



**M.Sc. Zoology syllabus for 2<sup>nd</sup> Semester as per NEP-2020  
(Batch-2025 onwards)**

Course Code	Course Title	Course Type	Hours / Week			Credits	Examinations / Marks		Total Marks
			L	T	P		Internal Assessment	Term End Examination	
MZOOCEB225	Evolutionary Biology	CC	3	0	2	4	28 Marks	72 Marks	100
MZOOCEZ225	Economic Zoology	CC	4	0	4	6	42 Marks	108 Marks	150
MZOOCAZ225	Applied Zoology	CC	4	0	4	6	42 Marks	108 Marks	150
MZOODVPH225	Veterinary Protozoology & Helminthology	DCEC	2	0	0	2	14 Marks	36 Marks	50
MZOODIIB225	Insect Invasion Biology	DCEC	2	0	0	2	14 Marks	36 Marks	50
MZOODFPR225	Fish Processing Technology	DCEC	2	0	0	2	14 Marks	36 Marks	50
MZOODBIW225	Biology of Indian Wildlife	DCEC	2	0	0	2	14 Marks	36 Marks	50

**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. Out of **20 credits** in a semester, a candidate has to obtain compulsorily **16 credits** from “**Core Course**” (CC) while the remaining **04 credits** can be obtained from the “**Discipline centric Elective course**”(DCEC) in the following manner:
  - ▶ Out of **08 credits (DCEC)** offered by the Department, a candidate has to obtain maximum of **04 credits** from the DCEC.
3. A candidate shall be free to obtain optional 04 credits from the **Open Elective Course (OEC)/Employability & Entrepreneurship Course (EEC)** offered by other departments. A candidate has the option to opt for **MOOC's** in place of **OEC/EEC**.
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: **EVOLUTIONARY BIOLOGY**

Course code: **MZOOCEB225** Total Credits: 4 (3L + 0T +1P) Max. Marks: **100** (75L+25P)

Unit-Wise CLOs (Course Learning Outcomes)	
MZOOCEB225.I	Understand the mechanisms of evolution and the existing biodiversity
MZOOCEB225.II	Explain the evolutionary relationship of existing taxa through their fossil remains
MZOOCEB225.III	Understand the role of different agents in evolution
MZOOCEB225.IV	Acquire the practical knowledge of evolution

**(Theory 03 Credits)**

**UNIT I: CONCEPT AND THEORIES OF EVOLUTION**

- 1.1 Concept of evolution, historical review of evolutionary concept
- 1.2 Lamarckism
- 1.3 Darwinism
- 1.4 Neo-Darwinism

**UNIT II: EVIDENCES OF EVOLUTION**

- 2.1 Analogy and homology
- 2.2 Embryological & molecular evidences
- 2.3 Paleontological evidences; Fossils, types and dating
- 2.4 Human Evolution

**UNIT III: EVOLUTIONARY CHANGES & PRINCIPLES OF POPULATION GENETICS**

- 3.1 Variations and mutations
- 3.2 Natural selection and its types
- 3.3 Concept of gene pool, gene frequencies – (Hardy-Weinberg equilibrium.)
- 3.4 Genetic drift and gene flow

**UNIT IV: PRACTICALS: (01 Credit)**

1. Study of fossil evidences from plaster cast models and pictures
2. Study of homology and analogy from suitable specimens/ pictures
3. Demonstration of changing allele frequencies with and without selection
4. Construction of cladogram based on morphological characteristics
5. Charts: a) Phylogeny of horse/Man with charts & models  
b) Darwin's finches with diagrams/ cut outs of beaks of different species

**Suggested Books / Reading Material**

1. Ridley, M. (2004). Evolution. III Edition. Blackwell Publishing
2. Hall, B. K. and Hallgrimsson, B. (2008). Evolution. IV Edition. Jones and Bartlett
3. Douglas, J. Futuyma (1997). Evolutionary Biology. Sinauer Associates.
4. Minkoff, E. (1983). Evolutionary Biology. Addison-Wesley
5. Mathur, Tomar, Singh. Evolution and Behaviour, Rastogi Publication, Merrut
6. Mohan P. Arora. Evolutionary Biology, Himalaya Publishing House, Bombay

**CLO - PLO Mapping**

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	Avg.
MZOOCEB225.I	3	1	1	2	1	2	2	1	0	2	1.5
MZOOCEB225.II	3	1	1	2	1	2	2	1	0	2	1.5
MZOOCEB225.III	2	2	2	3	1	2	2	1	1	3	1.9
MZOOCEB225.IV	2	2	2	3	1	2	2	1	2	3	2.0
<b>Avg. PLO</b>	2.5	1.5	1.5	2.5	1.0	2.0	2.0	1.0	0.75	2.5	1.7



Course Title: **ECONOMIC ZOOLOGY**

Course Code: **MZOOCEZ225** Total Credits: **6 (4L + 0T +2P)** Max. Marks: **150 (100L+50P)**

<b>Unit-Wise CLOs (Course Learning Outcomes)</b>	
MZOOCEZ225.I	Understand the methods for the rearing of silkworms, honey bees, dye producing insects and the establishment of insect based industries
MZOOCEZ225.II	Understand the role of different insect pests in agricultural economics
MZOOCEZ225.III	Assess the basic concepts of dairy and poultry farming
MZOOCEZ225.IV	Develop the basic concepts of aquaculture
MZOOCEZ225.V	Understand the practical concepts of animal based cottage industries like, sericulture, apiculture, dairy forming, fish farming and employment opportunistic therein

**Theory (4 Credits)**

**UNIT I: BENEFICIAL INSETS**

- 1.1 Apiculture: Honey bee species, methods of bee keeping, bee hives & products of apiculture
- 1.2 Sericulture: Silk worm species, methods of sericulture and its economic importance
- 1.3 Lac culture: Lac insect- life history, cultivation and uses of lac
- 1.4 Dye producing insects

**UNIT II: HARMFUL INSECTS**

- 2.1 Insect pests of cereals & pulses (stem borers & Leaf hoppers).
- 2.2 Insect pests of vegetables & fruits (Aphids, caterpillars & Cutworms).
- 2.3 Household & storage insect pests (Ants, cockroaches & weevils).
- 2.4 Insects as vectors of diseases (Mosquitos, tsetse & sand flies)

**UNIT III: DAIRY/POULTRY FARMING**

- 3.1 Introduction; indigenous & exotic breeds of cattle & commercial importance of dairy farming
- 3.2 Dairy farm management; rearing, housing, feed and rationing
- 3.3 Introduction, importance and types of poultry farming
- 3.4 Principles and management of poultry breeding; processing and preservation of eggs

**UNIT IV: ECONOMIC IMPORTANCE OF FISHRY**

- 4.1 Common freshwater and marine food fishes of India and their economic importance
- 4.2 Ornamental fishes and their economic importance
- 4.3 Larvivorous fishes in relation to public health
- 4.4 Fisheries legislation, transport and marketing



**UNIT V: PRACTICALS: (02 Credits)**

1. Collection, identification and preservation of beneficial insects
2. Collection, identification and preservation of medically important insects
3. Study of major vectors of animal diseases available in museum
4. Collection, identification and preservation of insects of veterinary importance
5. Collection, identification, classification and preservation of fish fauna of Kashmir
6. Maintenance of freshwater aquarium
7. Field visit to any dairy farm/poultry farm, fish farm/hatchery, apiculture/sericulture station for onsite demonstration

**Suggested Books / Reading Material**

1. Modern Entomology by D. B. Tembhare Himalaya Publishing House
2. Sardar Singh, Beekeeping in India, Indian council of Agricultural Research, New Delhi.
3. Sericulture, FAO Manual of Sericulture.
4. Hafez, E. S. E. (1962). Reproduction in Farm Animals, Lea and Fabiger Publishers.
5. Srivastava, C. L. (1999). Fishery Science & Indian Fisheries. Kitab Mahal publications, India.
6. Rath, R. K. 2000. Freshwater Aquaculture. Scientific Publishers (India) Jodhpur.
7. Piska, R. S. 1999. Fisheries and Aquaculture. Lahari Publications. Hyderabad.

**CLO - PLO Mapping**

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	Avg.
MZOOCEZ225.I	2	3	3	2	2	2	2	1	1	2	2.0
MZOOCEZ225.II	2	2	3	2	2	2	2	1	1	2	1.9
MZOOCEZ225.III	2	2	3	2	2	2	2	1	1	2	1.9
MZOOCEZ225.IV	2	3	3	2	2	2	2	2	1	2	2.1
MZOOCEZ225.V	2	3	3	2	2	2	2	2	1	2	2.1
<b>Avg. PLO</b>	2.0	2.6	3.0	2.0	2.0	2.0	2.0	1.4	1.0	2.0	2.0



**Course Title: APPLIED ZOOLOGY**

Course Code: **MZOOCAP225** Total Credits: **6 (4L + 0T +2P)** Max. Marks: **150 (100L+50P)**

<b>Unit-Wise CLOs (Course Learning Outcomes)</b>	
MZOOCAZ225.I	Understand the role of insects in day to day life, especially as medicine, forensics, agriculture etc.
MZOOCAZ225.II	Understand the role of animal and animal products in the human welfare
MZOOCAZ225.III	Develop the basic concepts of aquaculture and establishment of employment oriented aquaculture farming
MZOOCAZ225.IV	Understand the role of biotechnology in animal sciences
MZOOCAZ225.V	Acquire first hand practical knowledge about animal sciences

**Theory (4 Credits)**

**UNIT I: APPLIED ENTOMOLOGY**

- 1.1 Insects as food & medicine
- 1.2 Insects as biological control agents
- 1.3 Role of insects in forensic sciences
- 1.4 Role of beneficial insects in agriculture

**UNIT II: ANIMAL BREEDING AND ANIMAL PRODUCTS**

- 2.1. Inbreeding and outbreeding; modern methods of breeding for improvement of cattle
- 2.2. Types, action and uses of different animal venoms with reference to snakes
- 2.3. Classification, action and uses of animal poisons
- 2.4. Vermiculture and vermicompost

**UNIT III: AQUACULTURE AND CULTURE TECHNIQUES**

- 3.1 Aquaculture: Status & prospects; application of biotechnology in aquaculture; induced breeding
- 3.2 Trout and carp culture
- 3.3 Prawn culture & pearl culture techniques
- 3.4 Composite fish culture and integrated fish farming

**UNIT IV: ANIMAL BIOTECHNOLOGY**

- 4.1 Concept and scope of biotechnology
- 4.2 Gene manipulation
- 4.3 Genetically modified organisms: production of cloned, transgenic animals & their importance
- 4.4 Recombinant DNA technology and its applications for production of useful molecules



## UNIT V: PRACTICALS: (02 Credits)

1. Collection, preservation and identification of parasitoids & insect pollinators
2. Collection, preservation and identification of insects of forensic importance
3. Rearing of forensically important insects for mortem interval estimation
4. Identification and handling of trouts and carps
5. Morphology and sex differentiation in prawns
6. Isolation of DNA from animal tissues
7. Agarose Gel electrophoresis of nucleic acids
8. One-week field study cum collection trip within the UT's of J&K and Ladakh. Each student/group of students shall have to submit the collection of specimens for the departmental museum along with survey report.

## Suggested Books / Reading Material

1. Dennis, H. (2009). Agricultural Entomology. Timber Press
2. Sericulture, FAO Manual of Sericulture.
3. Hafez, E. S. E. (1962). Reproduction in Farm Animals, Lea and Fabiger Publishers.
4. Srivastava, C. B. L. (1999). Fishery Science and Indian Fisheries. Kitab Mahal publications, India.
5. Sardar Singh, Beekeeping in India, Indian council of Agricultural Research, New
6. Principles and Applications of Recombinant DNA, ASM press, Washington, USA.
7. Hafez, E. S. E. (1962). Reproduction in Farm Animals. Lea & Fabiger Publisher
8. Dunham R.A. (2004). Aquaculture and Fisheries Biotechnology. CABI publications, U.K.
9. An Introduction to Fishes by H.S. Bhamrah, Kavita Juneja Anmol Publications Pvt Ltd
10. Text Book of Applied Zoology by P.V. Jabde, Discovery Publishing House

## CLO - PLO Mapping

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	Avg.
MZOOCAZ225.I	2	3	3	2	2	2	2	1	1	2	2.0
MZOOCAZ225.II	2	2	3	2	2	2	2	1	1	2	1.9
MZOOCAZ225.III	2	3	3	2	2	2	2	2	1	2	2.1
MZOOCAZ225.IV	2	3	3	2	2	2	2	1	2	3	2.2
MZOOCAZ225.V	2	3	3	2	2	2	2	1	2	3	2.2
<b>Avg. PLO</b>	2.0	2.8	3.0	2.0	2.0	2.0	2.0	1.2	1.4	2.4	2.08



Course Title: **VETERINARY PROTOZOLOGY & HELMINTHOLOGY**

Course code: **MZOODVPH225**      **Total Credits: 02 (2L+0P)**      **Max. Marks: 50 (50L+0P)**

Unit-Wise CLOs (Course Learning Outcomes)	
MZOODVPH225.I	Understand the general characteristics, classification, life cycle patterns, pathogenicity & control of protozoan parasites of veterinary important
MZOODVPH225.II	Understand the general characteristics, classification, life cycle patterns, pathogenicity & control of helminth parasites of veterinary important

**Theory: (02 Credits)**

**UNIT I: VETERINARY PROTOZOLOGY**

- 1.1 Introduction to veterinary protozoology
- 1.2 Protozoan parasites of poultry
- 1.3 Protozoan parasites of ruminants
- 1.4 Antiprotozoal drugs

**UNIT II: VETERINARY HELMINTHOLOGY**

- 2.1 Introduction to helminth parasites with their life cycle patterns
- 2.2 Helminth parasites of fishes
- 2.3 Helminth parasites of ruminants
- 2.4 General account on anthelmintics and anthelmintic resistance

**Suggested Books / Reading Material**

- 1. Animal Parasitology by J. D. Smyth
- 2. Foundations of Parasitology by Gerald D. Schmidt and Larry S. Roberts
- 3. General parasitology by Thomas C. Cheng
- 4. Introduction to Parasitology by ASA C. Chandler & Clark P. Read
- 5. Parasitology by Elmer R. Nobel and Glenn A. Noble

**CLO - PLO Mapping**

CLOs	PL01	PL02	PL03	PL04	PL05	PL06	PL07	PL08	PL09	PL010	Avg.
MZOODVPH225.I	3	1	2	2	2	2	2	1	0	2	1.7
MZOODVPH225.II	3	1	2	2	2	2	2	1	0	2	1.7
<b>Avg. PLO</b>	3.0	1.0	2.0	2.0	2.0	2.0	2.0	1.0	0.0	2.0	1.7



Course Title: **INSECT INVASION BIOLOGY**

Course code: **MZOODIIB225**

**Total Credits: 02 (2L+0P)**

**Max. Marks: 50 (50L+0P)**

Unit-Wise CLOs (Course Learning Outcomes)	
<b>MZOODIIB225-I</b>	Understand the basic concepts, attributes and life history traits of invasive insect species with an impact of climate change on biological invasions
<b>MZOODIIB225-II</b>	Evaluate the challenges in managing invasive insect species with potential risks and benefits.

**Theory: 02 Credits**

**UNIT I: INVASIVE SPECIES**

- 1.1. Concepts and definitions of invasive species: stages of invasion (introduction, establishment, spread and impact).
- 1.2. Life history traits and adaptations of invasive insects
- 1.3. Effects on native insect communities, plants, food webs, and ecosystems
- 1.4. Climate change and insect invasions

**UNIT II: CONTROL AND MANAGEMENT OF INVASIVE INSECTS**

- 2.1. Threats and challenges in invasive species control
- 2.2. Quarantine measures, pest risk analysis (PRA), and early detection strategies
- 2.3. Long term and short-term control of invasive insect species
- 2.4. Sustainable management strategies of invasive Insects

**Suggested Reading:**

1. Jonatan Rodríguez, Petr Pysek & Ana Novoa (2023). *Biological Invasions and Global Insect Decline*, Elsevier publishing house.
2. Nanako Shigesada and Kohkichi Kawasaki (2001). *Biological Invasions: Theory and Practice*. Oxford UP.
3. Mark A. Davis (2009). *Invasion Biology*, Oxford University Press
4. Helen E. Roy and Éric Wajnberg (2008). *From Biological Control to Invasion: The Ladybird Harmonia Axyridis As A Model Species*. Springer-Verlag New York Inc.
5. Rhower GG. (1991). *Regulatory Plant Pest Management*. In: *Handbook of Pest Management in Agriculture*. 2nd Ed. Vol. II. (Ed. David Pimental), CRC Press.
6. Shukla A and Veda OP. (2007). *Introduction to Plant Quarantine*. Samay Prakashan, N. Delhi.

**PLO CLO Mapping**

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	Avg.
MZOODIIB225-I	3	2	3	3	2	2	3	3	3	3	2.7
MZOODIIB225-II	3	3	3	3	2	2	3	3	3	3	2.8
<b>Avg. PLO</b>	3.0	2.5	3.0	3.0	2.0	2.0	3.0	3.0	3.0	3.0	2.75



Course Title: **FISH PROCESSING TECHNOLOGY**

Course code: **MZOODFPT225**

**Total Credits: 02 (2L+0P)**

**Max. Marks: 50 (50L+0P)**

Unit-Wise CLOs (Course Learning Outcomes)	
MZOODFPT225-I	Analyze the biochemical composition of fish and evaluate the impact of post-mortem changes, such as rigor mortis and spoilage, on fish quality and human nutrition.
MZOODFPT225-II	Evaluate traditional and modern fish preservation techniques, by-product utilization, processing methods, focusing on their impact on quality, safety, and economic value.

**Theory: 02 Credits**

**UNIT I: BIOCHEMICAL COMPOSITION**

- 1.1 History, scope and importance of biochemical composition in fishes; role of fish in human nutrition
- 1.2 Biochemical composition of fish: Protein, carbohydrates, fats, vitamins and minerals; significance of red and dark muscle
- 1.3 Factors affecting the biochemical composition of fish (exogenous and endogenous)
- 1.4 Post-mortem changes in fish: rigor mortis and fish spoilage

**UNIT II: PROCESSING TECHNOLOGY**

- 2.1 Methods of fish preservation: Traditional methods; drying, salting, smoking, fermentation; Modern techniques; freezing, chilling, packaging, canning
- 2.2. Fish by-products and their utilization; value-added fish products: fish fingers, fish cutlets, surimi, fish wafers, fish sausages
- 2.3. Surimi technology: preparation, quality, and uses
- 2.4. Thermal Processing of Fish: factors affecting thermal processing, use of antibiotics in fish processing technology

**Suggested Reading:**

1. Wheaton & Lawson (1985). Processing Aquatic Food Products. Wiley-Inter-science.
2. Love, R. M. (1997). Biochemistry of Fish Muscle. Academic Press.
3. Huss, H. H. (1995). Quality & Quality Changes in Fresh Fish.
4. Murray, J., & Burt, J. R. (2001). The Composition of Fish. Torrey Research Station.
5. A Yadav, B. N. *Fish and Fisheries*. Daya Publishing House.
6. Pandey, K., & Shukla, J. P. *Fish and Fisheries*.
7. Khanna, S. S., & Singh, H. R. (2003). *A Textbook of Fish Biology and Fisheries*. Narendra Publishing House, New Delhi.

**PLO CLO Mapping**

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	Avg.
MZOODFPT225-I	3	2	2	3	1	2	1	1	1	3	1.9
MZOODFPT225-II	2	3	3	3	3	2	3	3	2	3	2.7
<b>Avg. PLO</b>	2.5	2.5	2.5	3.0	2.0	2.0	2.0	2.0	1.5	3.0	2.3



Course Title: **BIOLOGY OF INDIAN WILDLIFE**

Course code: **MZOODBIW225**

Total Credits: 02 (2L+0P)

Max. Marks: **50** (50L+0P)

Unit-wise CLOs (Course Learning Outcomes)	
<b>MZOODBIW225-I</b>	Develop understanding of different types of adaptations and strategies of mammals and birds for survival under different environmental conditions
<b>MZOODBIW225-II</b>	Explain aspects of biology of Indian amphibians and reptiles and highlight conservation issues affecting their survival

### UNIT I: MAMMALS AND BIRDS

- 1.1 Adaptations: aquatic, terrestrial and flying; metabolism and thermoregulation in mammals
- 1.2 Adaptive radiation in mammals
- 1.3 Avian flight-origin and mechanism
- 1.4 Avian migration and dispersal

### UNIT II: AMPHIBIANS AND REPTILES

- 2.1 Biology of major Indian amphibians
- 2.2 Biology of major Indian reptiles: fresh water and marine turtles, crocodylians and lizards
- 2.3 Poisonous and Non-poisonous snakes of India
- 2.4 An overview of conservation problems and issues of amphibians and reptiles of Indian sub-continent

### SUGGESTED BOOKS/READING MATERIAL

1. Wildlife Biology by Raymond F. Dasmann
2. Mammalogy by Nicholas J. Czaplewski, James M. Rayan, Terry A. Vaughan
3. Handbook of Bird Biology by Irby J. Lovette and John W. Fitzpatrick
4. Herpetology: An introductory biology of Amphibians and Reptiles by Laurie J. Vitt
5. The Book of Indian Reptiles and Amphibians by J.C. Daniel

### CLO-PLO Mapping

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	Avg.
MZOODBIW225-I	3	2	2	2	1	3	3	1	2	3	2.2
MZOODBIW225-II	3	2	2	2	1	2	3	1	2	3	2.1
<b>Avg. PLO</b>	3	2	2	2	1	2.5	3	1	2	3	2.15