

BHAKTA KAVI NARSINH MEHTA UNIVERSITY, JUNAGADH



BOARD OF STUDIES (ZOOLOGY)

FACULTY OF LIFE SCIENCE

SYLLABUS FOR

BACHELOR OF SCIENCE HONOURS PROGRAMME

IN

SUBJECT: ZOOLOGY

(SEMESTER- VII)

MAJOR MINOR & SEC

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, finalizing degree level syllabus requires to keep all these facts 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 finalized 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. Zoology (Honours) Sem-7. The present syllabus encompasses latest trends in the subject. We are hopeful that students will be able to enhance their knowledge and understanding of the subject well.

Board of Studies, Zoology
Bhakta Kavi Narsinh Mehta University,
Junagadh – 362 001

BHAKTA KAVI NARSINH MEHTA UNIVERSITY
Syllabus of B.Sc. (Honours) as per NEP-2020
Faculty of Lifesciences
Effective from June 2026
Subject: Zoology
SEMESTER- VII

INDEX

No.	Content		Page No.
1	Summary of the Syllabus Sem-7		4
2	Pattern of Examination Sem-7		5
3	Course structure and syllabus		
SEMESTER-VII	Major-17	Course details, objectives and outcomes	6
		Course content	7
		Reference Books	8
	Major-18	Course details, objectives and outcomes	9
		Course content	10
		Reference Books	11
	Major-19	Course details, objectives and outcomes	12
		Course content	13
		Reference Books	14
	Minor-7	Course details, objectives and outcomes	15
		Course content	16
		Reference Books	17
		Practical	18
	On Job Training/Major	Course details, objectives and outcomes	19
		Course content	20
		Reference Books	21
		Practical	21
	On Job Training/SEC	Course details, objectives and outcomes	22
		Course content	23
		Reference Books	24
		Practical	25
4	Examination Paper style		
	Theory Examination Paper Style : Major- 17, Major-18; Minor-07, OJT/Major		26
	Practical Examination Paper Style : Major- 19		27
	Practical Examination Paper Style : Minor-07, OJT/Major		27
	Theory & Practical Examination Paper Style : SEC		28

BHAKTA KAVI NARSINH MEHTA UNIVERSITYSyllabus of **B.Sc. (Honours)** as per NEP-2020Faculty of **Lifesciences**

Effective from June 2026

Subject: Zoology**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	Biotechnology and Immunology	6	4	60 Hrs.	50	50	100	2:00 Hrs.
	3	Major-19	Combined Practical : Biochemistry, Molecular Biology, Biotechnology and 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	Biostatistics, Research Methodology and AI	6	4 (3T+1P)	75 Hrs. (45T+30P)	50	50	100	4:00 Hrs.
	6	*OJT/SEC	Good Laboratory Practice and Biosafety	6	2	30 Hrs.	25	25	50	2:00 Hrs.
				Total	22					

*Select **On Job Training (OJT)** as per the NEP 2020 and BKNMU guideline **OR** Select **One Major +SEC** as per the basket provided with syllabus

BHAKTA KAVI NARSINH MEHTA UNIVERSITY
Syllabus of B.Sc. (Honours) as per NEP-2020
Faculty of Lifesciences
Effective from June 2026
Subject: Zoology
SEMESTER- VII

Pattern of Examination for Major-17/18

EVALUATION OF 100 MARKS (4 CREDIT PAPER)

Continuous and Comprehensive Evaluation (CCE)-50 Marks		Semester End Evaluation (SEE)-50 Marks
Mid Semester Exam (Mandatory)-25 Marks	1. Class assignment -- 05 2. Home assignment -- 05 3. Field assignment -- 05 4. Viva/Oral exam -- 05 5. Attendance -- 05	Semester End Theory Examination 50 Marks
Total 25 Marks	Total 25 Marks	Total 50 Marks

Pattern of Examination for Major-19

EVALUATION OF 100 MARKS (4 CREDIT PAPER-PRACTICAL BASED)

Continuous and Comprehensive Evaluation (CCE)-50 Marks		Semester End Evaluation (SEE)-50 Marks
Mid Semester Exam (Mandatory)-25 Marks	1. Class assignment -- 05 2. Home assignment -- 05 3. Field assignment -- 05 4. Viva/Oral exam -- 05 5. Attendance -- 05	Semester End Practical Examination 50 Marks
Total 25 Marks	Total 25 Marks	Total 50 Marks

Pattern of Examination for Minor-7 and OJT/Major

EVALUATION OF 100 MARKS (3+1 CREDIT PAPER)

Continuous and Comprehensive Evaluation (CCE)-50 Marks		Semester End Evaluation (SEE)-50 Marks
Practical Exam (Mandatory)-25 Marks	1. Class assignment -- 05 2. Home assignment -- 05 3. Test -- 10 4. Attendance -- 05	Semester End Theory Examination 50 Marks
Total 25 Marks	Total 25 Marks	Total 50 Marks

BHAKTA KAVI NARSINH MEHTA UNIVERSITYSyllabus of **B.Sc. (Honours)** as per NEP-2020Faculty of **Lifesciences**

Effective from June 2026

Subject: Zoology**SEMESTER- VII**

Course Level	6	Internal Marks	50
Programme	B.Sc. Zoology (Honours)	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:

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

Course Learning Outcomes: After completion of the course:

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

Course Contents

Major-17

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 interpretation, translational regulation, protein folding, targeting, and post-translational modifications.	15

		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:

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

BHAKTA KAVI NARSINH MEHTA UNIVERSITYSyllabus of **B.Sc. (Honours)** as per NEP-2020Faculty of **Lifesciences**

Effective from June 2026

Subject: Zoology**SEMESTER- VII**

Course Level	6	Internal Marks	50
Programme	B.Sc. Zoology (Honours)	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	Biotechnology and immunology		

Course Objectives:

- Introduce the concepts, tools, and methodologies of recombinant DNA technology and genetic engineering used in modern biotechnology.
- Develop knowledge of gene cloning, vector systems, gene transfer methods, and molecular techniques employed in biotechnology research and product development.
- Explain the structure and functions of the immune system, mechanisms of innate and adaptive immunity, and antigen-antibody interactions.

Course Learning Outcomes: After completion of the course:

- Students will be able to explain the principles and methodologies of recombinant DNA technology, including cloning vectors, restriction enzymes, ligases, and gene transfer techniques.
- Describe the principles, media requirements, and techniques used in plant and animal tissue culture.
- Understand the organization and functions of the immune system, including innate and adaptive immune responses.

BHAKTA KAVI NARSINH MEHTA UNIVERSITYSyllabus of **B.Sc. (Honours)** as per NEP-2020Faculty of **Lifesciences**

Effective from June 2026

Subject: Zoology**SEMESTER- VII****Course Contents****Major-18**

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	Animal and Plant Tissue Culture 2.1 Fundamental principles of plant tissue culture, aseptic techniques, and culture environment optimization. 2.2 Types of Plant Tissue Culture: Callus culture, Cell suspension, Meristem, Shoot tip, Anther/pollen, Embryo culture, Protoplast culture and fusion. 2.3 Basic Steps of Plant Tissue Culture 2.4 Animal cell culture principles, techniques (Aseptic handling techniques, Cell counting, Cell viability test, Sub-culturing, Cryopreservation of animal cells) and applications in biotechnology.	15
	3	Immunology-I 3.1 Antigen Antibody: Factors Influencing Immunogenicity, Structure of Ig, Ig Classes & Biological Activities, Monoclonal Antibodies, Polyclonal antibody 3.2 Innate and Adaptive Immune System 3.3 Antigen-Antibody Interactions: ELISA Test, Agglutination, Precipitation, Immunofluorescence, Radioimmunoassay	15
	4	Immunology-II 4.1 Immunodeficiency diseases 4.2 Hypersensitivity 4.3 Autoimmune diseases 4.4 Autoinflammatory disorders 4.5 Vaccines and immunization	15

Suggested Reading:

1. Biotechnology: Expanding Horizons – 3rd edition – B. D. Singh – Kalyani Publishers, New Delhi
2. Principles of Gene Manipulation and Genomics – 8th edition – S. B. Primrose, R. Twyman – Blackwell Publishing, Oxford
3. Gene Cloning and DNA Analysis: An Introduction – 7th edition – T. A. Brown – Wiley-Blackwell Publishers
4. Molecular Biotechnology: Principles and Applications of Recombinant DNA – 5th edition – Bernard R. Glick, Jack J. Pasternak, Cheryl L. Patten – ASM Press, Washington D.C.
5. Plant Tissue Culture: Theory and Practice – Revised edition – S. S. Bhojwani, M. K. Razdan – Elsevier Science Publishers, Amsterdam
6. Introduction to Plant Biotechnology – 3rd edition – H. S. Chawla – Science Publishers, New Hampshire
7. Animal Cell Culture and Technology – 2nd edition – Michael Butler – Garland Science Publisher
8. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications – 7th edition – R. Ian Freshney – Wiley-Blackwell Publishers
9. Biotechnology – 1st edition – U. Satyanarayana, U. Chakrapani – Books and Allied Pvt. Ltd., Kolkata
Immunology – 5th edition – J. Kubly, R. A. Goldsby, T.J. Kindt B.A. Osborne – W.H. Freeman and Company, New York
10. Principles of Microbiology- 2nd edition – R.M. Atlas – Wm.C. Brown Publishers
11. Microbiology – 5th edition – Prescott, Harley, Klein – McGrawHill Publishers
12. Instant Notes in Microbiology – P.M. Lyolyard, A. Whelan, M.W. Fanger
13. Immunology – Raj Khanna – Oxford University Press

BHAKTA KAVI NARSINH MEHTA UNIVERSITYSyllabus of **B.Sc. (Honours)** as per NEP-2020Faculty of **Lifesciences**

Effective from June 2026

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Course Level	6	Internal Marks	50
Programme	B.Sc. Zoology (Honours)	External Marks	--
Semester	VII	Practical Internal	--
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	4 hrs
Course Title	Combined Practical : Biochemistry, Molecular Biology, Biotechnology and Immunology		

Course Objectives:

- Apply biochemical and molecular biological concepts to interpret experimental data, analyze genetic phenomena, and solve problems related to metabolism, heredity, and genome function.
- Enable students to apply biotechnological and immunological principles to solve problems in healthcare, agriculture, industry, and research.

Course Learning Outcomes: After completion of the course:

- Analyze enzyme kinetic parameters and evaluate factors influencing enzyme-catalysed reactions.
- Evaluate the applications of biotechnology and immunology in medicine, agriculture, environmental management, and industrial production.
- Apply the immunological methods in diagnostics and research.

Course Contents**Major-19**

Sem.	Practical no.	Syllabi	Teaching Hours
7	1.	Estimation of sugar by DNSA method	60
	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.	

BHAKTA KAVI NARSINH MEHTA UNIVERSITYSyllabus of **B.Sc. (Honours)** as per NEP-2020Faculty of **Lifesciences**

Effective from June 2026

Subject: Zoology**SEMESTER- VII**

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.

Suggested Readings

1. Practical Microbiology – R. C. Dubey, D. K. Maheshwari – S. Chand & Company Ltd., New Delhi
2. Experimental Microbiology, Vol.– I – R. J. Patel, K. R. Patel – Aditya Publications, Ahmedabad, India
3. Experimental Microbiology, Vol.– II – R. J. Patel, K. R. Patel – Aditya Publications, Ahmedabad, India
4. Manual of Microbiology: Tools and Techniques – Konika Sharma – Ane Books, Delhi
5. Medical Laboratory Technology, Vol.– I, II & III – K. L. Mukherjee – Tata McGraw Hill Publishers
6. A Text Book of Medical Laboratory Technology – P. B. Godkar – Bhalani Publishing House, Mumbai
7. Practical Biochemistry – 5th edition – Keith Wilson, John Walker – Cambridge University Press, Cambridge
8. An Introduction to Practical Biochemistry – 3rd edition – David T. Plummer – McGraw Hill Education Publishers
9. Biochemical Methods – 3rd edition – S. Sadasivam, A. Manickam – New Age International Publishers, New Delhi

10. Experimental Biochemistry: A Student Companion – 1st edition – R. C. Dubey, D. K. Maheshwari – S. Chand & Company Ltd., New Delhi
11. Laboratory Manual in Biochemistry, Immunology and Biotechnology – 1st edition – P. K. Gupta – Rastogi Publications, Meerut
12. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications – 7th edition – R. Ian Freshney – Wiley-Blackwell Publishers
13. Immunology: An Introduction – 7th edition – Ian R. Tizard – Saunders Elsevier Publishers
14. Practical Immunology – 4th edition – Frank C. Hay, Olwyn M. R. Westwood – Blackwell Science Publishers, Oxford

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Effective from June 2026

Subject: Zoology**SEMESTER- VII**

Course Level	6	Internal Marks	25
Programme	B.Sc. Zoology (Honours)	External Marks	50
Semester	7	Practical Internal	25
Category of Course	Discipline Specific Minor Courses (Minor-7)	Practical External	--
Course Credit	04 (3-1)	Prac. External Exam Duration	2 Hrs.
Teaching Hours	60	Total	100
Course Code		Exam Duration	2 Hrs.
Course Title	Ecology and Climate Change		

Course Objectives:

This course aims to:

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

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

- Analyze population characteristics, species interactions, community organization, and ecological succession in natural ecosystems.
- Evaluate ecosystem productivity, nutrient cycling, ecosystem services, and approaches for ecosystem restoration and sustainability.
- Interpret climate system processes, assess causes and evidence of climate change, and apply climate monitoring concepts.
- Assess climate change impacts on ecosystems and explain mitigation, adaptation, and climate governance strategies.

BHAKTA KAVI NARSINH MEHTA UNIVERSITYSyllabus of **B.Sc. (Honours)** as per NEP-2020Faculty of **Lifesciences**

Effective from June 2026

Subject: Zoology**SEMESTER- VII****Course Contents****Minor-7**

Sem.	Unit No.	Syllabi	Teaching Hours
7	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 4.4 Climate Governance (India and Global Context): Overview of UNFCCC and Paris Agreement; India's climate policy	12

		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.

BHAKTA KAVI NARSINH MEHTA UNIVERSITYSyllabus of **B.Sc. (Honours)** as per NEP-2020Faculty of **Lifesciences**

Effective from June 2026

Subject: Zoology**SEMESTER- VII****Suggested Practical****Minor-7**

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/IPCC 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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Course Level	6	Internal Marks	25
Programme	B.Sc. Zoology (Honours)	External Marks	50
Semester	VII	Practical Internal	25
Category of Course	OJT/Major	Practical External	--
Course Credit	04 (3+1)	Prac. External Exam Duration	--
Teaching Hours	120	Total	100
Course Code		Exam Duration	04 hrs
Course Title	Biostatistics, Research Methodology and AI		

Course Objectives:

This course aims to:

- Provide students with an understanding of biostatistical concepts, data classification, probability distributions, and statistical measures commonly used in biological sciences.
- Develop knowledge of statistical tools such as correlation, regression, t-test, chi-square, ANOVA, and multivariate analysis for biological data interpretation.
- Familiarize students with scientific research methodology, including research design, hypothesis testing, sampling methods, data validation, plagiarism, and referencing tools.
- Introduce the fundamentals of artificial intelligence, machine learning concepts, and their applications in biology, healthcare, and modern scientific research.

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

- Organize and interpret biological data using descriptive statistics, probability distributions, and measures of variation.
- Apply statistical tests and analytical methods for interpretation of biological and experimental data.
- Design basic research studies, formulate hypotheses, validate data, and follow ethical scientific research practices.
- Explain fundamental concepts of artificial intelligence and evaluate its applications in biology, healthcare, and interdisciplinary sciences.

BHAKTA KAVI NARSINH MEHTA UNIVERSITY
Syllabus of B.Sc. (Honours) as per NEP-2020
Faculty of Lifesciences
Effective from June 2026
Subject: Zoology
SEMESTER- VII

Course Contents

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; 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 and review, scientific writing, and research ethics 3.3 Sampling techniques, optimization of protocol, graphical data analysis, data validation 3.4 Plagiarism, Referencing tools	15
	4	Artificial Intelligence Foundation 4.1 Introduction to Artificial Intelligence, AI fundamentals, use-cases and applications of AI, ethical concerns in AI, research ethics, algorithmic bias, career opportunities, and future scope. 4.2 Brief history of AI and ML in Healthcare and biology, Machine Learning workflow and basic terminologies, computational models of intelligence. 4.3 Conceptual frameworks from cognitive and educational psychology, neuroscience, information theory, and linguistics; philosophical foundations of AI.	15

BHAKTA KAVI NARSINH MEHTA UNIVERSITY
Syllabus of B.Sc. (Honours) as per NEP-2020
Faculty of Lifesciences
Effective from June 2026
Subject: Zoology
SEMESTER- VII

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

Suggested Practical

OJT/Major

No.	Syllabi	Teaching hours
1.	Frequency Distribution.	30
2.	Standard Deviation and Coefficient of Variation	
3.	Confidence limits for the population mean.	
4.	Student's t-test.	
5.	Analysis of Variance.	
6.	Regression and Correlation	
7.	Chi Square Test	
8.	Research proposal preparation.	
9.	Multivariate tools and its application	
10.	Data validation using statistical tools	
11.	Graphical data analysis	
12.	Introduction to AI tools for biological data analysis	
13.	Use of ChatGPT / Gemini / AI tools in scientific literature search	
14.	Introduction to machine learning datasets in biology	

BHAKTA KAVI NARSINH MEHTA UNIVERSITYSyllabus of **B.Sc. (Honours)** as per NEP-2020Faculty of **Lifesciences**

Effective from June 2026

Subject: Zoology**SEMESTER- VII**

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

Course Objectives: 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 to:

- 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.

BHAKTA KAVI NARSINH MEHTA UNIVERSITYSyllabus of **B.Sc. (Honours)** as per NEP-2020Faculty of **Lifesciences**

Effective from June 2026

Subject: Zoology**SEMESTER- VII****Course Contents****OJT/SEC**

Sem.	Unit No.	Syllabi	Teaching Hours
7	1	Introduction to Good Laboratory Practice (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, calibration and maintenance of laboratory equipment.	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 & LMOs. 2.4 Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture, ethical handling of experimental animals, overview of CPCSEA guidelines in biological research laboratories. 2.5 Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication.	15

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, Alpha Science International Ltd
8. Department of Biotechnology, Biosafety Manual
9. PR, Biosafety and Bioethics, Goel and Parashar, Pearson
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

BHAKTA KAVI NARSINH MEHTA UNIVERSITYSyllabus of **B.Sc. (Honours)** as per NEP-2020Faculty of **Lifesciences**

Effective from June 2026

Subject: Zoology**SEMESTER- VII****Suggested Practical****OJT/SEC**

No.	Syllabi	Teaching hours
1.	Laboratory Orientation and GLP Compliance Assessment - Familiarization with laboratory layout - Identification of GLP-compliant practices - Laboratory inspection checklist preparation	30
2.	Preparation of Standard Operating Procedures (SOPs). - Drafting SOP for media preparation - Drafting SOP for aseptic transfer of cultures - Drafting SOP for biological specimen handling	
3.	Good Documentation Practices. - Laboratory notebook maintenance - Recording observations and deviations - Preparation of equipment logbooks	
4.	Validation of Autoclave Sterilization - Use of biological indicators - Use of chemical indicators - Interpretation of sterilization results	
5.	Risk Assessment Exercise - Hazard identification - Risk categorization - Risk assessment documentation	
6.	Preparation and Evaluation of Disinfectants.	
7.	Surface and Workspace Decontamination Procedures. - Cleaning protocols - Monitoring effectiveness of decontamination	
8.	Sample Collection, Labelling, and Chain-of-Custody Documentation - Preservation of plant, animal and microbial samples - Specimen labelling - Sample tracking forms - Storage records	

BHAKTA KAVI NARSINH MEHTA UNIVERSITYSyllabus of **B.Sc. (Honours)** as per NEP-2020Faculty of **Lifesciences**

Effective from June 2026

Subject: Zoology**SEMESTER- VII****Theory Examination Paper Style NEP 2020****SEMESTER – VII****Major- 17,18/Minor-7 (Theory)****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	Unit 3 & 4	
	(1)		05
	(2)		05
Total			50

BHAKTA KAVI NARSINH MEHTA UNIVERSITY
Syllabus of **B.Sc. (Honours)** as per NEP-2020
Faculty of **Lifesciences**
Effective from June 2026
Subject: Zoology
SEMESTER- VII

Practical Examination Paper Style NEP 2020

Major-19: Biochemistry and Molecular Biology, Biotechnology and immunology

Time: 4 Hours

Total Marks: 50

Que. No.	Particulars	Marks
Que-1	Do as per instruction and show it to examiner.	08
Que-2	Do as per instruction and show it to examiner.	08
Que-3	Do as per instruction and show it to examiner.	08
Que-4	Do as per instruction and show it to examiner.	08
Que-5	Do as per instruction and show it to examiner.	08
Que-6	Certified Journal.	05
Que-7	Viva-voce.	05

Practical Examination Paper Style NEP 2020

Minor-07: Practical: Ecology and Climate Change

Time: 2 Hours

Total Marks: 25

Que. No.	Particulars	Marks
Que-1	Do as per instructions and show it to examiner.	04
Que-2	Do as per instructions and show it to examiner.	04
Que-3	Do as per instructions and show it to examiner.	04
Que-4	Do as per instructions and show it to examiner.	04
Que-5	Certified Journal.	04
Que-6	Viva-voce.	05

BHAKTA KAVI NARSINH MEHTA UNIVERSITY
Syllabus of B.Sc. (Honours) as per NEP-2020
Faculty of Lifesciences
Effective from June 2026
Subject: Zoology
SEMESTER- VII

Examination Paper Style NEP 2020

SEC : Good Laboratory Practice and Biosafety

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:

Ques. No.	Particulars	From which Unit	Marks
Que.1	Question 1 (1) (2)	1 & 2	05 05
	Or		
	Question 1 (1) (2)		05 05
Que.2	Question 2 (1) (2)	3 & 4	05 05
	Or		
	Question 2 (1) (2)		05 05
Que.3	Question 1	From Any Unit	05
	Or		
	Question 2		
Total			25