4: COURSE OUTCOMES (COs)

Semester III

Zoology Minor

1. Fundamentals of Non-Chordates

Course Outcomes (COs)

CO1: Understand structure and functions of Protozoa (Paramecium)
CO2: Analyze the anatomical and physiological systems in Annelida (Earthworm) CO3:

Compare and contrast functional adaptations in diverse invertebrate groups CO4:

Explore behavioral and structural specializations in minor invertebrate

CO5: Recognize the medical and economic significance of invertebrates

2. Biodiversity, Wild life management and Toxicology

Course Outcomes (COs)

CO1: Understand the Concept and Importance of Biodiversity CO2:

Demonstrate Knowledge of Wildlife Management Principles

CO3: Describe Key Features of National Parks and Sanctuaries in India CO4:

Understand Basic Principles of Toxicology

CO5: Develop Awareness of Environmental and Wildlife Conservation Challenge

Semester IV

Zoology Minor

1. Physiology, Endocrinology and Histology

Course Outcomes (COs):

CO1: Understand fundamental principles of animal physiology CO2:

Explain the mechanisms of respiration in vertebrates

CO3: Understand circulatory system functions and blood physiology CO4:

Comprehend excretory physiology and osmoregulatory mechanisms CO5:

Identify sources, roles, and deficiency symptoms of vitamins

CO6: Understand the endocrine system and hormonal regulation

CO7: Identify and describe the histological structure of mammalian digestive organs
CO8: Apply knowledge of physiology, endocrinology, and histology to understand health and disease

2. Economic Zoology and Parasitology

Course Outcomes (COs)

CO1: Describe the economic importance of major fin fishes such as Rohu, Catla, Mrigal, and Tilapia, and explain their role in aquaculture and nutrition.

CO2: Identify commercially important shellfishes like lobster, prawn, crab, mussel, and sepia, and explain their significance in the seafood industry.

CO3: Illustrate the process of fish farming, including the construction and maintenance of fish farms, and evaluate various fishing crafts and gears used in the industry.

CO4: Recognize different breeds of goats, and demonstrate knowledge of their feeding, housing, and economic value in rural and commercial farming systems.

CO5: Understand basic principles of dairy science, including the production and processing of milk and various milk products.

CO6: Define and classify parasites based on their nature and host interaction.

CO7: Describe the morphology, anatomy, life cycle, and reproductive features of Ascaris, and understand its pathogenicity and control measures.

CO8: Analyze the structural and physiological adaptations of parasites, particularly Ascaris, for their survival within the host.

B. Sc. PART – II SEMESTER – III (NEP 2.0)

MINOR ZOOLOGY PAPER - V

FUNDAMENTALS OF NON-CHORDATES

THEORY: 30 Hrs. MARKS-50 (CREDITS: 02)

Unit – I **7 hrs**

1. Type study: *Paramecium*
   a) Systematic Position
   b) Locomotion
   c) Nutrition
   d) Osmoregulation
   e) Reproduction

Unit – II **15 hrs**

2. Type study: Earthworm
   a) Systematic Position
   b) Morphology
   c) Coelom
   d) Digestive System
   e) Circulatory System
   f) Excretory System
   g) Nervous System
   h) Reproductive System (Copulation and Cocoon formation)

Unit – III **8 hrs**

3. Type study following General Topics
   a) Foot in Mollusca – Chiton,Pila, Mytilus, Unio and Sepa.
   b) Pedicelaria in Echinodermata
   c) Affinities of Hemichordata
   d) Stridulation in Cicada and Cricket
   e) Salient Features of Minor Phyla : Bugula, Sagitta and Lingula
   f) Invertebrates in Medicine :
      a. Leech (*Hirudo medicinalis*) – Leech Therapy
      b. Honey Bees – Apitherapy

Suggested Readings:

1. Modern Textbook of Zoology: Invertebrates – R.L. Kotpal
2. Invertebrate Zoology – E.L. Jordan & P.S. Verma
3. A Manual of Zoology Volume 1 (Invertebrates) – Ekambaranatha Ayyar and T.N. Ananthakrishnan
4. Invertebrates – Ruppert, Fox, and Barnes
5. General Zoology – S.K. Singh & N.C. Nair

B. Sc. PART – II SEMESTER – III (NEP 2.0)

MINOR ZOOLOGY PAPER - VI

BIODIVERSITY, WILD LIFE MANAGEMENT AND TOXICOLOGY

THEORY: 30 Hrs. MARKS-50 (CREDITS: 02)

Unit – I: Biodiversity **7 hrs**

a) Definition and types of Biodiversity
b) Scope and characterisation
c) Genetic, Species, and Ecosystem diversity
d) Levels of Biodiversity: Alpha, Beta, Gamma diversity
e) Importance of Biodiversity: Ecological, economic, and ethical values
f) Conservation Strategies

Unit – II: A] Wildlife Management **6 hrs**

a) Definition of wildlife and wildlife management
b) Scope and significance of wildlife management
c) Categories of wildlife: rare, endangered, vulnerable, endemic
d) Factors affecting wildlife: natural and anthropogenic

B] National Parks and Sanctuaries **09 hrs**

a) Malvan Marine Wildlife Sanctuary
b) Kaziranga National Park
c) Gir National Park
d) Bharatpur wildlife sanctuary
e) Tadoba- Andhari National Park
f) Radhanagari wildlife sanctuary

(Brief idea about locality, history, target animals, threats)

Unit – III: Toxicology **8 hrs**

a) Definition and classification of toxicology
b) Toxic agents and mode of action
   i. Pesticides- Synthetic insecticides (Organophosphate, Organochlorine, Carbamate- one each)
   ii. Metal toxicity: Lead, Mercury and Cadmium
c) Mycotoxins-
d) Applications

Suggested Readings:

1. Wildlife Ecology and Management – Eric G. Bolen & William L. Robinson
2. Wildlife Conservation and Management – S. K. Singh
3. Essentials of Wildlife Ecology and Conservation – G. C. Waugh

4. Wildlife of India – V. B. Saharia
5. Principles of Wildlife Management – R. B. Singh
6. Indian Wildlife Protection Laws – B. B. Hosetti
7. Principles of Toxicology – Stumph & Guthrie
8. Toxicology – K. C. Gupta
9. Essentials of Toxicology – Klaassen & Watkins
10. Elements of Toxicology – P. D. Sharma

B. Sc. PART – II SEMESTER – III (NEP 2.0)

MINOR ZOOLOGY PRACTICAL - III

(Based on Fundamentals of Non-Chordates, Biodiversity,

Wild life management and Toxicology)

PRACTICAL: 60 Hrs. MARKS-50 (CREDITS: 02)

Unit – I *Paramoecium*

A. Systematic position
B. Morphological characters
C. Study of locomotion in *Paramoecium* (through prepared video/animation)
D. Reproduction: Asexual (Binary fission), Sexual (Conjugation)

Unit – II Earthworm

A. Systematic position
B. Morphological characters
C. Dissections,
    a. Digestive system: Alimentary canal
    b. Circulatory system: Longitudinal blood vessels, hearts and loops
    c. Nervous System: Central nervous system
    d. Reproductive System: Male and female reproductive organs
D. Temporary Preparations,
    a. Gizzard
    b. Septal Nephridia
    c. Spermatheca
    d. Setae

Unit – III

A. Foot in Mollusca – Chiton,Pila, Mytilus, Unio and Sepa.
B. Pedicelaria in Echinodermata
C. Salient Features of Minor Phyla : Bugula, Sagitta and Lingula
D. Invertebrates in Medicine :
    1) Leech (*Hirudo medicinalis*) – Leech Therapy
    2) Honey Bees – Apitherapy

Unit – IV Biodiversity and Wildlife Management

A. Study of Alpha, Beta and Gamma Diversity (from Forest and Grassland Habitats)
B. Study of species richness, evenness and abundance using samples
C. Estimation of biodiversity by Simpson's Diversity Index using sample data.
D. Study of biodiversity conservation methods.
E. Study of identification of common Indian wild animals through indirect evidence (e.g. casts, pugmarks, scats, pellets, etc.)

F. Study of any one nearby national park or wildlife sanctuary
G. Study of the effects of insecticides on human health (endosulfan effect)
H. Study of heavy metals toxicity on human health:
   Pb- (Plumbism)
   Hg- (Minamata),
   Cd. (Itai-itai)

Suggested Readings:

1. Practical Zoology: Invertebrates" – S.S. Lal
2. Manual of Practical Zoology – Invertebrates" – P.S. Verma & B.S. Tyagi
3. Manual of Practical Zoology – Invertebrates" – P.S. Verma & B.S. Tyagi
4. Practical Zoology Manual" – A.C. Dutta
5. Methods in Ecology and Environmental Science" – H.S. Sharma
6. India's National Parks and Wildlife Sanctuaries" – Pradeep Sachdeva
7. Essentials of Toxicology" – M. Asha & P. Ramaswamy
8. A Textbook of Toxicology" – Pandey & Shukla

B. Sc. PART – II SEMESTER – IV (NEP 2.0)
MINOR ZOOLOGY PAPER - VII
Physiology, Endocrinology and Histology
THEORY: 30 Hrs. MARKS-50 (CREDITS: 02)

Unit – I: Physiology **16 hrs**

1: Introduction to Animal Physiology
- Definition, scope and importance
- Levels of physiological regulation
- Homeostasis and feedback mechanisms

2: Respiration
- Types of respiration: aerobic and anaerobic
- Respiratory organs and Mechanism of Breathing (in rat and *Scoliodon*)

3: Circulation
- Composition and functions of blood
- Blood groups and coagulation
- Structure and mechanism of working of heart in mammals

4: Excretion and Osmoregulation
- Structure and function of nephron
- Mechanism of urine formation

5: Vitamins (with reference to source role and deficiency)
- Water soluble vitamins: B complex and C
- Fat soluble vitamins: A, D, E and K

Unit – II: Endocrinology **7 hrs**

1: Introduction to Endocrinology
- Definition
- General properties of hormones

2: Study of Endocrine organs with respect to structure and functions
- Pituitary gland
- Adrenal Gland
- Thyroid Gland
- Pancreatic gland

Unit – III: Histology of mammalian organs **7 hrs**

1: Alimentary canal
- Oesophagus
- Stomach

- Small intestine
- Large intestine

2: Digestive glands

- Liver
- Pancreas

Suggested Readings:

1) Animal Physiology and Biochemistry – R. Rastogi
2) Animal Physiology – A.K. Berry
3) Animal Physiology – P.S. Verma, V.K. Agarwal (S. Chand & Co.)
4) Essentials of Animal Physiology – S.C. Rastogi
5) Animal Physiology and Anatomy – K. V. Sastry
6) Textbook of Endocrinology – Mac E. Hadley
7) Endocrinology – S. Vinay Kumar & Ramesh Gupta
8) Animal Physiology & Endocrinology – R.L. Kotpal
9) Vertebrate Endocrinology – Norris & Carr
10) Essentials of Animal Histology – G.P. Pal
11) A Textbook of Histology – Ham & Cormack
12) Animal Histology – Dr. M. A. Suvarna (Vidya Books, Kolhapur)
13) Histology and Histotechnique – M.A. Subramanian

B. Sc. PART – II SEMESTER – IV (NEP 2.0)

MINOR ZOOLOGY PAPER - VIII

Economic Zoology and Parasitology

THEORY: 30 Hrs. MARKS-50 (CREDITS: 02)

Unit – I: Fisheries **11 hrs**

1. Economic importance of fin fishes
   a) Rohu *(Labeo rohita)*
   a) Catla *(Catla catla)*
   b) Mrigal *(Cirrhinus mrigala)*
   c) Tilapia *(Oreochromis mossambicus)*

2. Economic importance of shell fishes
   a) Lobster
   b) Prawn
   c) Crab
   d) Mussel
   e) Sepia

3. Fish Farming
   a) Construction and Maintenance of a fish farm
   b) Fishing Crafts and gears

Unit – II: Goat farming and Dairy science **08 hrs**

1. Goat Farming
   a) Breeds of Goat
   b) Feeding
   c) Housing
   d) Economic Importance

2. Dairy Science
   a) Milk and milk products

Unit – III: Parasitology **11 hrs**

1. Definition and types of parasites
2. Type study: *Ascaris*
   a) Systematic Position
   b) Habit and Habitat
   c) Morphology
   d) Digestive System
   e) Reproductive system
   f) Life Cycle
   g) Pathogenicity
   h) Parasitic adaptations
   i) Prevention and control

Suggested Readings:

1. Economic Zoology – *Shukla & Upadhyay*

2. Applied Zoology – *S.K. Gupta*
3. Economic Zoology – *Vasanth Kumar*
4. Manual of Economic Zoology – *Jagdish Prasad*
5. Textbook of Applied Zoology – *R.L. Kotpal*
6. Introduction to Economic Zoology – *S.K. Sharma*
7. Parasitology – K.D. Chatterjee
8. Medical Parasitology – R.L. Kotpal
9. Textbook of Parasitology – S.C. Parija

B. Sc. PART – II SEMESTER – IV (NEP 2.0)

MINOR ZOOLOGY PRACTICAL - IV

(Based on Physiology, Endocrinology, Histology, Economic Zoology and Parasitology)

PRACTICAL: 60 Hrs. MARKS-50 (CREDITS: 02)

Unit I: Physiology and Endocrinology

A. Estimation of Haemoglobin percentage using Sahli's Hemoglobinometer.
B. Determination of Bleeding time (own or provided blood sample)
C. Determination of Coagulation time (own or provided blood sample)
D. Microscopic Examination of Blood Smear
E. Peak expiratory flow rate
F. Study of vitamins: Water and fat soluble
G. Study of Endocrine Glands (Slides/Charts/Models)
    - Pituitary gland
    - Thyroid gland
    - Adrenal gland
    - Pancreas (Islets of Langerhans)

Unit II: Histology

A. Study of following Permanent Slide
    - Oesophagus
    - Stomach
    - Small intestine
    - Large intestine
    - Liver
    - Pancreas

Unit III: Fisheries

A. Study of Economically Important Fishes
(Using preserved specimens/charts/models)
    - Rohu *(Labeo rohita)*
    - Catla *(Catla catla)*
    - Mrigal *(Cirrhinus mrigala)*
    - Tilapia *(Oreochromis mossambicus)*

B. Study of Economic importance of followings
(using preserved specimens/charts/models)
    - Prawn
    - Lobster
    - Crab
    - *Sepia*
    - Mussel

C. Study of Fish Farm Design (Chart/Model)
    - Structure and layout of fish pond:
    - Hatchery, nursery, grow-out pond
    - Water inlet/outlet, bunds, aerators

D. Fishing Crafts:
Gill net, cast net, trawl net, long lines, Seine net, Drift net, Purse seines,

Unit IV: Goat Farming and Dairy Science

A. Study of Goat Breeds:
Sirohi, Jamunapari, Osmanabadi, Boer, Beetal, Saanen

B. Study dairy products:
Milk, curd, ghee, paneer, cheese, khoa

Unit V: Parasitology

A. Ascaris:
   a. Morphology (Male, Female, Sexual dimorphism)
   b. Life cycle
   c. Parasitic adaptations

Study tour: visit to any one sea shore or national park, sanctuary or zoo to study animal diversity. Submission of report during the practical examination. Duration for study tour may be of 2 to 7 days.

Suggested Readings:

1. Practical Zoology – Vertebrates" – S.S. Lal
2. Practical Zoology: Vertebrate" – P.S. Verma & B.S. Tyagi
3. Human Histology" – Inderbir Singh
4. Fish Biology and Fisheries" – J.S. Datta Munshi & H. Srivastava
5. A Handbook of Animal Husbandry" – ICAR Publication
6. Goat Farming" – K. Pradhan
7. Dairy Technology" – Sukumar De