

Bhakta Kavi Narsinh Mehta University Junagadh



FACULTY OF LIFE SCIENCE

SYLLABUS FOR
BACHELOR OF SCIENCE (Honors with Research)

PROGRAMME
MICROBIOLOGY (SEMESTER – 8)

(w.e.f. June– 2026)

BHAKTA KAVI NARSINH MEHTA UNIVERSITY
Syllabus of B.Sc. (Honors with Research) as per NEP-2020
Faculty of Life Sciences
Effective from June 2026
Subject: Microbiology
SEMESTER- VIII

SUMMARY OF THE SYLLABUS

Sem No.	Sr. No.	Category of Course	Course Title	Course Level	Credit	Teaching Hrs.	SEE Marks	CCE Marks	Total Marks	Exam Duration
Sem-8	1	Major-20	Analytical Techniques	6.0	4	60	50	50	100	2 hrs.
	2	Major-21	Marine Biology and Forestry	6.0	4	60	50	50	100	2 hrs.
	3	Major-22	Combined Practical	6.0	4	120	50	50	100	4 hrs.
	4	Minor-8	Environmental Biology	6.0	4 (3T + 1P)	75 (45T + 30P)	50	50	100	4 hrs.
	5	*Research	-	6.0	6	-	75	75	150	6 hrs.
				Total	22	-	275	275	550	

*Research Project performed as per the NEP 2020, and BKNMU guideline.

BHAKTA KAVI NARSINH MEHTA UNIVERSITY
Syllabus of B.Sc. (Honors with Research) as per NEP-2020
Faculty of Life Sciences
Effective from June 2026
Subject: Microbiology
SEMESTER- VIII

Course Level	6.0	Internal Marks	50
Programme	B.Sc. Microbiology (HR)	External Marks	50
Semester	VIII	Practical Internal	-
Category of Course	MAJOR-20	Practical External	-
Course Credit	04	Prac. External Exam Duration	-
Teaching Hours	60	Total	100
Course Code	MAJMBT801	Exam Duration	2 hrs.
Course Title	Analytical Techniques (Theory)		

Course Objectives:

1. Understand the principles, fundamentals, and applications of microscopy and autoradiography.
2. Describe the principles and instrumentation of spectroscopic techniques.
3. Apply chromatographic and electrophoresis methods for the separation and analysis of biomolecules.

Course Learning Outcomes: After completion of the course:

1. Explain and understand the principles of microscopy and autoradiographic techniques.
2. Understand and interpret spectroscopy for biomolecular analysis.
3. Apply chromatographic and electrophoresis methods for separation and quantification.

Course Contents

Sem	Unit No.	Syllabi	Teaching Hours
7	1	Microscopy and Autoradiography • Theories of Tissue fixation and staining techniques. • Principles of Transmission and Scanning Electron Microscopy. • Principles of Phase Contrast and Fluorescence Microscopy. • Principle and applications of Autoradiography.	15
	2	Spectroscopy • Basic principles of Spectroscopy, UV, IR, Raman, ESR, ORD. • CD and structure of proteins using NMR.	15

BHAKTA KAVI NARSINH MEHTA UNIVERSITY
Syllabus of B.Sc. (Honors with Research) as per NEP-2020
Faculty of Life Sciences
Effective from June 2026
Subject: Microbiology
SEMESTER- VIII

		• Neutron and X-Ray diffraction for elucidation of 3D structure. • Molecular modelling, Mass Spectrometry	
	3	Chromatographic techniques • Basic Principles and Types of Chromatography. • Gas Chromatography & GC-MS, MALDI-TOF, LC-MS/MS. • Ion Exchange Chromatography, gel permeation, Affinity chromatography. • High Performance Liquid Chromatography and FPLC.	15
	4	Centrifugation and Electrophoretic Techniques • Principles and applications of Centrifugation techniques. • Basic principles of Electrophoresis, Agarose gel, native and SDS-PAGE. • Isoelectric focusing, 2D-PAGE and their uses in protein research. • Fractionation and Blotting Technique.	15

Suggested Reading:

1. Principles and Techniques of Biochemistry and Molecular Biology by Keith Wilson & John Walker.
2. Introduction to Spectroscopy by Donald L. Pavia
3. Chromatography: Concepts and Contrasts by James M. Miller

BHAKTA KAVI NARSINH MEHTA UNIVERSITY
Syllabus of B.Sc. (Honors with Research) as per NEP-2020
Faculty of Life Sciences
Effective from June 2026
Subject: Microbiology
SEMESTER- VIII

Course Level	6.0	Internal Marks	50
Programme	B.Sc. Microbiology (HR)	External Marks	50
Semester	VIII	Practical Internal	-
Category of Course	MAJOR-21	Practical External	-
Course Credit	04	Prac. External Exam Duration	-
Teaching Hours	60	Total	100
Course Code	MAJMBT802	Exam Duration	2 hrs.
Course Title	Marine Biology and Forestry (Theory)		

Course Objectives:

1. Understand microbial diversity in marine and forest ecosystems.
2. Explore the role of microorganisms in nutrient cycling and ecosystem functioning.
3. Learn applications of marine and forest microbiology in biotechnology and conservation, and analyze the impact of climate change and anthropogenic activities on microbial communities.

Course Learning Outcomes: After completion of the course:

1. Explain microbial diversity in marine and forest ecosystems.
2. Analyze microbial roles in nutrient cycling and ecosystem functioning.
3. Evaluate plant-microbe and marine host-microbe interactions and assess impacts of climate change on microbial communities and ecosystem sustainability

Course Contents

Sem	Unit No.	Syllabi	Teaching Hours
7	1	Introduction of Marine and Forest Microbiology • Oceans, seas, estuaries, mangroves, coral reefs • Physical and chemical characteristics of marine environments; Marine biodiversity and ecological significance. • Tropical, temperate, boreal, and mangrove forests, forest structure and ecological functions, Importance of microbial communities in forests • Methods for studying environmental microorganisms; Culture-dependent and metagenomic approaches.	15

BHAKTA KAVI NARSINH MEHTA UNIVERSITY
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Faculty of Life Sciences
Effective from June 2026
Subject: Microbiology
SEMESTER- VIII

	2	Marine Microbiology - Marine bacteria and archaea, Cyanobacteria and marine algae, Marine fungi and viruses. - Carbon, Nitrogen, sulfur, phosphorus cycle. - Coral-microbe interactions, Sponge associated microbiomes, Fish and shellfish microbiota - Deep-sea microorganisms, Hydrothermal vent microbiology, Psychrophiles and halophiles	15
	3	Forest Microbiology - Forest soil microbial diversity, Rhizosphere microbiology, Litter decomposition. - Mycorrhizal fungi, Nitrogen-fixing bacteria, Endophytes and epiphytes. - Fungal pathogens, Bacterial plant diseases, Biological control agents. - Carbon sequestration, Nutrient recycling, Soil fertility maintenance	15
	4	Climate Change, Conservation and Sustainable Management - Ocean acidification, Rising temperatures, Harmful algal blooms. - Forest degradation, Carbon cycling alterations, Emerging diseases. - Microbial biodiversity conservation, Restoration ecology, Sustainable forest and marine resource management. - AI-assisted environmental microbiology, Blue biotechnology and green biotechnology.	15

Suggested Reading:

1. Marine Microbiology: Ecology & Applications by Colin B. Munn,
2. Microbial Ecology of the Oceans, by David L. Kirchman (Ed.)
3. Forest Microbiology: Tree-Microbe Interactions, by Fred O. Asiegbu, (Eds.)
4. Environmental Microbiology by Pepper,
5. Brock Biology of Microorganisms, Fifteenth Edition, Global Edition, Michael T. Madigan
6. Environmental Microbiology: Fundamentals and Applications, by Jean-Claude (Eds.)
7. Soil Microbiology, Ecology and Biochemistry by Eldor A. Paul

BHAKTA KAVI NARSINH MEHTA UNIVERSITY
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Faculty of Life Sciences
Effective from June 2026
Subject: Microbiology
SEMESTER- VIII

Course Level	6.0	Internal Marks	-
Programme	B.Sc. Microbiology (HR)	External Marks	-
Semester	VIII	Practical Internal	50
Category of Course	MAJOR-22	Practical External	50
Course Credit	04	Prac. External Exam Duration	4 hrs.
Teaching Hours	120	Total	100
Course Code	MAJMBP803	Exam Duration	-
Course Title	Combined Practical (Practical)		

Course Objectives:

1. Provide hands-on experience with modern analytical instruments and laboratory techniques used in microbiological research.
2. Train students in microscopy, spectroscopic, chromatographic, and purification methods for biological sample analysis.
3. Develop skills in sampling, isolation, cultivation, and characterization of microorganisms from marine and forest ecosystems.

Course Learning Outcomes: After completion of the course:

1. Perform purification, separation, and characterization of biomolecules using modern analytical methodologies.
2. Isolate, identify, enumerate, and characterize microorganisms from diverse ecological habitats and evaluate their ecological significance.
3. Collect, process, and analyze marine, aquatic, and forest environmental samples using standard microbiological techniques.

Sem	No.	Syllabi	Teaching Hours
8	1.	Calibration and operation of light microscope.	120
	2.	To study the Beer-Lambert Law using a colorimetric assay.	
	3.	UV-Visible spectrophotometric estimation of proteins.	
	4.	Determination of DNA concentration by spectrophotometry.	
	5.	Separation of amino acids by ascending paper chromatography	

BHAKTA KAVI NARSINH MEHTA UNIVERSITY
Syllabus of B.Sc. (Honors with Research) as per NEP-2020
Faculty of Life Sciences
Effective from June 2026
Subject: Microbiology
SEMESTER- VIII

6.	Separation of amino acids by TLC methods.
7.	To interpret the HPLC data.
8.	To perform the separation technique by using centrifugation method.
9.	Demonstration of SDS-PAGE analysis of proteins.
10.	Protein purification using ammonium sulfate precipitation.
11.	Isolation of marine bacteria from seawater samples.
12.	Enumeration of microbial populations in marine and forest soils.
13.	Isolation of rhizosphere microorganisms.
14.	Observation of mycorrhizal associations.
15.	Water quality analysis of marine samples.
16.	Estimation of microbial biomass carbon.
17.	Isolation of cellulolytic microorganisms from forest litter.
18.	Screening for enzyme-producing marine microbes.
19.	Preparation of the Winogradsky column and interpretation of the results.

Suggested Reading:

1. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-I, Aditya Publications, Ahmedabad, India.
2. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-II, Aditya Publications, Ahmedabad, India.
3. Dubey. R.C., Maheshwari. D.K., Practical Microbiology, S. Chand & Company Ltd., New Delhi
4. Konika Sharma., manual of Microbiology – Tools & Techniques, Ane Books, Delhi.
5. Microbiology- A laboratory Manual 4th edition. by James G. Chappuccino & Natalie Sherman

BHAKTA KAVI NARSINH MEHTA UNIVERSITY
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Faculty of Life Sciences
Effective from June 2026
Subject: Microbiology
SEMESTER- VIII

Course Level	6.0	Internal Marks	25
Programme	B.Sc. Microbiology (HR)	External Marks	50
Semester	VIII	Practical Internal	25
Category of Course	MINOR-8	Practical External	-
Course Credit	04 (03T+01P)	Prac. External Exam Duration	-
Teaching Hours	75 (45T+30P)	Total	100
Course Code	MINMBT801	Exam Duration	2 Hrs.
Course Title	Environmental Biology (Theory)		

Course Objectives:

1. Develop skills in studying physiological responses and adaptations of organisms to environmental factors.
2. Familiarize students with environmental monitoring techniques and assessment of pollution impacts.
3. Introduce concepts of environmental toxicology and ecological health assessment.

Course Learning Outcomes: After completion of the course:

1. Investigate the effects of environmental factors such as temperature, water availability, salinity, and light on living organisms.
2. Isolate, enumerate, and characterize microorganisms from soil, water, and air environments using standard microbiological techniques.
3. Evaluate the role of microorganisms in nutrient cycling, biofertilization, biopesticide production, and environmental management.

Course Contents

Sem.	Unit No.	Syllabi	Teaching Hours
8	1	Environmental Physiology and Adaptation • Organism and environment: environmental factors affecting organisms; tolerance limits; acclimatization, adaptation and homeostasis • Plant responses to environmental stress: effects of temperature, water, salinity and light; drought and salinity tolerance mechanisms	12

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Faculty of Life Sciences
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Subject: Microbiology
SEMESTER- VIII

		- Animal adaptations: thermoregulation and osmoregulation; adaptations in desert, aquatic, polar and high-altitude animals - Stress biology: abiotic stress responses; oxidative stress; heat shock proteins; antioxidant defence mechanisms.	
	2	Environmental Microbiology - Microbial diversity and habitats: soil, water and air microorganisms - Microbial roles in environment: decomposition and nutrient transformation (basic concepts only) - Beneficial applications: biofertilizers and biopesticides - Environmental applications: wastewater treatment; basic bioremediation concepts	12
	3	Environmental Toxicology and Health Biology - Basic toxicology: toxic agents; dose-response relationship; concept of toxicity - Major pollutants: heavy metals and pesticides (mercury, lead, cadmium, arsenic) - Ecotoxicology basics: bioaccumulation and biomagnification - Environmental health: water-borne, air-borne and vector-borne diseases; occupational and indoor pollution	11
	4	Environmental Biology Tools and Applications - Basic environmental biotechnology: biosensors and bioindicators - DNA-based tools: DNA barcoding and species identification - Environmental DNA (eDNA): basic concept and applications in biodiversity monitoring - Conservation applications: gene banks and wildlife forensics	10

Suggested Reading:

1. Environmental Biology by P.D. Sharma
2. Environmental Microbiology by Pepper, Gerba & Gentry
3. Fundamentals of Ecology by Odum & Barrett
4. Animal Physiology: Adaptation and Environment by Schmidt-Nielsen
5. Environmental Biotechnology: Principles and Applications by Rittmann & McCarty
6. Microbial Ecology: Fundamentals and Applications by Ronald M. Atlas & Richard Bartha
7. Brock Biology of Microorganisms by Michael T. Madigan
8. Microbial Ecology, Larry L. Barton & Diana E. Northup

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Faculty of Life Sciences
Effective from June 2026
Subject: Microbiology
SEMESTER- VIII

9. Environmental Biotechnology: Principles and Applications by Bruce E. Rittmann & Perry L. McCarty
10. Principles of Ecotoxicology by C.H. Walker, R.M. Sibly,
11. Principles of Ecotoxicology by Walker et al.
12. Wildlife DNA Analysis: Applications in Forensic Science by Adrian Linacre & Shanan Tobe
13. Environmental DNA: For Biodiversity Research and Monitoring by Pierre Taberlet, Aurélie Bonin,
14. Biodiversity and Conservation by Michael J. Groom.

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SEMESTER- VIII

Practical Course (Minor-8)

Sem	No.	Syllabi	Teaching Hours
8	1	Study of the effect of temperature on seed germination and seedling growth.	30
	2	Determination of chlorophyll content under environmental stress conditions.	
	3	Estimation of relative water content (RWC) in plants under drought stress.	
	4	Observation of stomatal density and stomatal responses under different environmental conditions.	
	5	Isolation and enumeration of soil microorganisms by serial dilution method.	
	6	Isolation and characterization of water microorganisms.	
	7	Air microbiology: microbial load determination by settle plate technique.	
	8	Isolation and study of nitrogen-fixing bacteria.	
	9	Preparation and evaluation of biofertilizers.	
	10	Determination of physicochemical parameters of water.	
	11	Assessment of water quality using biological indicators.	
	12	Assessment of indoor and occupational pollution using environmental monitoring records.	
	13	Analysis of DNA barcode sequences using public databases.	
	14	Visit to biodiversity repository, gene bank, wastewater treatment plant, or environmental monitoring laboratory.	

Suggested Reading:

1. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-I, Aditya Publications, Ahmedabad, India.
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SEMESTER- VIII

Theory Paper Style:
(Major and Minor)

Time: 2 Hours

Total Marks: 50

Instructions:

1. Illustrate your answer with neat and labelled diagrams.
2. Figure to the right side indicates full marks of questions.

EXTERNAL ASSESSMENT BY UNIVERSITY			
Que. No.	Particulars	Unit	Marks
Que. 1	(1)	Unit 1	05
	(2)		05
	Or		
	(1)		05
	(2)		05
Que. 2	(1)	Unit 2	05
	(2)		05
	Or		
	(1)		05
	(2)		05
Que. 3	(1)	Unit 3	05
	(2)		05
	Or		
	(1)		05
	(2)		05
Que. 4	(1)	Unit 4	05
	(2)		05
	Or		
	(1)		05
	(2)		05
Que. 5	(1)	Unit 1 & 2	05
	(2)		05
	Or		
	(1)	Unit 3 & 4	05
	(2)		05
Total			50

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SEMESTER- VIII

INTERNAL EVALUATION SCHEME (MAJOR)			
INTERNAL ASSESSMENT			
No.	Particulars	Marks	Weightage
1	Internal Test	50	25
2	Assignment		10
3	Field visit report/ class presentation		10
4	Attendance		05
	Total		50

INTERNAL EVALUATION SCHEME (MINOR)			
INTERNAL ASSESSMENT			
No.	Particulars	Marks	Weightage
1	Internal Practical	50	25
2	Internal Test		10
3	Field visit report/ class presentation		10
4	Attendance		05
	Total		50

INTERNAL EVALUATION SCHEME		
INTERNAL ASSESSMENT		
No.	Particulars	Weightage
1	Practical Performance	40
2	Viva	10
	Total	50

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SEMESTER- VIII

Paper Style:

INTERNAL EVALUATION SCHEME		
INTERNAL ASSESSMENT PRACTICAL		
No.	Particulars	Weightage
1	Perform any Four practical from the given list of exercises as per the instruction of the examiner.	40
2	Viva	10
Total		50

ASSESSMENT BY UNIVERSITY		
Que. No.	Particulars	Marks
EXTERNAL EXAMINER		
1	Perform any Three or Four practical from the given list of exercises as per the instruction of the examiner	40
2	Viva-voce	10
Total		50