

BHAKTA KAVI NARSINH MEHTA UNIVERSITY, JUNAGADH



BOARD OF STUDIES (BOTANY)

FACULTY OF LIFE SCIENCES

SYLLABUS FOR

BACHELOR OF SCIENCE (HONORS WITH RESEARCH)

PROGRAMME

SUBJECT: BOTANY

(SEMESTER- VII & VIII)

MAJOR & MINOR

EFFECTIVE FROM JUNE, 2026

FORWARD

In academics, syllabus serves as a roadmap for teaching various topics in a well-defined manner. Along with constant changes in the field of subject, it is always required to review and update the syllabus so as to meet changing scenario at regional, national and global levels. In science, higher education at degree level creates base for students to sharpen their skills and enable them for securing employment. Moreover, for a few this also opens a new realm of research and education at post-graduation level. Hence, while designing the degree-level syllabus, it is necessary to keep all these aspects in mind.

The NEP 2020 states, “Assessments of educational approaches in undergraduate education that integrate the humanities and arts with Science, Technology, Engineering and Mathematics (STEM) have consistently shown positive learning outcomes, including increased creativity and innovation, critical thinking and higher-order thinking capacities, problem-solving abilities, teamwork, communication skills, more in-depth learning and mastery of curricula across fields, increases in social and moral awareness, etc., besides general engagement and enjoyment of learning”.

Here, the current syllabus is finalised after elaborate discussions amongst well-qualified and experienced teachers. The syllabus is prepared according to the guidelines of UGC under NEP 2020. We are delighted to share the curriculum and credit framework for B.Sc. Botany (Honors with Research) Semester VII and VIII. The present syllabus encompasses the latest trends in the subject. We are hopeful that students will be able to enhance their knowledge and understanding of the subject.

Board of Studies, Botany

Bhakta Kavi Narsinh Mehta University,

Junagadh – 362 001

BHAKTA KAVI NARSINH MEHTA UNIVERSITY**Major/Minor/SEC****Syllabus of B.Sc. (Honors) as per NEP-2020****Faculty of Life Sciences****Effective from June 2026****Subject: Botany****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
7	1	Major-17	Biochemistry and Molecular Biology	6	4	60 Hrs.	50	50	100	2:00 Hrs.
	2	Major-18	Biostatistics, Research Methodology and AI	6	4	60 Hrs.	50	50	100	2:00 Hrs.
	3	Major-19	Combine Practical: Biochemistry, Molecular Biology, Biostatistics, Research Methodology and AI	6	4	120 Hrs.	50	50	100	4:00 Hrs.
	4	Minor-7	Ecology and Climate Change	6	4 (3T+1P)	75 Hrs. (45T+30P)	50	50	100	4:00 Hrs.
	5	Research*	-	6	6	-	75	75	150	4:00 Hrs.
				Total	22		275	275	550	

* Honours with Research performed as per the NEP-2020 and BKNMU guidelines

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Course Level	6	Internal Marks	50
Programme	B. Sc. Botany	External Marks	50
Semester	VII	Practical Internal	--
Category of Course	Discipline Specific Major Courses (Major-17)	Practical External	--
Course Credit	04	Prac. External Exam Duration	--
Teaching Hours	60	Total	100
Course Code		Exam Duration	2.0 Hrs.
Course Title	Biochemistry and Molecular Biology		

Course Objectives:

1. To develop an understanding of biochemical processes governing cellular metabolism, enzyme action, and energy transformation in living systems.
2. To explain the molecular organization of genes and genomes and analyze mechanisms regulating gene expression in prokaryotes and eukaryotes.
3. To evaluate mutations, chromosomal alterations, DNA repair mechanisms, and their significance in heredity, evolution, and biotechnology.

Course Learning Outcomes: After completion of the course, students will be able:

1. Analyze metabolic pathways, enzyme kinetics, and biochemical mechanisms underlying cellular functions.
2. Interpret gene organization and explain molecular mechanisms of transcription, translation, and gene regulation.
3. Evaluate the effects of mutations and chromosomal abnormalities and assess DNA repair systems in maintaining genome integrity.
4. Apply molecular biology concepts in biotechnology, plant breeding, and genetic improvement programmes.

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Sem.	Unit No.	Syllabi	Teaching Hours
7	1	Advanced Metabolic Biochemistry 1.1 Macronutrients and micronutrients: vitamins, and major minerals; their roles in enzyme function, nerve conduction, and oxygen transport. 1.2 Photosynthesis: light reactions, photophosphorylation, electron transport, and Calvin cycle. 1.3 Biosynthesis and functions of plant secondary metabolites: alkaloids, flavonoids, terpenoids; ecological and medicinal roles. 1.4 Bioenergetics: ΔG , ATP as energy currency, high-energy phosphate compounds (e.g., phosphoenolpyruvate, 1,3-bisphosphoglycerate, creatine phosphate).	15
	2	Enzymes and Enzyme Kinetics 2.1 Enzyme nomenclature, active site, cofactors, coenzymes, and isoenzymes. 2.2 Michaelis–Menten kinetics, Lineweaver–Burk plots, and kinetic parameters (K_m , V_{max}); inhibition types: competitive, non-competitive, uncompetitive, and mixed inhibition. 2.3 Allosteric regulation, feedback inhibition, and cooperativity (e.g., hemoglobin and aspartate transcarbamoylase). 2.4 Microbial enzyme production and industrial applications: amylases, proteases, lipases, cellulases, and pectinases. 2.5 Recombinant microbial systems for production of human proteins (e.g., insulin, growth hormone) using bacteria and yeast.	15
	3	Gene Structure and Expression 3.1 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. 3.2 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). 3.3 Gene expression II: translation in prokaryotes and eukaryotes, ribosome structure and function, genetic code	15

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		interpretation, translational regulation, protein folding, targeting, and post-translational modifications. 3.4 Regulation of gene expression: operon models in prokaryotes, transcriptional regulation in prokaryotes and eukaryotes, epigenetic regulation, RNA-mediated regulation, chromatin remodeling, and gene regulatory networks.	
	4	Mutation, Chromosomal Variation, DNA Repair, and Cytoplasmic Inheritance 4.1 Molecular basis of mutations: spontaneous and induced mutations, types of gene mutations, mutagenic agents, mechanisms of mutagenesis, and effects on gene function. 4.2 Structural and numerical chromosomal aberrations: mechanisms, causes, and genetic consequences. 4.3 DNA damage: sources, types, and molecular mechanisms of DNA repair systems in prokaryotes and eukaryotes. 4.4 Cytoplasmic inheritance: mitochondrial and chloroplast genomes, maternal inheritance, and non-Mendelian inheritance patterns.	15

Suggested Reading:

- Lehninger Principles of Biochemistry by David L. Nelson & Michael M. Cox
- Harper's Illustrated Biochemistry by Victor W. Rodwell, David A. Bender, Kathleen M. Botham, Peter J. Kennelly & P. Anthony Weil
- Introduction to Plant Biochemistry by Trevor Palmer
- Enzymes: Biochemistry, Biotechnology, Clinical Chemistry by Palmer & Bonner
- Industrial Microbiology by L. E. Casida Jr.
- Genes XII by Benjamin Lewin
- Biochemistry by U. Satyanarayana & U. Chakrapani
- Cell and Molecular Biology by P. K. Gupta
- Molecular Biology by Veer Bala Rastogi.
- The physiology and Biochemistry of Prokaryotes, 2nd edition By. David white
- Outlines of biochemistry By- Conn E.E. and Stumpt P.K.: 4th Ed
- General microbiology by Stanier R.Y.: 5th Ed.
- General microbiology by Powar and Daginawala Vol-1
- Molecular Biology of the Gene
- Molecular Biology of the Cell
- Molecular Cell Biology

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Course Level	6	Internal Marks	50
Programme	B. Sc. Botany	External Marks	50
Semester	VII	Practical Internal	--
Category of Course	Discipline Specific Major Courses (Major-18)	Practical External	--
Course Credit	04	Prac. External Exam Duration	--
Teaching Hours	60	Total	100
Course Code		Exam Duration	2.0 hrs
Course Title	Biostatistics, Research Methodology and AI		

Course Objectives:

1. To introduce statistical concepts and analytical tools used in biological research.
2. To develop skills in research design, data collection, hypothesis formulation, and scientific writing.
3. To familiarize students with emerging applications of Artificial Intelligence and Machine Learning in biological sciences.
4. To enable students to interpret biological data and apply statistical and computational tools in research.

Course Learning Outcomes: After completion of the course:

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

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Sem.	Unit No.	Syllabi	Teaching Hours
7	1	Basics and Concepts of Biostatistics 1.1 Data classification, Frequency distribution and Graphs. 1.2 Measure of Central Tendency: Meaning, Objectives, Merits, Demerits & Uses. 1.3 Measure of Dispersion – Range, Variance, Standard deviation, Coefficient of Variation; Confidence limit and confidence interval. 1.4 Probability distributions (Binomial, Poisson and normal), Sampling distribution; Difference between parametric and non-parametric statistics; Confidence Interval; Errors; Levels of significance.	15
	2	Statistical tests in Biology 2.1 Regression and Correlation analysis. 2.2 Student's t-test: Paired and Unpaired. 2.3 Level of Significance & Degree of Freedom: Chi-square test (X ²); Analysis of Variance (ANOVA) 2.4 Basics of Multivariate statistics.	15
	3	Basic Research Methodology 3.1 Research problem, Aims & Objectives, types of scientific research 3.2 Hypothesis formulation and testing; Literature survey, literature review and scientific writing. 3.3 Sampling techniques, optimization of protocol, graphical data analysis, data validation 3.4 Plagiarism, Referencing tools	15
	4	Foundations of Artificial Intelligence 4.1 Introduction to Artificial Intelligence, AI fundamentals, Use-cases and applications of AI, Issues concerning AI in business, ethics and bias, jobs and scope. 4.2 Brief history of AI and ML in Healthcare and biology, Machine Learning workflow and terminologies, computational models of intelligence. 4.3 Application of AI in genomics, bioinformatics, disease diagnostics, drug discovery and biological data analysis.	15

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Suggested Readings

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	Internal Marks	--
Programme	B. Sc. Botany	External Marks	--
Semester	VII	Practical Internal	50
Category of Course	Discipline Specific Major Courses (Major-19)	Practical External	50
Course Credit	04	Prac. External Exam Duration	4 Hrs.
Teaching Hours	120	Total	100
Course Code		Exam Duration	-
Course Title	Biochemistry and Molecular Biology, Biostatistics, Research Methodology and AI (Practical)		

Course Objectives:

1. To develop practical skills in biochemical analysis, enzyme assays, and molecular biological techniques used in plant sciences.
2. To provide hands-on training in plant biotechnology, tissue culture, and immunological techniques employed in biological research and industry.
3. To familiarize students with experimental approaches used in the study of plant immunity, plant-microbe interactions, and disease management.

Course Learning Outcomes: After completion of the course:

1. Perform biochemical estimations, enzyme assays, and molecular biological experiments accurately and interpret the results.
2. Demonstrate laboratory skills in plant tissue culture, ELISA, nucleic acid analysis, and other biotechnology techniques.
3. Analyze experimental data related to immunological techniques, plant defense mechanisms, and plant-microbe interactions.
4. Apply practical knowledge of biotechnology, applied immunology, and biological control strategies in plant science research and crop improvement programmes.

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Sr. No.	Syllabi	Teaching Hours
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	
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.	Preparation of frequency distribution tables and graphical representation of biological data (Histogram, Bar diagram, Pie chart, Frequency polygon).	
14.	Calculation of measures of central tendency (Mean, Median and Mode).	
15.	Calculation of measures of dispersion (Range, Variance, Standard Deviation and Coefficient of Variation).	
16.	Estimation of confidence limits and confidence intervals from biological datasets.	
17.	Correlation and regression analysis using biological data.	
18.	Application of Student's t-test (paired and unpaired) and Chi-square test.	
19.	Analysis of Variance (ANOVA) using experimental datasets.	
20.	Preparation of research problem, aims, objectives and hypothesis for a selected biological topic.	
21.	Literature search using online databases (Google Scholar, PubMed, Scopus/Web of Science) and preparation of a review summary.	
22.	Reference management using Mendeley/Zotero and plagiarism checking using suitable software tools.	
23.	Graphical data presentation and interpretation using spreadsheet/statistical software (MS Excel, R or SPSS).	

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24.	Demonstration and application of AI tools in biological sciences: AI-assisted literature review, data analysis, scientific writing and research applications.	
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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. Medical Laboratory Technology – Vol – I , II , III – Mukherji K.L.
6. A Text Book in Medical Laboratory Technology – P.B.Godkar
7. Jayaraman, J. Laboratory Manual in Biochemistry.
8. Wilson, K. and Walker, J. Principles and Techniques of Biochemistry and Molecular Biology.
9. Bhojwani, S.S. and Razdan, M.K. Plant Tissue Culture: Theory and Practice.
10. Agrios, G.N. Plant Pathology.
11. Introduction to Bio-Statistics, Banerjee Pranab Kumar, S Chand & Company
12. Biostatistics, Veer Bala Rastogi, Medtech
13. Biostatistics Analysis, Zar, Pearson
14. Biostatistics for health and life sciences, Rao K Surya, Himalaya Publishing house
15. An Introduction to Biostatistics, Gurumani
16. Research methodology, C R Kothari, New Age Publishers
17. Principles of Biostatistics by Marcello Pagano, Duxbury Thomson Learning
18. Russell, Norvig, Artificial Intelligence: A Modern Approach, Third edition, Prentice Hall, 2010
19. Artificial Intelligence in Healthcare
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Course Level	6	Internal Marks	25
Programme	B.Sc. Botany	External Marks	50
Semester	VII	Practical Internal	25
Category of Course	Minor-7	Practical External	--
Course Credit	04 (3 + 1)	Prac. External Exam Duration	--
Teaching Hours	(45+30)	Total	100
Course Code		Exam Duration	2 Hrs.
Course Title	Ecology and Climate Change		

Course Objectives:

1. To explain the principles of population and community ecology and analyze ecological interactions in natural ecosystems.
2. To evaluate ecosystem productivity, nutrient cycling, ecosystem services, and sustainability practices.
3. To interpret climate system processes and assess scientific evidence of climate change.
4. To examine ecological impacts of climate change and evaluate mitigation, adaptation, and governance strategies.

Course Learning Outcomes: After completion of the course, students will be able to:

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.
4. Assess climate change impacts on ecosystems and explain mitigation, adaptation, and climate governance strategies.

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Sem.	Unit No.	Syllabi	Teaching Hours
5	1	Population and Community Ecology 1.1 Ecological Foundations: Levels of ecological organization; habitat, ecological niche and ecological adaptations; Gause's principle of competitive exclusion and resource partitioning 1.2 Population Ecology: Population characteristics and growth patterns; carrying capacity and population regulation 1.3 Population Interactions: Competition, predation, parasitism, mutualism and commensalism 1.4 Community Ecology: Community structure and organization; species diversity, richness and evenness; ecotone and edge effect 1.5 Ecological Succession: Types and processes; climax concept	10
	2	Ecosystem Ecology 2.1 Ecosystem Productivity: Primary and secondary productivity; factors affecting productivity 2.2 Biogeochemical Cycles: Carbon, nitrogen, phosphorus and hydrological cycles 2.3 Ecosystem Services: Provisioning, regulating, supporting and cultural services 2.4 Ecosystem Resilience and Sustainability: Ecosystem resilience; ecological restoration; sustainable ecosystem management	11
	3	Climate Change and Earth System Processes 3.1 Climate System and Basics: Weather and climate; atmospheric structure; solar radiation; Earth's heat budget; greenhouse effect 3.2 Causes of Climate Change: Natural climate variability; human activities; greenhouse gases; land-use change and deforestation 3.3 Evidence of Climate Change: Global warming; glacier retreat; sea-level rise; ocean acidification; extreme weather events 3.4 Climate Monitoring: Climate indicators; basic ideas of climate monitoring and modelling; carbon footprint and ecological footprint	12
	4	Climate Change Impacts, Responses and Governance 4.1 Impacts of Climate Change: Effects on terrestrial, freshwater, coastal and marine ecosystems; species distribution shifts; phenology 4.2 Climate Change Mitigation: Carbon cycle; carbon sequestration; carbon budgeting; renewable energy; nature-based solutions 4.3 Climate Change Adaptation: Climate-smart agriculture; ecosystem-based adaptation; water resource management; disaster risk reduction	12

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		4.4 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	
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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.
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.

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Sr. No.	Syllabi	Teaching hours
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.	Population Ecology: Determination of population characteristics including density, dispersion patterns and growth patterns using field data.	
5.	Estimation of Primary Productivity: Determination of primary productivity using light and dark bottle method or suitable ecosystem models.	
6.	Ecosystem Structure and Energy Flow Analysis: Construction and analysis of food chains, food webs and ecological pyramids from field observations.	
7.	Carbon Stock and Biomass Estimation: Estimation of above-ground biomass and carbon sequestration potential of selected plant communities.	
8.	Climate Data Analysis: Analysis of long-term climatic data (temperature, rainfall, humidity and CO ₂ concentration) using IMD datasets.	
9.	Climate Change Vulnerability Assessment: Assessment of ecological vulnerability of selected ecosystems using standard indicators.	
10.	GIS and Remote Sensing Applications: Introduction to GIS software for land-use and land-cover analysis and interpretation of satellite images for environmental monitoring.	
11.	Ecological Niche and Species Distribution Mapping: Mapping species distribution and habitat suitability using available GIS datasets.	
12.	Biodiversity Documentation: Preparation of biodiversity inventory of a selected ecosystem using field survey methods.	
13.	Carbon Footprint Assessment: Calculation of individual, household or institutional carbon footprint.	
14.	Field Study: Field visit to a protected area, wetland, coastal ecosystem, forest ecosystem or biodiversity hotspot and submission of a field report.	

Suggested Readings

- Misra, R. – Ecology Workbook, Oxford & IBH Publishing Co.
- Greig-Smith, P. – Quantitative Plant Ecology, Blackwell Scientific Publications.
- Krebs, C.J. – Ecological Methodology, Harper & Row Publishers.
- Magurran, A.E. – Measuring Biological Diversity, Blackwell Publishing.
- Odum, E.P. & Barrett, G.W. – Fundamentals of Ecology, Cengage Learning.
- Sharma, P.D. – Ecology and Environment, Rastogi Publications.
- Forest Survey of India – National Forest Inventory Manual, FSI, Dehradun.
- Chang, K.T. – Introduction to Geographic Information Systems, McGraw-Hill Education.

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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	4	60	50	50	100	2 hrs.
	2	Major-21	Marine Biology and Forestry	6	4	60	50	50	100	2 hrs.
	3	Major-22	Combined Practical	6	4	120	50	50	100	4 hrs.
	4	Minor-8	Environmental Biology	6	4 (3T + 1P)	75 (45T + 30P)	50	50	100	4 hrs.
	5	Research	-	6	6	-	75	75	150	4 hrs.
	Total				22		275	275	550	

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Course Level	6	Internal Marks	50
Programme	B.Sc. Botany	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		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. • Principles and applications of Autoradiography.	15
	2	Spectroscopy • Basic principles of Spectroscopy, UV, IR, Raman, ESR, ORD.	15

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		• CD and structure of proteins using NMR. • 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
- 4.

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Course Level	6	Internal Marks	50
Programme	B.Sc. Botany	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		Exam Duration	2 hrs.
Course Title	Marine Biology and Forestry (Theory)		

Course Objectives:

1. Develop skills in identification and classification of marine plants and forest vegetation.
2. Train students in ecological methods used for marine and forest ecosystem studies.
3. Understand conservation, resource assessment and sustainable management of marine and forest ecosystems.

Course Learning Outcomes: After completion of the course, students will be able to:

1. Identify major groups of marine algae and coastal vegetation.
2. Analyze vegetation structure and biodiversity using ecological techniques.
3. Evaluate forest resources and conservation practices through field and laboratory studies.

Course Contents

Sem	Unit No.	Syllabi	Teaching Hours
7	1	Marine Ecosystems and Coastal Vegetation: • Oceans, seas, estuaries and coastal ecosystems; • Physical and chemical characteristics of marine environments; • Marine biodiversity and ecological significance; • Coastal Vegetation: Mangrove ecosystems: distribution, zonation and adaptations; Seagrass ecosystems and ecological importance; Salt marsh vegetation; Coral reef ecosystems and associated flora.	15
	2	Marine Botany and Marine Resources	15

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		• Marine Plant Diversity: Classification and characteristics of marine algae, Green algae (Chlorophyta), Brown algae (Phaeophyta), Red algae (Rhodophyta), etc.; • Phytoplankton diversity and ecological significance; Cyanobacteria and their role in marine productivity. • Economic Importance of Marine Plants: Seaweeds as food, fodder and fertilizers; Medicinal and pharmaceutical importance of marine algae; • Marine Environmental Issues: Coastal pollution and eutrophication; Harmful algal blooms	
	3	Forestry and Forest Ecology • Introduction to Forestry: Scope and importance of forestry; Classification of forests; Major forest types of India. • Forest Ecology: Forest structure and stratification; Plant-soil interactions in forests • Forest Biodiversity: Mycorrhizal associations; Endophytes and epiphytes; Keystone and endangered plant species. • Forest Resources: Timber resources; Non-timber forest products (NTFPs); Medicinal and aromatic plants; Ethnobotanical importance of forests.	15
	4	Forest Conservation and Sustainable Management • Forest Conservation: Deforestation and forest degradation; Biodiversity conservation strategies; Protected areas and biosphere reserves. • Sustainable Forestry: Social forestry; Agroforestry; Urban forestry; Joint Forest Management (JFM). • Forests and Climate Change: Carbon sequestration and carbon budgeting; Forests as carbon sinks; REDD+ concept. • Emerging Areas: Green biotechnology in forestry; GIS and Remote Sensing in forest management; Forest certification and sustainable resource management.	15

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Suggested Reading:

1. Dawes, C.J. (1998). Marine Botany (2nd Edition). New York: John Wiley & Sons, Inc.
2. Chapman, V.J. & Chapman, D.J. (1980). Seaweeds and Their Uses (3rd Edition). London: Chapman & Hall.
3. Lee, R.E. (2008). Phycology (4th Edition). Cambridge: Cambridge University Press.
4. Champion, H.G. & Seth, S.K. (1968). A Revised Survey of the Forest Types of India. New Delhi: Government of India Press, Manager of Publications.
5. Trivedi, P.C. (2005). Forestry and Forest Ecology. Jaipur: Pointer Publishers.
6. Negi, S.S. (1994). Forests and Forestry in India. New Delhi: Indus Publishing Company.
7. Odum, E.P. & Barrett, G.W. (2005). Fundamentals of Ecology (5th Edition). Belmont, California: Thomson Brooks/Cengage Learning.
8. Sharma, P.D. (2021). Ecology and Environment (14th Edition). Meerut: Rastogi Publications.
9. Groom, M.J., Meffe, G.K. & Carroll, C.R. (2006). Principles of Conservation Biology (3rd Edition). Sunderland, Massachusetts: Sinauer Associates Inc.

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Course Level	6	Internal Marks	-
Programme	B.Sc. Botany	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		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.	

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4.	Determination of DNA concentration by spectrophotometry.
5.	Separation of amino acids by ascending paper chromatography
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.	Study and identification of representative marine algae belonging to Chlorophyta, Phaeophyta and Rhodophyta, and economically important seaweeds.
10.	Study of mangrove and seagrass species, their distribution, adaptive features and ecological significance using specimens, photographs and field observations.
11.	Analysis of marine/aquatic water samples for salinity and pH.
12.	Estimation of chlorophyll content in marine algae or aquatic plants.
13.	Preparation of herbarium specimens of marine algae, mangrove plants and selected forest species.
14.	Identification of major forest tree species, medicinal plants and non-timber forest products (NTFPs) based on vegetative and reproductive characters.
15.	Vegetation analysis using Quadrat Method: determination of Frequency, Density, Abundance and Importance Value Index (IVI).
16.	Field visit to Mangrove Forest / Botanical Garden / Forest Ecosystem / Forestry Research Institute and submission of a field report including biodiversity documentation and vegetation profile analysis.

Suggested Reading:

1. Pandey, B.P. (Latest Edition). Practical Botany. New Delhi: S. Chand & Company Ltd.
2. Yadav, R.P. (Latest Edition). A Textbook of Practical Botany. Meerut: Rastogi Publications.
3. Jain, S.K. & Sinha, S.C. (1993). Practical Plant Ecology. New Delhi: CBS Publishers & Distributors Pvt. Ltd.
4. Greig-Smith, P. (1983). Quantitative Plant Ecology (3rd Edition). Oxford: Blackwell Scientific Publications.
5. Forest Survey of India (Latest Edition). National Forest Inventory Manual. Dehradun: Forest Survey of India, Ministry of Environment, Forest and Climate Change, Government of India.

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Course Level	6	Internal Marks	25
Programme	B.Sc. Botany	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		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.

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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 • 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	12
	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

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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
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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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.
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

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(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 practicals from the given list of exercises as per the instructions of the examiner	40
2	Viva-voce	10
Total		50