



M.Sc. Zoology syllabus for 4th Semester as per NEP-2020 (Batch-2025 onwards)

(CW / R)

Course Code	Course Title	Course Type	Hours / Week			Credits	Examinations / Marks		Total Marks
			L	T	P		Internal Assessment	Term End Examination	
MZOOCVN425	Agriculture and Veterinary Nematology	CC	3	0	4	5	35 Marks	90 Marks	125
MZOOCAD425	Advanced Entomology	CC	3	0	4	5	35 Marks	90 Marks	125
MZOOCFL425	Fundamentals of Limnology	CC	3	0	4	5	35 Marks	90 Marks	125
MZOICTW425	Techniques in Wildlife	CC	3	0	4	5	35 Marks	90 Marks	125
OR									
MZOOPDI425	Research Project with Dissertation	CC	Research 40 hours/week			20	140	360	500

GENERAL INSTRUCTIONS

1. A student must earn a minimum of 20 credits in each semester. To be eligible for the award of a **1-year diploma** (02 semesters) or **2-year Master's degree** (04 semesters), a minimum of 40 or 80 credits respectively is required.
2. The **20 credits** in the **4th semester** can be earned by completing **04 Core Courses (CC)**, each carrying **05** credits

OR

3. A candidate can obtain all **20 credits** from the research project with dissertation. A candidate has to choose the area of research project from four the specializations available in the Department. The selection of candidates for the said research project will be on the basis of academic merit obtained in M.Sc. 1st & 2nd semester.
4. Maximum marks per credit are **25** (One unit is equivalent to 01 credit)
5. One credit in theory is **16 Hours** direct teaching learning; where as in practical and tutorial it is **32 hours**.



Course Title: **VETERINARY AND PLANT NEMATODOLOGY**

Course code: **MZOOCVPN425**

Total Credits: **05(03L+02P)**

Max. Marks: **125 (75L+50P)**

Unit-Wise CLOs (Course Learning Outcomes)	
MZOOCVPN425 - I	Gain in-depth knowledge of nematode taxonomy, anatomy, physiology, and life cycles
MZOOCVPN425 –II	Understand the general characteristics, classification, life cycle patterns, pathogenicity & control of plant parasitic nematodes
MZOOCVPN425 -III	Study nematodes affecting livestock, including their life cycles & zoonotic potential and develop control measures for nematode infections
MZOOCVPN425-IV	Study to learn different techniques for sampling, extraction & identification of nematodes

Theory (03 Credits)

UNIT I: INTRODUCTION TO NEMATODOLOGY

- 1.1 History, importance & classification: Milestones in nematology; taxonomy, evolutionary relationships; major groups of plant-parasitic and animal-parasitic nematodes
- 1.2 Nematode morphology and anatomy: General structure, key features for identification, and variations among different nematode groups
- 1.3 Nematode ecology: The role of nematodes in soil ecosystems, their interactions with other organisms, and their impact on nutrient cycling.
- 1.4 Entomopathogenic Nematodes (EPN's): Introduction & their use as biological control agents

UNIT II: PLANT-PARASITIC NEMATODES:

- 2.1 Major plant-parasitic nematode genera: Detailed study of *Meloidogyne*, *Heterodera*, *Globodera*, *Pratylenchus*, *Rotylenchulus*, *Tylenchulus*, *Ditylenchus*, *Paratylenchus*.
- 2.2 Host-parasite interactions: Mechanisms of infection, feeding, and the development of symptoms in plants.
- 2.3 Nematode-induced plant diseases: Symptoms, pathogen-host specificity, and factors influencing disease development.
- 2.4 Management Strategies: Integrated pest management (IPM) approaches, including cultural practices, biological control, chemical control, and the use of resistant varieties.

UNIT III: VETERINARY NEMATODOLOGY:

- 3.1 Major animal-parasitic nematode genera: *Haemonchus*, *Trichostrongylus*, *Nematodirus*, *Ostertagia*, *Cooperia*, *Strongyloides*, *Oesophagostomum*.
- 3.2 Life Cycles, pathogenesis & disease: Mode of transmission, mechanisms of disease caused by parasitic nematodes
- 3.3 Molecular techniques for nematode identification, population genetics, and host-parasite interactions
- 3.4 Control and management: Strategies for managing nematode infections in livestock, including anthelmintic treatments and other preventative measures.



UNIT IV: PRACTICALS : (02 Credits)

1. Slide/Specimen study of nematodes of agriculture and veterinary importance
2. Nematode extraction techniques from soil and plant samples
3. Methods of fixation of plant parasitic nematode
4. Methods of collection, preservation of nematode parasites from sheep, goat and cattle
5. Preparation of permanent mounts of nematodes of veterinary importance
6. Field visit to various sheep farms & agriculture fields for collection of nematodes
7. Submission of a detailed report of laboratory findings with power point presentation

Suggested Books / Reading Material

1. Animal Parasitology by J. D. Smyth
2. Foundations of Parasitology by Gerald D. Schmidt and Larry S. Roberts
3. Foundations of Parasitology by Larry S. Roberts, John Janovy & Steve Nadler
4. Georgis' Parasitology for Veterinarians 10th Edition Evolve Elsevier.
5. Helminthes Arthropods and Protozoa of Domesticated Animals by E.J.L Soulsby
6. Plant Nematology by N.G. Ravichandra
7. Plant Nematology 2nd Edition by Roland N. Perry & Maurice Moens
8. Introduction to Parasitology by ASA C. Chandler & Clark P. Read
9. Parasitology Easy to Learn by Chandra T Jaya, Jaypee Brothers Medical Publishers
10. Practical Exercises in Parasitology by D. W. Halton
11. Practical Guide to Diagnostic Parasitology by Lynne S. Garcia.

CLO - PLO Mapping

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	Avg.
MZOOCV425 - I	3	1	2	2	2	2	2	1	0	2	1.7
MZOOCV425 -II	2	3	3	2	2	2	2	1	1	2	2.0
MZOOCV425 -III	2	3	3	2	2	2	2	1	1	2	2.0
MZOOCV425 -IV	2	2	3	2	2	2	2	1	1	3	2.0
Avg. PLO	2.25	2.25	2.75	2.0	2.0	2.0	2.0	1.0	0.75	2.25	1.9



Course Title: **ADVANCED ENTOMOLOGY**

Course Code: **MZOOCAE425**

Total Credits: **5 (3L + 2T +0P)**

Maxi. Marks: **125 (75+50)**

Unit-wise CLOs	
MZOOCAE425 I	Understand the concepts of molecular entomology and novel techniques routinely used in research to investigate the molecular mechanisms of insect systems and will also cover whole insect genome projects
MZOOCAE425 II	The course will also introduce students to the fundamental concepts of insect biotechnology
MZOOCAE425 III	The course will introduce the students to the biotechnological application to insect science

Theory: 03 Credits

UNIT I: MOLECULAR ENTOMOLOGY

- 1.1. History of molecular entomology
- 1.2. Molecules of life; regulation of gene expression in insects
- 1.3. Gene regulation in insect physiology
- 1.4. Insect whole genome sequencing projects; DNA sequencing

UNIT II: INSECT BIOTECHNOLOGY I

- 2.1. General introduction to insect biotechnology.
- 2.2. Use of insects in tissue culture and genetic studies as model animals.
- 2.3. Cell culture methods and cell line development in insects
- 2.4. Importance of insects in medicine and cosmetics with respect to biotechnology.

UNIT III: INSECT BIOTECHNOLOGY II

- 3.1. Genetic engineering of insects: Introducing new genes into insects viz. silkmoths and honey bees
- 3.2. Bioassays and bioassays for insecticidal molecules, Testing the effectiveness of insecticides and biopesticides
- 3.3. Insect biotechnology in environmental management: use of insects in Pollution Monitoring, Waste Management and Bioremediation
- 3.4. Role of biotechnology in plant resistance to insects

UNIT IV: SEMINARS AND TUTORIALS (02 Credits)



Suggested Readings:

1. Dhaliwal GS & Singh R. (Eds). 2004. Host Plant Resistance to Insects - Concepts and Applications. Panima Publ., New Delhi.
2. Maxwell FG & Jennings PR. (Eds). 1980. Breeding Plants Resistant to Insects. John Wiley & Sons, New York.
3. Painter RH.1951. Insect Resistance in Crop Plants. MacMillan, London.
4. Panda N & Khush GS. 1995. Plant Resistance to Insects. CABI, London.
5. Smith CM. 2005. Plant Resistance to Arthropods – Molecular and Conventional Approaches. Springer, Berlin

CLO - PLO Mapping:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	Avg.
MZOOCAE425 I	3	3	3	3	3	2	1	2	2	2	2.4
MZOOCAE425 II	3	3	2	2	2	2	3	2	2	2	2.3
MZOOCAE425 III	3	3	2.5	2.5	2.5	2	2	2	2	2	2.35
Avg. PLO	3	3	2.5	2.5	2.5	2	2	2	2	2	2.35

**Course Title: FUNDAMENTALS OF LIMNOLOGY**Course Code: **MZOOCL425**Total Credits: **5 (3L + 0T +2P)** Maxi. Marks: **125 (75+50)**

Unit-wise CLOs	
MZOOCL425 I	Understand the fundamental principles and scope of limnology. Analyze the physical, chemical, and biological characteristics of freshwater bodies.
MZOOCL425 II	Interpret ecological interactions and nutrient dynamics in aquatic ecosystems.
MZOOCL425 III	Assess the impact of pollution and eutrophication on freshwater habitats.
MZOOCL425 IV	Apply limnological knowledge and practical skills in freshwater conservation and management

Theory: 03 Credits**UNIT 1: INTRODUCTION TO LIMNOLOGY AND PHYSICOCHEMICAL PROPERTIES**

- 1.1 Introduction to Limnology: Definition, historical development, scope, and importance. Classification and zonation of freshwater ecosystems. Lake origins and morphometry.
- 1.2 Properties of water: Transparency and turbidity. Thermal stratification in lake and its modification.
- 1.3 Physicochemical parameters of water bodies (temperature, pH, dissolved oxygen, total alkalinity, turbidity and total dissolved solids)
- 1.4 Role of macro and micro-nutrients in water bodies; eutrophication in lakes, its causes and consequences.

UNIT II: BIOLOGICAL LIMNOLOGY AND ECOSYSTEM PROCESSES

- 2.1 Producers: Phytoplankton (major groups and adaptations). Periphyton and benthic algae. Aquatic macrophytes and their ecological roles.
- 2.2 Consumers & Decomposers: Zooplankton & their role in the food web. Benthic macro-invertebrates as bio-indicators. Nekton & their ecological functions. Aquatic bacteria & fungi
- 2.3 Trophic Dynamics and Productivity: Primary productivity and its limiting factors. Energy transfer through aquatic food chains, food webs, and the microbial loop.
- 2.4 Ecological Interactions: Competition, predation, and symbiosis in aquatic environments. Concept of ecological succession in freshwater bodies.

UNIT III: APPLIED LIMNOLOGY AND FRESHWATER MANAGEMENT

- 3.1 Pollution: Sources and types. Causes, process, and consequences of cultural eutrophication. Harmful Algal Blooms (HABs) and their control.
- 3.2 Bioaccumulation and biomagnification of toxins (heavy metals, pesticides). Use of bioindicators and biomarkers for pollution monitoring.
- 3.3 Physical, chemical, and biological indicators of water quality. Introduction to Water Quality Indices (WQI).
- 3.4 Watershed management principles. Strategies for lake and river restoration. Impacts of climate change on freshwater ecosystems.



UNIT IV: PRACTICALS : (02 Credits)

1. Visit to a local freshwater body (lake/pond/river) for an overview of the ecosystem.
2. Demonstration and use of water and plankton sampling equipment (e.g., Van Dorn sampler, plankton net).
3. Collection of water, sediment, and biological samples for laboratory analysis.
4. Measurement of water transparency using a Secchi disc, Total Dissolved Solids (TDS) and conductivity, pH and Dissolved Oxygen (DO) using probes or titration (Winkler’s method).
5. Estimation of water alkalinity and hardness.
6. Spectrophotometric analysis of major nutrients: Nitrates (NO_3^-) & Orthophosphates (PO_4^{3-}).
7. Determination of Biochemical Oxygen Demand and Chemical Oxygen Demand (COD).
8. Qualitative and quantitative analysis of phytoplankton and zooplankton using a Sedgwick-Rafter counting cell. Identification of common freshwater plankton and macrophytes.
9. Collection, separation, and identification of benthic macroinvertebrates.
10. Submission of a detailed report of the field visit and laboratory findings.

Recommended Textbooks & References

1. Limnology: Lake and River Ecosystems – Robert G. Wetzel
2. Fundamentals of Limnology – F.R. Wetzel & G.E. Likens
3. Introduction to Limnology – Stanley I. Dodson
4. Aquatic Ecology – Paul A. Keddy
5. Water Quality and Pollution Control – C.K. Varshney
6. Standard Methods for the Examination of Water and Wastewater - APHA, AWWA, WEF. (Especially for Practicals)
7. Textbook of Limnology - Gerald A. Cole

CLO - PLO Mapping

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	Avg.
MZOOCFL425 I	3	2	2	2	2	1	1	3	1	2	1.90
MZOOCFL425 II	3	3	3	3	2	1	2	3	1	3	2.40
MZOOCFL425 III	3	2	3	3	3	2	2	3	2	3	2.60
MZOOCFL425 IV	2	3	3	3	2	2	2	3	3	3	2.60
Average PLO	2.75	2.50	2.75	2.75	2.25	1.50	1.75	3.00	1.75	2.75	2.38



Course Title: **HUMAN WILDLIFE INTERACTIONS AND SUSTAINABILITY**

Course code: **MZOOCHWI425** Total Credits: **5 (L3+2T+0P)** Max. Marks: **125 (75+50)**

Unit-wise CLOs (Course Learning Outcomes)	
MZOOCHWI425 I	Explain the concept, causes, drivers and consequences of human-wildlife conflict
MZOOCHWI425 II	Analyze the importance of ecosystem services, their categorization, and valuation techniques
MZOOCHWI425 III	Assess management approaches, policy frame works, community engagement, and technological innovations in promoting co-existence
MZOOCHWI425 IV	Evaluate case studies to identify successful strategies and challenges in achieving sustainability through seminars and tutorials

Theory (03 Credits)

UNIT 1: HUMAN–WILDLIFE CONFLICT

- 1.1 Definition, damage to crops, livestock, and property, threats to human safety; wildlife mortality, disease transmission.
- 1.2 Major drivers: Habitat loss and fragmentation, land-use change, resource competition, climate change, expanding human populations and infrastructure development.
- 1.3 Species in conflict: Region-specific and globally significant examples; Successes, failures, and context-dependent factors of mitigation and policies.
- 1.4 Consequences: Ecological, economic, and social impacts; methods for measuring and evaluating conflict severity.

UNIT II: ECOSYSTEM SERVICES FROM WILDLIFE

- 2.1 Understanding ecosystem services (ES) and their importance.
- 2.2 Categorization of ecosystem services: Provisioning services, regulating services, cultural services, supporting services
- 2.3 Species Links, connecting specific wildlife species or groups to the services they provide.
- 2.4 Economic and non-economic valuation approaches; Factors undermining the provision of ecosystem services.

UNIT III: MANAGEMENT FRAMEWORKS AND SUSTAINABILITY

- 3.1 Integrated Management Approaches: Prevention, habitat management, land-use planning, deterrents (physical, chemical, biological), compensation/insurance schemes, adaptive management
- 3.2 Policy and Governance: International agreements (CITES, CBD), national laws, local institutions, and community-based conservation; Interdisciplinary approaches: Integrating ecology, sociology, economics, and political science.
- 3.3 Sustainable Coexistence: Social tolerance, role of education and communication in fostering coexistence; future directions; climate change adaptation for HWC and ES; landscape-scale conservation and corridor management
- 3.4 Technological innovations (genetic tools, advanced monitoring); integrating one health perspectives (human, animal, environmental health); moving beyond mitigation to genuine shared landscapes.



UNIT IV: CASE STUDIES, TUTORIALS AND SEMINARS (02 Credits)

4.1 Practical Applications – Case studies in conflict resolution and management

Case Studies: Black bear and crop raiding, predators and livestock depredation, primates in urban areas, birds and aviation safety; strategy implementation: **Applying approaches from Unit-3 in different contexts**; Technology use: GPS collars, camera traps, early warning systems, AI.

4.2 Tutorials & Seminars

Suggested Books/ Reading Material

1. Woodroffe, R., Thirgood, S., & Rabinowitz, A. (Eds.). (2005). *People and Wildlife: Conflict or Coexistence?* Cambridge University Press. – Foundational text; concepts remain highly relevant.
2. Frank, B., Glikman, J. A., & Marchini, S. (Eds.). (2019). *Human–Wildlife Interactions: Turning Conflict into Coexistence.* Cambridge University Press. – Contemporary focus on coexistence.
3. Daily, G. C. (Ed.). (1997). *Nature’s Services: Societal Dependence on Natural Ecosystems.* Island Press. – Seminal work defining ES.
4. Millennium Ecosystem Assessment. (2005). *Ecosystems and Human Well-being: Synthesis.* Island Press. – Global ES categorization framework. [Available free](#)
5. Pascual, U., et al. (2010). *The Economics of Valuing Ecosystem Services and Biodiversity.* TEEB Foundations. – Valuation-focused; part of the TEEB series. [Available online]
6. Sinclair, A. R. E., Fryxell, J. M., & Caughley, G. (2006). *Wildlife Ecology, Conservation, and Management* (2nd ed.). Blackwell Publishing. – Ecology with strong management links.
7. Redpath, S. M., et al. (Eds.). (2015). *Conflicts in Conservation: Navigating Towards Solutions.* Cambridge University Press. – Social dimensions and conflict resolution.
8. World Bank. (2009). *Human–Wildlife Conflict in Africa: An Overview of Causes, Consequences and Management Strategies.* – Regional and practical focus. [Free online]
9. FAO. (2009). *Human–Wildlife Conflict in Africa: Causes, Consequences and Management Strategies.* – Similar scope, practical orientation. [Free online]

CLO-PLO Mapping

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	Avg.
MZOOCHWI425 I	3	2	1	1	1	2	3	2	1	3	1.9
MZOOCHWI425 II	3	2	1	1	1	2	3	2	1	3	1.9
MZOOCHWI425 III	3	3	2	2	2	2	3	3	2	3	2.5
MZOOCHWI425 IV	2	3	2	2	2	3	3	3	2	3	2.5
Avg. PLO	2.75	2.5	1.5	1.5	1.5	2.25	3	2.5	1.5	3	2.2



Course Title: **Project with Dissertation (Student Centric)**

Course code: **MZOOCPI425**

Total Credits: **20 (Research Work)**

Max. Marks: **500**

Unit-Wise CLOs	
MZOOCPI425	Analyse existing literature and identify gaps, formulate research questions and hypotheses, sampling and research methods, data analysis and scientific Communicate

CLO - PLO Mapping

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	Avg.
MZOOCPI425	3	3	3	3	3	2	2	1	2	3	2.5
Avg. PLO	3	3	3	3	3	2	2	1	2	3	2.5