Students will perform enumeration of rhizospheric bacteria and perform the preparation of bioinoculant.

Detailed Syllabus:

Sr.No.	Title of the Experiment	Allotted Practical
1.	Air Flora: a. Diversity determination. b. Simpson index and settling velocity determination	1
2.	Bacteriological tests for potability of water: a. MPN, Confirmed and Completed test. b. Membrane filtration technique (Demonstration)	4
3.	Enrichment, Isolation and Preparation of Bioinoculant (<i>Azotobacter/Rhizobium</i> / Blue Green Algae (cyanobacteria))	2
4.	Enumeration of bacteria from rhizosphere soil.	1
5.	Nitrate reduction test.	1
6.	Double diffusion test.	1
7.	Demonstration of ELISA (Ag/Ab detection).	1
8.	Blood grouping.	1
9.	Blood Cross matching.	1
10.	Industrial visit.	1

Suggested Readings/Material:

1. Harley, J.P. and Prescott, L.M., (2002). Laboratory Exercises in Microbiology, 5th Edition, The McGraw-Hill Companies.
2. Saravanan R., Dhachinamoorthi D., CH. M.M., Prasada Rao (2013). 1st Edition, A Handbook of Practical Microbiology, LAP LAMBERT Academic Publishing.

3. Goldman and E., Green H.L. (2015) Practical Handbook of Microbiology 3rd Edition, ,CRC Press.
4. Subhash Chandra Parija ,Practical Microbiology For Undergraduate Medical Students (2018), Ahuja Publishing House.
5. Dubey R.C. and Maheshwari D.K.,Practical Microbiology(2002),1st Edition, S.Chand Paul

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Syllabus

B.Sc. Microbiology (Major)

Title of the Course: Biochemical Techniques and Instrumentation								
Year: II				Semester: III				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
SEC-3	BS-MR 234 P	00	02	02	60	15	35	50

Learning Objectives: The objective of this course is to introduce the student working, SOPs and calibration of analytical instruments used in Microbiology. It also focus on the qualitative and the quantities estimation of carbohydrates and proteins, electrophoresis etc.

Course Outcomes (Cos)

1. Students will be able to detect the presence of protein and carbohydrates by different methods.
2. Students will be able to separate and detect amino acids and carbohydrates using chromatography techniques.
3. students will learn the process of agarose gel electrophoresis and automated hemocytometer

Detailed Syllabus:

Sr. No.	Title of the Experiment	Allotted Practical
1.	Basic lab safety and hazards, SOPs	1
2.	Calibration of pH meter and spectrophotometer	2
3.	Determination of absorption spectra and molar extinction co-efficient of two different dyes (by colorimetry /spectrophotometry)	1
4.	Qualitative analytical tests using flow charts for : a. Proteins (tests for aromatic amino acids, sulfur containing amino acids, different amino acids) b. Carbohydrates (tests for monosaccharides, disaccharides, and polysaccharides)	2
5.	Paper Chromatography/ Thin layer Chromatography a. Separation and Identification of amino acids from mixture. b. Separation and Identification of sugars from mixture	2
6.	Extraction and quantitative estimation of carbohydrates /proteins from natural sample: a. Estimation of total carbohydrates from natural sources by Phenol -Sulfuric acid method b. Estimation of reducing sugar from natural sources by DNSA method c. Estimation of proteins from natural sources by Folin- Lowry method	3
7.	Demonstration of agarose gel electrophoresis	2
8.	Working of automated hemocytometer	1

Suggested Readings/Material:

1. Ausubel F. M., Brent R., Kingston R. E., Moore D. D., Seidman J.G., Smith J. A. and Struhl K. (Editors.). (2003). Current Protocols in Molecular Biology. Copyright © John Wiley and Sons, Inc. ISBN: 047150338

2. Segel I. H., (1997). Biochemical Calculations. 2nd Edition, John Wiley and Sons, NY.
3. Jayaraman J. (2011). Laboratory Manual in Biochemistry. New Age International Private Limited. ISBN-13: 978-8122430493
4. Martzy R., Bica-Schröder K., Pálvölgyi, Á.M., Kolm C., Jakwerth S., Kirschner A. K. T., Sommer R., Krska R., Mach R. L., Farnleitner A. H. and Reischer G. H. (2019).9. Plummer T. (2001). Introduction to Practical Biochemistry. Tata McGraw Hill Publishing Company. ISBN-13: 978-0070994874
5. Sadashivam S. and Manickam A. (2018). Biochemical Methods. Third edition. NewAge International Publication. ISBN-13: 978-8122421408
6. Katoch R. (2011). Analytical Techniques in Biochemistry and Molecular Biology. Springer New York Dordrecht Heidelberg London. ISBN: 978-1-4419-9784-
7. Wilson K. and Walker J. (Editors). (2010). Principles and Techniques of Biochemistry and Molecular Biology. 7th edition. Cambridge University Press, New York. ISBN-13: 978- 0521731676

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

Title of the Course: Field Project								
Year: II				Semester: III				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
FP-1	BS-MR 235P	00	02	02	30	15	35	50

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

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
DSC-9	BS-MR 241T	03	00	03	45	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 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 the concept of plasmid types, replication, compatibility and curing.

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:	08
	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. Hershey & 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

Unit II Prokaryotic DNA replication 12

- 1. Models of DNA replication. (Conservative, semiconservative, and Dispersive)
- 2. Meselson and Stahl's experiment (semiconservative)
- 3. Bacterial cell cycle
- 4. Enzymes, proteins and other factors involved in Semi discontinuous DNA replication: Single replicon, bidirectional movement of replication fork, OriC, Pre-priming reaction and priming reaction, DNA polymerase, DNA synthesis of leading and lagging strands, Okazaki Fragment, Termination-Ter sequence and Tus protein
- 5. Modes of DNA replication- Rolling circle mechanism, theta model.

Unit III Gene expression 08

- a. Concept of Genetic code and its properties, codon bias, codon optimization, Wobble hypothesis
- b. Transcription in prokaryotes
- c. Translation in prokaryotic

Unit IV Mutations 12

- a. Concept of Mutation and Types of mutations:**
 - Nonsense, Missense, Silent, frame shift mutation
- b. Spontaneous Mutation**
 - i. Discovery of spontaneous mutation (Fluctuation test)

- ii. Mechanism of spontaneous mutation
- iii. Isolation of Mutants: Replica plate technique

c. Concept of Induced Mutations

- i. Base pair substitution (Transitions, Transversions),
Insertions and deletions- Frame /Phase shift mutations
- ii. Physical Mutagenic agents: UV and X ray
- iii. Chemical mutagenic agents:
 - Base analogues (2amino purine, 5bromo uracil),
 - HNO₂, Alkylating agents
 - Intercalating agents (EtBr, acridine orange)

Unit V	Plasmid genetics	05
	<ol style="list-style-type: none">1. Types of plasmids2. Properties of Plasmid3. Plasmid replication4. Plasmid incompatibility5. Plasmid curing	

Suggested Readings/Material:

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 Manipulation 6th Edn. Oxford: Blackwell Scientific Publications.
7. <https://microbenotes.com/plasmids/>
8. <https://www.khanacademy.org/science/biology/gene-expression-central-dogma/translation-polypeptides/a/the-stages-of-translation>

**New Arts, Commerce and Science College, Ahmednagar
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Syllabus

B.Sc. Microbiology (Major)

Title of the Course: Bacterial Physiology and Enzymology								
Year: II				Semester: IV				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-10	BS-MR 242T	03	00	03	45	30	70	100

Learning Objectives: The objective of this is to introduce the students with the basics processes in the microbial physiology, pathways of carbohydrate metabolism and energy generation. The course also focuses on the basic and applied enzymology.

Course Outcomes (Cos)

1. Students will understand working, structure and function of enzyme.
2. Students will learn various metabolic pathways, of metabolic regulations and their importance.
3. Students will learn to perform enzyme assay, purification and quantification of enzyme activity

Detailed Syllabus:

Unit No.	Topic	Allotted lectures
Unit I	Bacterial Physiology	10
	1. Definitions of Metabolism, catabolism, anabolism, respiration and fermentation	
	2. Metabolic pathways (with structures)	
	a. Embden Meyerhof Parnas pathway (Glycolysis)	
	b. Hexose monophosphate pathway	
	c. Entner Doudoroff pathway	
	d. TCA cycle (with emphasis on amphibolism)	
	3. Electron Transport Chain- components, mechanism of	

ATP synthesis

4. Ethanol fermentation and Lactic acid fermentation

Unit II Enzymes 10

1. Introduction to Enzymes:

Basic structure and function of enzyme

i. Holoenzyme, Coenzymes, Cofactors, Prosthetic groups, Active Site

ii. Working of enzyme-Activation energy, transition state.

Ribozymes and Abzymes

2. Nomenclature & classification as per IUB (up to class level), EC number (with the explanation of tripeptide aminopeptidase)

3. Models for catalysis –

i. Lock and key

ii. Induced fit

iii. Transition state.

4. Effect of pH & temperature, substrate concentration & enzyme concentration.

5. Enzyme Inhibitors and their types.

Use of enzyme inhibitor as drug (with one example)

6. Enzyme activators

6. Applications of enzyme

Unit III Enzyme assays: 15

a. Principles of enzyme assays and calculation of enzyme unit, specific activity.

Enzymes assays with examples by:

i. Spectrophotometric methods

ii. Radioisotope assay

2. Principles and Methods of Enzyme purification:

- a. Methods of cell fractionation
- b. Principles and methods of enzyme purification:
 - i. Based on molecular size
 - ii. Based on charge
 - iii. Based on solubility differences
 - iv. Based on specific binding property and selective adsorption
- c. Construction of enzyme purification chart

Unit IV **Metabolic Regulations:** **10**

- a. Enzyme compartmentalization at cellular level
- b. Allosteric enzymes
- c. Feedback mechanisms
- d. Covalently modified regulatory enzymes (Glycogen phosphorylase)
- e. Proteolytic activation of zymogens
- f. Isozymes - concept and examples
- g. Multienzyme complex e.g. Pyruvate dehydrogenase complex(PDH)

Suggested Readings/Material:

1. Nelson D. L. and Cox M. M. (2021). Lehninger's Principles of Biochemistry. 8th Edition. Mac Millan Worth Pub. Co. New Delhi. ISBN:9781319228002
2. Berg J. M., Stryer L., Tymoczko J. and Gatto G. (2019). Biochemistry. 9th Edition. Palgrave Macmillan. ISBN-978-1319114657
3. Conn E. E., Stumpf P. K., Bruening G. and Doi R. H. (1987). Outlines of Biochemistry. 5th Edition. John Wiley and Sons. ISBN-13: 9780471052883
4. Hall D. A. and Krishna Rao K. (1994). Photosynthesis (Studies in Biology). 6th Edition. Cambridge University Press, London. ISBN-13: 978-1-133-10629-
5. Garrett R. H. and Grisham C. M. (2013). Biochemistry. 5th Edition. Brooks/Cole, Publishing Company, California. ISBN-13: 978-1-133-10629-6

6. Katoch R. (2011). Analytical Techniques in Biochemistry and Molecular Biology. Springer New York. ISBN 978-1-4419-9785-2.
7. A.H. Patel. (1985), Industrial Microbiology, Macmillan India Ltd.
8. Bioreactor Design and Product Yield (1992), BIOTOL series, Butterworths Heinemann.
9. Casida, L. E., (1984), Industrial Microbiology, Wiley Easterbs, New Delhi
10. Pepler, H. L (1979), Microbial Technology, Vol I and II, Academic Press, New York.
11. Peter F. Stanbury. Principles of Fermentation Technology, 2E, Elsevier (A Division of Reed Elsevier India Pvt. Limited), 2009
12. Prescott, S.C. and Dunn, C. G., (1983) Industrial Microbiology, Reed G. AVI tech books.
13. Reed G. Ed. Prescott and Dunn's Industrial Microbiology. 4th Ed., CBS Pub. New Delhi.
14. Stanbury, P. F. and Whittaker, A. (1984) Principles of Fermentation technology, 1st edition, Pergamon press.

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's
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Syllabus
B.Sc. Microbiology (Major)

Title of the Course: Practical course based on theory paper I and II								
Year: II				Semester: IV				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-11	BS-MR 243P	00	02	02	60	15	35	50

Learning Objectives: The course has been organized to cover most of the important aspects related characterization and identification of bacteria. The course will provide a brief overview of understanding the calibration of micrometers. This course provides the knowledge of isolation of mutants. It also provides information about the concept of screening enzyme and its activator and inhibitor. The course provide the information to learn bacterial growth curve .

Course Outcomes (Cos)

1. Students will be able to determine cell dimensions using micrometry and perform blood grouping
2. Students will be able to perform biochemical characterization and identification of bacteria.
3. Students will be able to carry out primary screening of amylase enzyme
4. Student will learn the concept of activator and inhibitor of enzymes.
5. Students will perform the isolation of mutants.

Detailed Syllabus:

Sr. No.	Title of the Experiment	Allotted Practical
1	Determination of calibration factor of an ocular micrometer- Measurements of cell dimension by micrometry using 10x,45x,100x objectives	1
2	Biochemical characterization of bacteria: a. Sugar utilization test (minimal medium + sugar) b. Sugar fermentation test c. IMViC test d. Enzyme detection – Gelatinase, Catalase, Oxidase e. Oxidative-fermentative test	4
3.	Isolation and identification of <i>E. coli</i> and <i>Staphylococcus aureus</i> from clinical samples using- a. Gram staining, motility/ slide culture b. Cultural and biochemical characterization	3
4.	Screening of Microorganisms producing industrially important enzyme- amylase	1
5.	Effect of activator and inhibitor on enzyme Amylase	1
6.	Study of Bacterial growth curve	1
7.	a. Induction of mutations by using physical mutagen (e.g. UV rays) b. Isolation of mutants by any suitable method c. Demonstration of UV survival curve	3

Suggested Readings/Material:

1. Russel Peter. (2009), Genetics: A Molecular Approach, 3rd Edn. Publisher Benjamin Cummings
2. Russel, Peter, (1990), Essential Genetics, 7thEdn. Blackwell Science Pub.
3. Stanier, R. Y. (1987), General Microbiology, 5th Edition, Macmillan Pub. Co. NY
4. Strickberger, M.W. (1985), Genetics, 3rd Edition Macmillan Pub. Co. NY.
5. R. J. Brooker, Genetics: analysis and principles, 6th edition, ISBN10: 1259616029
ISBN13: 9781259616020

**New Arts, Commerce and Science College, Ahmednagar
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Syllabus

B.Sc. Microbiology (Major)

Title of the Course: Clinical Pathology and Biochemistry								
Year: II				Semester: IV				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
VSC-2	BS-MR 244 P	00	02	02	60	15	35	50

Learning Objectives: The objective of this course is to enable the students to perform routine examination of different clinical specimens, perform routine hematological tests and to estimate sugar, protein, urea, cholesterol from blood/serum

Course Outcomes (Cos)

1. Students will learn the collection, handling and transport of clinical specimens.
2. Students will learn physical, chemical and microscopic examination of clinical specimens.
3. Students will learn to perform routine hematological tests.
4. Students will learn Quantitative determination of blood/serum glucose.

Detailed Syllabus:

Sr.No.	Title of the Experiment	Allotted Practicals
1.	Collection ,handling and transport of clinical specimens	1
2.	Physical, chemical and microscopic examination of clinical specimens –Pus,urine, pus,blood	3
3.	Routine haematological tests <ol style="list-style-type: none"> a. Estimation of haemoglobin b. Determination of ESR/PCV c. Determination of total WBC and RBC count d. Differential WBC count 	4
4.	Quantitative determination of blood/serum glucose by GOD-POD method	1

5.	Quantitative determination of urea in blood/serum	1
6.	Quantitative determination of cholesterol in blood/serum	1
7.	Quantitative Determination of serum Protein/albumin	1
8.	Preparation of molar and normal solutions	1
9.	Preparation of buffer and calibration of pH meter	1
10.	Visit to Blood bank / Diagnostic laboratory	1

Suggested Readings/Material:

1. Godkar P. B. (2020). Textbook of Medical Laboratory Technology Volume 1 and 2.3rd edition Bhalani Publishing House. ASIN: 9381496196. ISBN-13: 978-9381496190
2. Maheshwari N. (2017). Clinical Pathology Hematology and Blood Banking (For Dmlt Students). 3rd edition. Jaypee Brothers Medical Publishers. ISBN-13: 978- 9386261182
3. Mukherjee K. L. and Ghosh S. (2010). Medical Laboratory Technology, Volume I:Procedure Manual for Routine Diagnostic Tests. 2nd edition. McGraw Hill Education (India) Private Limited. ISBN-13: 978-1259061233
4. Mukherjee K. L. and Ghosh S. (2010). Medical Laboratory Technology, Volume II:Procedure Manual for Routine Diagnostic Tests. 2nd edition. McGraw Hill Education CBCS: 2019 Pattern T. Y. B. Sc. Microbiology(India) Private Limited. ISBN-13: 978-1259061240
5. Mukherjee K. L. and Ghosh S. (2010). Medical Laboratory Technology, Volume III:Procedure Manual for Routine Diagnostic Tests. 2nd edition. McGraw Hill Education(India) Private Limited. ISBN-13: 978-1259061257
6. Talib V. H. (2019). Handbook Medical Laboratory Technology. 2nd edition. CBS Publishers and Distributors Pvt. Ltd. ISBN-13: 978-8123906775

**New Arts, Commerce and Science College, Ahmednagar
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Syllabus

B.Sc. Microbiology (Major)

Title of the Course: Community engagement and Service								
Year: II				Semester: IV				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
CEP-1	BS-MR 245P	00	02	02	60	15	35	50