

Bhakta Kavi Narsinh Mehta University Junagadh



FACULTY OF LIFE SCIENCE

SYLLABUS FOR
BACHELOR OF SCIENCE (Honors with Research)

PROGRAMME
MICROBIOLOGY (SEMESTER – 7)

(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- VII

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-7	1	Major-17	Biochemistry and Molecular Biology	6.0	4	60	50	50	100	2 hrs.
	2	Major-18	Biostatistics, Research Methodology and AI	6.0	4	60	50	50	100	2 hrs.
	3	Major-19	Combine Practical	6.0	4	120	50	50	100	4 hrs.
	4	Minor-7	Ecology and Climate Change	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.

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Course Level	6.0	Internal Marks	50
Programme	B.Sc. Microbiology (HR)	External Marks	50
Semester	VII	Practical Internal	-
Category of Course	MAJOR-17	Practical External	-
Course Credit	04	Prac. External Exam Duration	-
Teaching Hours	60	Total	100
Course Code	MAJMBT701	Exam Duration	2 hrs.
Course Title	Biochemistry and Molecular Biology (Theory)		

Course Objectives:

1. Understand the classification, mechanism of action, regulation, and biological significance of enzymes, and analyze factors affecting enzyme activity through enzyme kinetics.
2. Explain the molecular organization of genes and genomes, including gene structure, regulation of gene expression, and mechanisms controlling transcription and translation in prokaryotic and eukaryotic systems.
3. To understand gene mutations, chromosomal variations, and their biological significance.

Course Learning Outcomes: After completion of the course:

1. Analyze enzyme kinetic parameters and evaluate factors influencing enzyme-catalyzed reactions.
2. Examine the organization of genes and genomes, and describe the molecular mechanisms governing gene expression in prokaryotes and eukaryotes.
3. Assess the impact of mutations, chromosomal abnormalities, and defects in DNA repair pathways.

Course Contents

Sem	Unit No.	Syllabi	Teaching Hours
7	1	Advanced Metabolic Biochemistry • Macronutrients and micronutrients: vitamins, and major minerals; their roles in enzyme function, nerve conduction, and oxygen transport.	15

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		• Photosynthesis: light reactions, photophosphorylation, electron transport, and Calvin cycle. • Biosynthesis and functions of plant secondary metabolites: alkaloids, flavonoids, terpenoids; ecological and medicinal roles. • Bioenergetics: ΔG, ATP as energy currency, high-energy phosphate compounds (e.g., phosphoenolpyruvate, 1,3-bisphosphoglycerate, creatine phosphate).	
	2	Enzymes and enzyme kinetics • Enzyme nomenclature, active site, cofactors, coenzymes, and isoenzymes. • Michaelis–Menten kinetics, Lineweaver–Burk plots, and kinetic parameters (K_m, V_{max}); inhibition types: competitive, non-competitive, uncompetitive, and mixed inhibition. • Allosteric regulation, feedback inhibition, and cooperativity (e.g., hemoglobin and aspartate transcarbamoylase). • Microbial enzyme production and industrial applications: amylases, proteases, lipases, cellulases, and pectinases. • Recombinant microbial systems for production of human proteins (e.g., insulin, growth hormone) using bacteria and yeast.	15
	3	Gene Structure and Expression • Concept of Gene: classical to molecular definition, fine structure of gene (cistron–recon–muton), gene organization, split genes, gene families, pseudogenes, overlapping genes, and transposable elements. • Gene expression I: genetic code and its properties, transcription in prokaryotes and eukaryotes, RNA polymerases, transcription factors, and RNA processing (capping, splicing, polyadenylation, RNA editing and transport). • Gene expression II: translation in prokaryotes and eukaryotes, ribosome structure and function, genetic code interpretation, translational regulation, protein folding, targeting, and post-translational modifications. • Regulation of gene expression: operon models in prokaryotes, transcriptional regulation in prokaryotes and eukaryotes, epigenetic regulation, RNA-mediated	15

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		regulation, chromatin remodeling, and gene regulatory networks.	
	4	Mutation, Chromosomal Variation, DNA Repair, and Cytoplasmic Inheritance • Molecular basis of mutations: spontaneous and induced mutations, types of gene mutations, mutagenic agents, mechanisms of mutagenesis, and effects on gene function. • Structural and numerical chromosomal aberrations: mechanisms, causes, and genetic consequences. • DNA damage: sources, types, and molecular mechanisms of DNA repair systems in prokaryotes and eukaryotes. • Cytoplasmic inheritance: mitochondrial and chloroplast genomes, maternal inheritance, and non-Mendelian inheritance patterns.	15

Suggested Reading:

1. The physiology and Biochemistry of Prokaryotes, 2nd edition By. David white
2. Outlines of biochemistry By- Conn E.E. and Stumpt P.K.: 4th Ed
3. General microbiology by Stanier R.Y.: 5th Ed.
4. Principles of Biochemistry By Lehninger
5. General microbiology by Powar and Daginawala Vol-1
6. Molecular Biology of the Gene
7. Molecular Biology of the Cell
8. Lewin's Genes
9. Molecular Cell Biology

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Programme	B.Sc. Microbiology (HR)	External Marks	50
Semester	VII	Practical Internal	-
Category of Course	MAJOR-18	Practical External	-
Course Credit	04	Prac. External Exam Duration	-
Teaching Hours	60	Total	100
Course Code	MAJMBT702	Exam Duration	2 hrs.
Course Title	Biostatistics, Research Methodology and AI (Theory)		

Course Objectives:

1. To develop skills in research design, data collection, hypothesis formulation, and scientific writing.
2. To familiarize students with emerging applications of Artificial Intelligence and Machine Learning in biological sciences.

Course Learning Outcomes: After completion of the course:

1. Apply statistical methods for analysis and interpretation of biological data and design scientific research projects using appropriate methodologies and ethical practices.
2. Use statistical software and AI-based tools for data analysis and problem-solving.
3. Explain the applications of Artificial Intelligence and Machine Learning in agriculture, plant sciences, biodiversity studies, and environmental monitoring.

Course Contents

Sem	Unit No.	Syllabi	Teaching Hours
7	1	Basics and Concepts of Biostatistics • Data classification, Frequency distribution and Graphs. • Measure of Central Tendency: Meaning, Objectives, Merits, Demerits & Uses. • Measure of Dispersion – Range, Variance, Standard deviation, Coefficient of Variation; Confidence limit and confidence interval. • Probability distributions (Binomial, Poisson and normal), Sampling distribution; Difference between parametric and non-parametric statistics; Confidence Interval; Errors; Levels of significance.	15

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	2	Statistical tests in Biology • Regression and Correlation analysis. • Student's t-test: Paired and Unpaired. • Level of Significance & Degree of Freedom: Chi-square test (X²); Analysis of Variance (ANOVA) • Basics of Multivariate statistics.	15
	3	Basic Research Methodology • Research problem, Aims & Objectives, types of scientific research • Hypothesis formulation and testing, Literature survey and review, and Mentoring • Sampling techniques, optimization of protocol, graphical data analysis, data validation • Plagiarism, Referencing tools	15
	4	Artificial intelligence foundation • Introduction to Artificial Intelligence, AI fundamentals, Use-cases and applications of AI, Issues concerning AI in business, ethics and bias, jobs and scope. • Brief history of AI and ML in Healthcare and biology, Machine Learning workflow and terminologies, computational models of intelligence. • Applications of AI in genomics, bioinformatics, disease diagnosis, drug discovery and biological data analysis.	15

Suggested Reading:

1. Introduction to Bio-Statistics, Banerjee Pranab Kumar, S Chand & Company
2. Biostatistics, Veer Bala Rastogi, Medtech
3. Biostatistics Analysis, Zar, Pearson
4. Biostatistics for health and life sciences, Rao K Surya, Himalaya Publishing house
5. An Introduction to Biostatistics, Gurumani
6. Research methodology, C R Kothari, New Age Publishers
7. Principles of Biostatistics by Marcello Pagano, Duxbury Thomson Learning
8. Russell, Norvig, Artificial Intelligence: A Modern Approach, Third edition, Prentice Hall, 2010
9. Artificial Intelligence in Healthcare
10. Foundations of Artificial Intelligence in Healthcare and Bioscience

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Course Level	6.0	Internal Marks	-
Programme	B.Sc. Microbiology (HR)	External Marks	-
Semester	VII	Practical Internal	50
Category of Course	MAJOR-19	Practical External	50
Course Credit	04	Prac. External Exam Duration	4 hrs.
Teaching Hours	120	Total	100
Course Code	MAJMBP703	Exam Duration	-
Course Title	Combined Practical (Practical)		

Course Objectives:

1. Apply biochemical and molecular biological concepts to interpret experimental data, analyze genetic phenomena, and solve problems related to metabolism, heredity, and genome function.
2. Enable students to prepare and understand statistical analysis, research design, data collection, hypothesis formulation, and scientific writing.
3. Familiarize students with emerging applications of Artificial Intelligence and Machine Learning in biological sciences.

Course Learning Outcomes: After completion of the course:

1. Analyse enzyme kinetic parameters and evaluate factors influencing enzyme-catalysed reactions.
2. Explain the applications of Artificial Intelligence and Machine Learning in agriculture, plant sciences, biodiversity studies, and environmental monitoring.
3. Apply the statistical tools and Artificial intelligence in research.

Course Contents

Sem	No.	Syllabi	Teaching Hours
7	1	Estimation of sugar by DNSA method	120
	2	Extraction and estimation of protein by Folin-Lowry method	
	3	To determine the saponification value of fats and oils	
	4	Perform the qualitative test of plant secondary metabolites	
	5	Perform the amylase activity	

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6	Determination of Vmax and Km for the amylase enzyme by performing a substrate curve with a Lineweaver-Burk plot.
7	Determination of Vmax and Km for phosphatase by performing a substrate curve with the Lineweaver-Burk plot
8	Preparation of plant tissue culture media
9	Perform the surface sterilization of explants
10	Preparation of animal cell culture media
11	Quantitative estimation of DNA by the diphenylamine method
12	Quantitative estimation of RNA by orcinol method
13	Frequency Distribution.
14	Standard Deviation and Coefficient of Variation
15	Confidence limits for the population mean.
16	Students 't' test.
17	Analysis of Variance.
18	Regression and Correlation
19	Frequency Distribution.
20	Chi Square Test
21	Research proposal preparation.
22	Multivariate tools and its application
23	Data validation using statistical tools
24	Graphical data analysis
25	Introduction to AI tools for biological data Analysis
26	Uses of ChatGPT/Gemini/AI tools in scientific literature search

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. An Introduction to Biostatistics, Gurumani.
5. Research methodology, C R Kothari, New Age Publishers

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Course Level	6.0	Internal Marks	25
Programme	B.Sc. Microbiology (HR)	External Marks	50
Semester	VII	Practical Internal	25
Category of Course	MINOR-7	Practical External	-
Course Credit	04 (03T+01P)	Prac. External Exam Duration	2 Hrs.
Teaching Hours	75 (45T+30P)	Total	100
Course Code	MINMBT701	Exam Duration	2 Hrs.
Course Title	Ecology and Climate Change (Theory)		

Course Objectives:

1. Provide students with an understanding of population and community ecology, including ecological organization, species interactions, community structure, and ecological succession.
2. Develop knowledge of ecosystem functioning through productivity, biogeochemical cycles, ecosystem services, resilience, and sustainable management practices.
3. Familiarize students with the Earth's climate system, causes of climate change, climate indicators, and scientific approaches to climate monitoring.

Course Learning Outcomes: After completion of the course:

1. Analyze population characteristics, species interactions, community organization, and ecological succession in natural ecosystems.
2. Evaluate ecosystem productivity, nutrient cycling, ecosystem services, and approaches for ecosystem restoration and sustainability..
3. Interpret climate system processes, assess causes and evidence of climate change, and apply climate monitoring concepts..

Course Contents

Sem	Unit No.	Syllabi	Teaching Hours
7	1	Population and Community Ecology • Ecological Foundations: Levels of ecological organization; habitat, ecological niche and ecological adaptations; Gause's principle of competitive exclusion and resource partitioning • Population Ecology: Population characteristics and growth patterns; carrying capacity and population regulation	12

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		- Population Interactions: Competition, predation, parasitism, mutualism and commensalism - Community Ecology: Community structure and organization; species diversity, richness and evenness; ecotone and edge effect - Ecological Succession: Types and processes; climax concept	
	2	Ecosystem Ecology - Ecosystem Productivity: Primary and secondary productivity; factors affecting productivity - Biogeochemical Cycles: Carbon, nitrogen, phosphorus and hydrological cycles - Ecosystem Services: Provisioning, regulating, supporting and cultural services - Ecosystem Resilience and Sustainability: Ecosystem resilience; ecological restoration; sustainable ecosystem management	11
	3	Climate Change and Earth System Processes - Climate System and Basics: Weather and climate; atmospheric structure; solar radiation; Earth's heat budget; greenhouse effect - Causes of Climate Change: Natural climate variability; human activities; greenhouse gases; land-use change and deforestation - Evidence of Climate Change: Global warming; glacier retreat; sea-level rise; ocean acidification; extreme weather events - Climate Monitoring: Climate indicators; basic ideas of climate monitoring and modelling; carbon footprint and ecological footprint	10
	4	Climate Change Impacts, Responses and Governance - Impacts of Climate Change: Effects on terrestrial, freshwater, coastal and marine ecosystems; species distribution shifts; phenology - Climate Change Mitigation: Carbon cycle; carbon sequestration; carbon budgeting; renewable energy; nature-based solutions - Climate Change Adaptation: Climate-smart agriculture; ecosystem-based adaptation; water resource management; disaster risk reduction - Climate Governance (India and Global Context): Overview of UNFCCC and Paris Agreement; India's climate policy framework with special reference to NAPCC and regulatory role of National Green Tribunal (NGT); climate resilience and community participation	12

Suggested Reading:

1. Fundamentals of Ecology by Eugene P. Odum and Gary W. Barrett.
2. Ecology: From Individuals to Ecosystems by Michael Begon, Colin R. Townsend and John L. Harper.
3. Elements of Ecology by Thomas M. Smith and Robert L. Smith.
4. Ecology by Michael L. Cain, William D. Bowman and Sally D. Hacker.

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5. Ecological Methodology by Charles J. Krebs.
6. A Primer of Ecology by Nicholas J. Gotelli.
7. Community Ecology by Peter J. Morin.
8. The Economy of Nature by Robert E. Ricklefs and Rick Relyea.
9. Environmental Biology by P. D. Sharma.
10. Introduction to Modern Climate Change by Andrew E. Dessler.
11. Climate Change: The Science of Global Warming and Our Energy Future by Edmond A. Mathez and Jason E. Smerdon.
12. Climate Change Biology by Lee Hannah.
13. Principles of Environmental Science by William P. Cunningham and Mary Ann Cunningham.
14. Environmental Science: Earth as a Living Planet by Daniel B. Botkin and Edward A. Keller. P. J. Quinn, B. K. Markey, F. C. Leonard, P. Hartigan, S. Fanning, E. S. Fitzpatrick. Veterinary Microbiology and Microbial Disease. Wiley-Blackwell (2011).

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Practical Course (Minor-7)

Sem	No.	Syllabi	Teaching Hours
7	1	Ecological Sampling and Vegetation Analysis: Study of vegetation using quadrat methods for determination of frequency, density, abundance and Importance Value Index (IVI).	30
	2	Biodiversity Assessment: Assessment of species richness, diversity and evenness using Shannon-Wiener and Simpson's diversity indices.	
	3	Community Structure Analysis: Study of community composition, dominance and species associations in selected ecosystems.	
	4	Determination of population characteristics including density, dispersion patterns and growth patterns using field data.	
	5	Determination of primary productivity using light and dark bottle method or suitable ecosystem models.	
	6	Construction and analysis of food chains, food webs and ecological pyramids from field observations.	
	7	Estimation of above-ground biomass and carbon sequestration potential of selected plant communities.	
	8	Analysis of long-term climatic data (temperature, rainfall, humidity and CO ₂ concentration) using IMD datasets.	
	9	Assessment of ecological vulnerability of selected ecosystems using standard indicators.	
	10	Preparation of biodiversity inventory of a selected ecosystem using field survey methods.	
	11	Calculation of individual, household or institutional carbon footprint.	
	12	Field visit to a protected area, wetland, coastal ecosystem, forest ecosystem or biodiversity hotspot and submission of a field report.	

Suggested Reading:

1. Environmental and Ecology by P. D. Sharma..
2. Fundamentals of Ecology by Eugene P. Odum and Gary W. Barrett..
3. Elements of Ecology by Thomas M. Smith and Robert L. Smith.

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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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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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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