

BHAKTA KAVI NARSINH MEHTA UNIVERSITY, JUNAGADH



BOARD OF STUDIES (BOTANY)

FACULTY OF LIFE SCIENCES

SYLLABUS FOR

BACHELOR OF SCIENCE (HONORS) 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) 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 & 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
7	1	Major-17	Biochemistry and Molecular Biology	6	4	60 Hrs.	50	50	100	2:00 Hrs.
	2	Major-18	Plant Biotechnology and Applied Immunology	6	4	60 Hrs.	50	50	100	2:00 Hrs.
	3	Major-19	Combine Practical: Biochemistry, Molecular Biology, Plant Biotechnology and Applied Immunology	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	OJT*/Major & SEC*	-	6	6	-	75	75	150	6:00 Hrs.
	Total				22		275	275	550	

* Select **On-Job Training (OJT)** as the NEP 2020, BKNMU guidelines**OR***Select **One Major + SEC** as per the Basket provided with the syllabus

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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 Dagainawala 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	Plant Biotechnology and Applied Immunology		

Course Objectives:

1. To introduce the principles and applications of plant biotechnology, recombinant DNA technology, and genetic manipulation in agriculture, industry, and environmental management.
2. To develop an understanding of plant and animal tissue culture techniques and their applications in crop improvement and biotechnology research.
3. To explain the fundamental concepts of immunology and immunological techniques used in biological research and diagnostics.
4. To examine plant defense mechanisms, plant immune responses, and plant-microbe interactions and evaluate their applications in disease management and sustainable agriculture.

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

1. Apply recombinant DNA technology, gene transfer methods, and tissue culture techniques in plant biotechnology and crop improvement.
2. Analyze antigen-antibody interactions and interpret immunological techniques used in biological research and diagnostics.
3. Explain plant defense mechanisms and plant immune responses, including PTI, ETI, SAR, and ISR, in plant-pathogen interactions.
4. Evaluate the role of plant biotechnology, disease resistance breeding, biological control agents, PGPR, and sustainable disease management strategies in modern agriculture.

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Sem.	Unit No.	Syllabi	Teaching Hours
7	1	Basics of Biotechnology and Recombinant Technology 1.1 Biotechnology: definition, scope, historical development, and applications; enzyme and cell immobilization techniques and their industrial applications. 1.2 Principles of bioremediation, fundamentals of genetic engineering, and techniques for nucleic acid isolation and purification. 1.3 Restriction endonucleases, molecular scissors in DNA manipulation, and gene targeting strategies for genome modification. 1.4 Molecular cloning vectors: plasmids (pBR322, pUC series), bacteriophages (λ phage), cosmids, and host–vector systems for gene cloning and expression (YACs).	15
	2	Plant Tissue Culture 2.1 Fundamental principles of plant tissue culture, aseptic techniques, and culture environment optimisation. 2.2 Types of Plant Tissue Culture: Callus culture, cell suspension culture, meristem culture, shoot-tip culture, anther culture, embryo culture, protoplast culture and fusion. 2.3 Basic Steps of Plant Tissue Culture 2.4 Micropropagation	15
	3	Immunology 3.1 Antigen Antibody: Factors Influencing Immunogenicity, Structure of Ig, Ig Classes & Biological Activities, Monoclonal antibodies and polyclonal antibodies 3.2 Innate and Adaptive Immune System 3.3 Antigen-Antibody Interactions: ELISA Test, Agglutination, Precipitation, Immunofluorescence, Radioimmunoassay	15
	4	Plant Immunity and Plant-Microbe Interactions 4.1 Plant Defense Mechanisms: Structural defense mechanisms, Chemical defense mechanisms, Phytoalexins and PR proteins 4.2 Plant Immune Responses: Pattern-Triggered Immunity (PTI), Effector-Triggered Immunity (ETI), Gene-for-gene hypothesis	15

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		4.3 Plant-Pathogen Interactions: Host-pathogen recognition, Hypersensitive response (HR), Systemic Acquired Resistance (SAR) 4.4 Applications: Disease resistance breeding, Biological control, Plant Growth-Promoting Rhizobacteria (PGPR), Induced Systemic Resistance (ISR)	
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Suggested Reading:

1. Immunology – 5th edition – J. Kuby, R. A. Goldsby , T.J.Kindt B.A. Osborne – W.H. Freeman and Company , New York
2. Principles of Microbiology- 2nd edition – R.M.Atlas – Wm.C.Brown Publishers
3. Microbiology – 5th edition – Prescott , Harley , Klein – McGrawHill Publishers
4. Instant Notes in Microbiology – P.M. Lyolyard , A. Whelan, M.W. Fanger
5. Immunology – Raj Khanna – Oxford University Press
6. Agrios, G.N. *Plant Pathology*. Academic Press.
7. Singh, R.S. *Introduction to Plant Pathology*. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
8. Sharma, P.D. *Plant Pathology*. Rastogi Publications, Meerut.
9. Mehrotra, R.S. and Aggarwal, A. *Plant Pathology*. Tata McGraw-Hill Education.
10. Purohit, S.S. *Plant Biotechnology*. Agrobios (India), Jodhpur.

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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, Plant Biotechnology and Applied Immunology (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.	Practical	Teaching Hours
1.	Estimation of sugar by DNSA method	120
2.	Extraction and estimation of protein by the 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 V _{max} and K _m for the amylase enzyme by performing a substrate curve with a Lineweaver-Burk plot.	
7.	Determination of V _{max} and K _m 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.	Dot ELISA	
14.	Direct ELISA Technique	
15.	Indirect ELISA Technique	
16.	To perform the Ouchterlony double diffusion.	
17.	To perform the technique of radial immunodiffusion	
18.	To learn the technique of agglutination.	
19.	Study of disease symptoms in plants.	
20.	Demonstration of structural defense mechanisms.	
21.	Estimation of total phenolic compounds.	
22.	Isolation of Rhizobium from root nodules.	
23.	Dual culture technique using <i>Trichoderma</i> against a fungal pathogen.	

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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.

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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	Discipline Specific Minor Courses (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	12

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		4.3 Climate Change Adaptation: Climate-smart agriculture; ecosystem-based adaptation; water resource management; disaster risk reduction 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.	

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Suggested Readings

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

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Course Level	6	Internal Marks	25
Programme	Botany	External Marks	50
Semester	VII	Practical Internal	25
Category of Course	Major/OJT	Practical External	--
Course Credit	04 (3+1)	Prac. External Exam Duration	--
Teaching Hours	45+30	Total	100
Course Code		Exam Duration	2.00 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.	12
	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.	13
	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	10
	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.	10

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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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Sr. No.	Practical Exercise	Teaching Hours
1.	Preparation of frequency distribution tables and graphical representation of biological data (Histogram, Bar diagram, Pie chart, Frequency polygon).	30
2.	Calculation of measures of central tendency (Mean, Median and Mode).	
3.	Calculation of measures of dispersion (Range, Variance, Standard Deviation and Coefficient of Variation).	
4.	Estimation of confidence limits and confidence intervals from biological datasets.	
5.	Correlation and regression analysis using biological data.	
6.	Application of Student's t-test (paired and unpaired) and Chi-square test.	
7.	Analysis of Variance (ANOVA) using experimental datasets.	
8.	Preparation of research problem, aims, objectives and hypothesis for a selected biological topic.	
9.	Literature search using online databases (Google Scholar, PubMed, Scopus/Web of Science) and preparation of a review summary.	
10.	Reference management using Mendeley/Zotero and plagiarism checking using suitable software tools.	
11.	Graphical data presentation and interpretation using spreadsheet/statistical software (MS Excel, R or SPSS).	
12.	Demonstration and application of AI tools in biological sciences: AI-assisted literature review, data analysis, scientific writing and research applications.	

References Readings

1. Banerjee, P.K. – Introduction to Biostatistics. S. Chand & Company Ltd., New Delhi.
2. Rastogi, V.B. – Biostatistics. Medtech Publishers, New Delhi.
3. Kothari, C.R. – Research Methodology: Methods and Techniques. New Age International Publishers, New Delhi.
4. Pagano, M. & Gauvreau, K. – Principles of Biostatistics. Duxbury Thomson Learning.
5. Daniel, W.W. & Cross, C.L. – Biostatistics: A Foundation for Analysis in the Health Sciences. Wiley India.

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6. Dawson, B. & Trapp, R.G. – Basic and Clinical Biostatistics. McGraw-Hill Education.
7. Kumar, R. – Research Methodology: A Step-by-Step Guide for Beginners. Sage Publications.
8. Russell, S. & Norvig, P. – Artificial Intelligence: A Modern Approach. Pearson Education.
9. Bhargava, A. – Grokking Artificial Intelligence Algorithms. Manning Publications.
10. VanderPlas, J. – Python Data Science Handbook. O'Reilly Media.

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Course Level	6	Internal Marks	25
Programme	B.Sc. Botany	External Marks	25
Semester	VII	Practical Internal	--
Category of Course	Skill Enhancement Course-5/ OJT	Practical External	--
Course Credit	02 (T)	Prac. External Exam Duration	--
Teaching Hours	30	Total	50
Course Code		Exam Duration	01 Hrs.
Course Title	Good Laboratory Practice and Biosafety		

Course Objectives: By completing the course, this course aims to:

- Understand the principles, history, regulatory requirements, and significance of Good Laboratory Practices (GLP) in microbiological research, diagnostics, and industrial laboratories.
- Develop competency in laboratory organization, documentation, standard operating procedures (SOPs), and quality management systems essential for laboratory operations.
- Apply biosafety and biosecurity principles to identify, assess, and manage biological, chemical, and physical hazards in microbiology laboratories.

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

- Explain the concepts, principles, and regulatory framework of GLP, biosafety, and laboratory quality management systems.
- Describe laboratory biosafety levels (BSL-1 to BSL-4), risk assessment procedures, containment measures, and waste disposal practices.
- Prepare, implement, and maintain laboratory documentation, SOPs, equipment records, and quality assurance records.

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Sem.	Unit No.	Syllabi	Teaching Hours
7	1	Introduction to GLP 1.1 Principles and objectives of GLP; OECD and WHO guidelines. 1.2 Laboratory design and layout, Roles and responsibilities of laboratory personnel, Laboratory management structure 1.3 Preparation and implementation of SOPs, Documentation practices, Record keeping and data integrity Sample and Data Management 1.4 Sample collection, labelling, transport, and storage, Specimen processing and preservation, Contamination control. 1.5 Good Documentation Practices (GDP), Electronic data management, Data integrity principles, Study reports. 1.6 Sterility testing, Environmental monitoring, Culture collection management, Quality control of media and reagents	15
	2	Biosafety and its Regulation 2.1 Biosafety fundamentals: Introduction; Historical Background; Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels. 2.2 Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals. 2.3 Biosafety regulation: Biosafety guidelines-Government of India; Definition of GMOs and LMOs. 2.4 Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture. 2.5 Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication.	15

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Suggested Reading:

1. Handbook: Good Laboratory Practice Published by the World Health Organization.
2. OECD Principles on Good Laboratory Practice,
3. Handbook: Laboratory Quality Management System, Published by the World Health Organization
4. Mackie and McCartney Practical Medical Microbiology
5. Training Manual: Good Laboratory Practice, WHO
6. Bioethics and Biosafety M.K. Sateesh, I K International Publishing House
7. Biosafety and Regulation for Genetically Modified Organisms, Xue Dayuan, Alpha Science International Ltd.
8. Department of Biotechnology, Biosafety Manual
9. PR, Biosafety and Bioethics, Goel and Parashar, Person
10. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-I, Aditya Publications, Ahmedabad, India.
11. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-II, Aditya Publications, Ahmedabad, India.
12. Dubey. R.C., Maheshwari. D.K., Practical Microbiology, S.Chand & Company Ltd., New Delhi

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INTERNAL EVALUATION SCHEME		
INTERNAL ASSESSMENT		
No.	Particulars	Weightage
1	Internal test (Theory or Practical)	13
2	Assignment/Practical Assignment	5
3	Field Visit Report/ Class Presentation	5
4	Attendance	2
	Total	25

Paper Style:**External Evaluation Scheme**

Ques. No.	Particulars	From which Unit	Marks
1 (A)	Describe in detail (Anyone) (1) (2)	1	06
1 (B)	Write a Short Note (Anyone) (1) (2)	1	04
2 (A)	Describe in detail (Anyone) (1) (2)	2	06
2 (B)	Write a Short Note (Anyone) (1) (2)	2	04
3	Do as Directed (Any Five from Seven) (1) (2) (3) (4) (5) (6) (7)	1 & 2	05
Total			25

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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	OJT*/Major & SEC*	-	6	6	-	75	75	150	6 hrs.
	Total				22		275	275	550	

* Select **On-Job Training (OJT)** as the NEP 2020, BKNMU guidelines**OR***Select **One Major + SEC** as per the Basket provided with the syllabus

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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
8	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	15

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		• Basic principles of Spectroscopy, UV, IR, Raman, ESR, ORD. • 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

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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
8	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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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 (Analytical Techniques, Marine Biology & Forestry)		

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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Course Level	6	Internal Marks	25
Programme	B.Sc. Botany	External Marks	50
Semester	VIII	Practical Internal	25
Category of Course	OJT/MAJOR	Practical External	-
Course Credit	04 (3T+1P)	Prac. External Exam Duration	-
Teaching Hours	45+30	Total	100
Course Code		Exam Duration	2.00 Hrs.
Course Title	Evolution and Biodiversity		

Course Objectives:

1. To understand the origin and evolution of life and the genetic mechanisms underlying evolutionary processes and biological diversity.
2. To explain the principles of classical genetics, inheritance, linkage, recombination, gene mapping, and sex determination in relation to evolution.
3. To evaluate biodiversity, conservation strategies, and national and international policies for the sustainable management of biological resources.

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

5. Analyze the origin and evolution of life, mechanisms of evolution, speciation, and patterns of biodiversity.
6. Apply principles of classical genetics to interpret inheritance patterns, linkage relationships, gene mapping, and sex determination mechanisms.
7. Assess biodiversity conservation approaches, genetic resource management strategies, and the role of biodiversity-related policies and legislation in sustainable development.

Course Contents

Sem	Unit No.	Syllabi	Teaching Hours
8	1	Evolution of life • Origin of life and early evolution; Evolution of cellular structures, functions and multicellularity; • Mechanisms of evolution - Natural selection, genetic drift, gene flow, and mutation;	12

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		• Mechanisms of speciation; Extinction events and their role in shaping biodiversity; • Adaptive radiation and convergent evolution; Coevolution and evolutionary arms races; • Human evolution	
	2	Classical Genetic 1. Mendelian Genetics: Mendel's experiments and laws of inheritance, Extensions of Mendelian inheritance, Multiple alleles and polygenic inheritance 2. Linkage and Recombination: Bateson's concepts of coupling and repulsion, Morgan's concept of linkage and linkage groups, Complete and partial linkage, Recombination and linkage maps 3. Gene Mapping: Three-point test cross, Interference, Coefficient of coincidence, Negative interference 4. Sex Determination: Genetic, chromosomal, hormonal and environmental mechanisms of sex determination, Sex-linked inheritance, Dosage compensation, Barr body and Lyon's hypothesis	11
	3	• Biodiversity and Conservation • Biodiversity and its importance; Threats to biodiversity; IUCN categories of threat; • Conservation genetics; Population viability analysis (PVA); Ex-situ and in-situ conservation strategies; • Community-based conservation and the role of indigenous knowledge; • International and national conservation policies and legislation.	10
	4	• Act and policies • Biodiversity Act 2002; Agricultural biodiversity; • International Treaty on Plant Genetic Resources for Food and Agriculture (PGRFA); Conservation strategies for seed gene bank; • Climate change and conservation of plant genetic resources; • Strategies on PPVFR and Biodiversity Acts.	12

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Suggested Reading:

1. Gupta, P.K. (2021). Genetics (11th Edition). Meerut: Rastogi Publications.
 2. Verma, P.S. & Agarwal, V.K. (Latest Edition). Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. New Delhi: S. Chand & Company Ltd.
 3. Verma, P.S. & Agarwal, V.K. (Latest Edition). Genetics. New Delhi: S. Chand & Company Ltd.
 4. Singh, B.D. (2018). Genetics (5th Edition). Ludhiana: Kalyani Publishers.
 5. Singh, B.D. (2018). Plant Breeding: Principles and Methods (11th Edition). Ludhiana: Kalyani Publishers.
 6. Singh, J.S., Singh, S.P. & Gupta, S.R. (2017). Ecology, Environmental Science and Conservation. New Delhi: S. Chand & Company Ltd.
 7. Sharma, P.D. (2021). Ecology and Environment. Meerut: Rastogi Publications.
 8. Kumar, H.D. (Latest Edition). Biodiversity and Sustainable Conservation. New Delhi: Oxford & IBH Publishing Co. Pvt. Ltd.
 9. Trivedi, P.C. (Ed.) (Latest Edition). Environmental Biology. Jaipur: Pointer Publishers.
 10. NBPGR (National Bureau of Plant Genetic Resources). Plant Genetic Resources Conservation Guidelines. New Delhi: ICAR-NBPGR.
 11. Ministry of Environment, Forest and Climate Change (MoEFCC). The Biological Diversity Act, 2002 and Rules. Government of India, New Delhi.
 12. Protection of Plant Varieties and Farmers' Rights Authority (PPV&FRA). Protection of Plant Varieties and Farmers' Rights Act, 2001. Government of India, New Delhi.
- Community Ecology by Peter J. Morin.

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Major/Minor

Syllabus of B.Sc. (Honors) as per NEP-2020

Faculty of Life Sciences

Effective from June 2026

Subject: Botany

SEMESTER- VII & VIII

Suggested Practical

Sr. No.	Practical	Teaching Hours
1.	Study of Mendelian inheritance patterns using suitable genetic problems and pedigree analysis.	30
2.	Construction and interpretation of linkage maps using recombination data and three-point test cross problems	
3.	Study of sex-linked inheritance and sex determination mechanisms through suitable examples and case studies.	
4.	Study of fossil records, geological time scale and major evolutionary events using charts/models/specimens.	
5.	Study of adaptive radiation, convergent evolution and coevolution through selected case studies.	
6.	Biodiversity assessment using species richness, Shannon-Wiener and Simpson diversity indices.	
7.	Preparation of biodiversity inventory and documentation of a selected ecosystem using field survey methods	
8.	Study of IUCN Red List categories and assessment of conservation status of selected species.	
9.	Study of seed gene banks, biodiversity registers and ex-situ conservation methods through reports, databases and case studies.	
10.	Field visit to a protected area, botanical garden, biodiversity park, herbarium, museum or gene bank and submission of a field report.	

Suggested readings:

1. Gupta, P.K. – Genetics, Rastogi Publications
2. Verma, P.S. & Agarwal, V.K. – Genetics, S. Chand & Co.
3. Krebs, C.J. – Ecological Methodology, Harper & Row.
4. Magurran, A.E. – Measuring Biological Diversity, Blackwell Publishing.
5. Misra, R. – Ecology Workbook, Oxford & IBH Publishing Co.

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Course Level	UG	Internal Marks	25
Programme	B.Sc. (Honors)	External Marks	25
Semester	VIII	Practical Internal	-
Category of Course	Skill Enhancement Course-6	Practical External	-
Course Credit	02 (T)	Prac. External Exam Duration	-
Teaching Hours	30	Total	50
Course Code		Exam Duration	1 Hrs.
Course Title	Intellectual Property Rights (Theory)		

Course Objectives: By completing the course, students have to:

- Introduce the concepts, scope, and importance of Intellectual Property Rights in life sciences.
- Develop understanding of patent systems, patent drafting, and patent searching.
- Examine national and international regulations governing intellectual property in microbiology.

Course Learning Outcomes: After completion of the course:

- Explain the principles, scope, and significance of Intellectual Property Rights in microbiology and biotechnology.
- Analyze legal, ethical, and regulatory issues related to microbial resources and biodiversity.
- Conduct patent searches and interpret patent documents using international databases.

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Sem	Unit No.	Syllabus	Teaching Hours
8	1	Fundamentals of Intellectual Property Rights • Introduction to Intellectual Property Rights (IPR): concept, importance, and scope. • Types of Intellectual Property: Patents, Copyright, Trademarks, Industrial Designs, Geographical Indications (GI), and Traditional Knowledge. • Intellectual Property Rights in Biological Sciences and Biotechnology. • Protection of Plant Varieties and Farmers' Rights (PPV&FR). • Introduction to Genetically Modified Organisms (GMOs) and their protection. • International organizations and agreements related to IPR: WIPO, WTO, TRIPS, and GATT. • Case studies: Turmeric, Neem, and Basmati Rice.	15
	2	IPR Applications, Bioethics and Emerging Issues • Patents in Biotechnology: Gene patents, microorganism patents, and process patents. • Technology transfer, licensing, innovation, start-ups, and entrepreneurship. • Indian Patent Act, 1970 (with amendments). • Biological Diversity Act, 2002 and National Biodiversity Authority (NBA). • Bioethics in biological research and use of biological resources. • Emerging trends in IPR: Synthetic biology, CRISPR and gene-editing technologies. • Global challenges and future perspectives in Intellectual Property Rights.	15

Suggested Reading:

13. IPR, Biosafety and Bioethics, Goel and Parashar, Person

14. A Book on Indian Patenting System and Patent Agent Examination, Sheetal Chopra, Notion

15. Press

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16. Fundamentals of Intellectual Property Rights: For Students, Industrialist and Patent Lawyers, Anil Kumar, Ramakrishna, Notion Press
17. Intellectual Property Rights (IPRs): TRIPS Agreement & Indian Laws, E. T. Lokganathan, New Century Publications
18. How to Patent an Idea in India, Prasad Karhad
19. Building Biotechnology: Biotechnology Business, Regulations, Patents, Law, Policy and
20. Science Paperback, Yali Friedman, Logos PressPR, Biosafety and Bioethics, Goel and Parashar, Person
21. Intellectual Property Rights in Agricultural Biotechnology by F.H. Erbis
22. Intellectual Property Rights by Neeraj Pandey
23. WIPO Intellectual Property Handbook, World Intellectual Property Organization

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INTERNAL EVALUATION SCHEME		
INTERNAL ASSESSMENT		
No.	Particulars	Weightage
1	Internal test (Theory or Practical)	13
2	Assignment/Practical Assignment	5
3	Field Visit Report/ Class Presentation	5
4	Attendance	2
	Total	25

Paper Style:**External Evaluation Scheme**

Ques. No.	Particulars	From which Unit	Marks
1 (A)	Describe in detail (Anyone) (1) (2)	1	06
1 (B)	Write a Short Note (Anyone) (1) (2)	1	04
2 (A)	Describe in detail (Anyone) (1) (2)	2	06
2 (B)	Write a Short Note (Anyone) (1) (2)	2	04
3	Do as Directed (Any Five from Seven) (1) (2) (3) (4) (5) (6) (7)	1 & 2	05
Total			25

BHAKTA KAVI NARSINH MEHTA UNIVERSITY**Major/Minor****Syllabus of B.Sc. (Honors) as per NEP-2020****Faculty of Life Sciences****Effective from June 2026****Subject: Botany****SEMESTER- VII & 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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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-Voce	10
	Total	50

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Major/Minor

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SEMESTER- VII & 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-Voce	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