

Tribhuvan University  
**Institute of Science and Technology**  
Three year B.Sc. Zoology course of study  
(2052)

**Course Title:** Non-Chordata **Full Marks:** 100  
**Course No.:** ZOL 311 (major/minor) **Pass Marks:** 35  
**Nature of the course:** Theory **Year:** I

**Course Objectives:**

At the end of the course the students will be able:

- to take interest in pursuing further about the details and applications of lower non-chordates.
- to distinguish between unicellular and multicellular species.
- to appreciate the division of labour in the lower organized animals.
- to explain the structures and characteristics of different parasites.
- to identify and study the bewildering variety of insects found on earth.
- to participate team work even in small animals.
- to distinguish between various shelled animals and study their habitats.

**Group A: Lower Non-chordata**

**Detailed study of animal types:**

**Protozoa:** a. Classification upto orders and brief ecological notes. Habit, habitat and economic importance of *Entamoeba*, *Trypanosoma*, *Giardia*, *Monocystis*, *Vorticella*, *Opalina*, *Balantidium*, *Nyctotherus* and *Noctiluca*. b. Detail study of Amoeba and Plasmodium. **10 hrs.**

**Metazoa:** Introduction to metazoa, origin of metazoa. 1 hrs.

**Porifera:** a. Distinguishing characters, classifications upto orders with ecological notes (habit, habitat and economic importance) on *Grantia*, *Spongilla*, *Euplectella* and *Hyalonema*. b. General structure of *Sycon*. c. Canal system of Skeleton. **10 hrs.**

**Coelenterata:** a. distinguishing characters, classification upto orders with ecological notes on *Hydra*, *Sertularia*, *Plumularia*, *Tubularia*, *Bougainvillea*, *Porpita*, *Velella*, *Physalia*, *Rhizostoma*, *Millepora*, *Aurelia*, *Alcyonium*, *Tubipora*, *Zoanthus*, *Metridium* and corals (*Madrepora*, *Favia*, *Fungia*, *Astrangea*) b. Detailed study of *Obelia*. c. Polymorphism in Hydrozoa. d. Introduction of corals. **14 hrs.**

**Platyhelminthes:** a. distinguishing character and classification upto orders with ecological notes on *Dugesia*, *Schistosoma*, *Echinococcus*, *Planaria*. b. Detailed study of *Fasciola hepatica* and *Taenis solium*. **14 hrs.**

**Aschelminthes:** a. Distinguishing characters and classification upto orders with ecological note on *Oxyurias*. b. Detailed study of *Ascaris lumbricoides* and *Wuchereria bancrofti* (Filaria). c. Economic importance of *Helminths*. **10 hrs.**

**Annelida:** a. Distinguishing character and classification upto orders with ecological notes on *Pheretima*, *Polynoe*, *Eunice*, *Arenicola*, *Aphrodite*, *Amphitrite*, *Chaetopterus*, *Tubifex*, *Pontobdella*. b. External character and general anatomy of *hirudinaria* (leech). **8 hrs.**

## **Group B: Higher Non-Chordata and Protochordata**

**Arthropoda:** a. Distinguishing character and classification upto orders with ecological notes (habit, habitat and economic importance) on *Peripatus*, *Lobgster Cancer*, *Sacculina*, *Eupagurus* (hermit carb) *Lepas*, *Balanus*, *Apus*, bug, *Leptocoriza*, beetle, *Phyllophogus Lepisma*, *Gryllus*, *Mantis*, *Cicada*, *Forficula*, Drogon fly, moth sick worm, *Julus*, *Scolopendra*, Scorpion, Spider and *Limulus*. b. Detailed study of Cockroach and Prawn. c. Mouth parts of insects: (i) Chewing and biting type (ii) Piercing and sucking type (iii) Sponging type (iv) Chewing and lapping type (v) Siphoning type. d. Economic importance of insects. Social life in insects (honey bee and termite). **22 hrs.**

**Mollusca:** a. Distinguishing character and classification upto orders with ecological notes on *Chiton*, *Anodonta*, *Ostrea*, *Solen*, *Pecten*, *Haliotis*, *Patella*, *Aplysia*, *Doris*, *Limax*, *Sepia*, *Octopus*, *Nautilus* and *Dentalium*. b. Detail study of *Pila* and *Unio*. c. Economic importance of mollusca. **20 hrs.**

**Echinodermata:** a. Distinguishing character and classification upto orders with ecological notes on *Asterias*, *Echinus*, *Cucumaria*, *Ophiuroidea* and *Antedon*. b. External features and water vascular system in starfish. c. Affinities of Echinodermata. **10 hrs.**

**Protochordata:** a. Classification upto orders with brief ecological notes on *Pyrosoma*, *Doliolum*, *Salpa* and *Oikopleura*. b. Shstematic position, distribution, ecology, general organization and affinities of *Balanoglossus*, *Herdmania* and *Branchiostoma*. c. Metamorphosis of *Herdmania*. **2 hrs.**

**Text Books:**

1. Kotpal (retd.), R.L., *Modern Text Book of Zoology*, Invertebrates. 6<sup>th</sup> edition. Rastogi Publication, Meerut India, 1992.

**Reference Books**

1. Dhami &Dhami, *Invertebarte Zoology*. R. Chand & Co. New Delhi, 1989.
2. Majupuria, T.C., *Invertebrate Zoology*, S. Nagin & Co. India.
3. Prasad, S.N., *Life of Invertebrates*. Vikas Publishing House Pvt. Ltd., New Delhi, 1992.

**Course Title:** Lower & Higher Non-chordata    **Full Marks:** 50  
**Course No.:** ZOL 312 (major/minor)                      **Pass Marks:** 20  
**Nature of the course:** Practical    **Year:** I

**Course Objectives:**

At the end of the course the students will be able:

- to identify the different representatives of different phyla.
- to identify and study different pathogenic animals which cause diseases.
- to identify and explain the structures of different organs of invertebrates.

Study of representative examples of different phyla (mentioned in theory papers) upto order from museum specimens / slides.

**Study of slides:** Binary fission and conjugation in *Paramecium*. L.S. & T.S. of *Sycon*. Sporocyst, redia, cercaria, scolex and proglottids of *Taenia*. T.S. of *Fasciola* (Different regions). T.S. of *Ascaris*. T.S. *Neris*. T.S. of Star fish arm. T.S. of (*Branchiostoma*) *Amphioxus* (various regions). Spicules and pharynx of *Herdmania* and pharynx of *Amphioxus*. Mounting of coelenterates by sucking borax carmine.

**Dissections of following animals:** Leech – General anatomy, excretory and reproductive organs. Prawn – Appendages, digestive organs and nervous system. Cockroach – General anatomy, digestive, nervous and reproductive systems. *Pila* – General anatomy and nervous system. Unio - General anatomy and nervous system.

**Mounting:** Temporary – Osphradium and Radula of *pila*, Jaw of Leech. Permanent slide preparation – Mouth parts of insects (z) Cockroach, (b) Mosquito, (c) Honey bee, (d) Butterfly, (e) Housefly.

**Whole mounts of the following:** (Permanent Slides) – *Daphnia*, *Cyclops*, *Cypris*, Mosquito larva and pedicellaria of star fish.

Practical note books, permanent slides and collection of animals to be submitted at the time of examination.

**Text Books:**

1. Verma, P.S., *A manual of Practical Invertebrate Zoology*. S. Chand & Co., India.

**Reference Books:**

1. Werse, P.B., *Science of Biology*. McGraw Hill Co. India.
2. Lal, S.S., *A Text Book of Practical Zoology Invertebrate*.

**Course Title:** Chordata., CellaAd

Tissue Biology

**Full Marks:** 100

**Course No.:** ZOL 321 (major/minor)

**Pass Marks:** 35

**Nature of the course:** Theory

**Year:** II

**Course Objectives:**

On completion of this course the students will be able:

- to distinguish chordates and non-chordates.
- to describe anatomy of fishes, amphibians, reptiles, birds and mammals.
- to explain characteristics of certain groups of chordates.
- to explain the differences in composition of various tissues which from the basis of their functions.
- to relate the structure functioning different systems of the body.
- to explain how different functions of the body are regulated.
- to describe the structure and chemistry of basic units of life.

**Group A: Chordata**

Cyclostomata: External characters of Petromyzon and Myxine. Distinguishing characters and classification upto orders. 2 hrs.

Pisces: External characters and functional anatomy of Scoliodon, Economic importance of fishes, Distinguishing characters and classification upto orders. Ecological notes, habit and habitat and economic importance of: *Chondrichthys: Zygaena Pristis, Trygon; Rhinobatus and Chimaera. Actinopterygii :- Polypterus, Acipencer, Lepidosteus, Mystus, Tetradon, Echeineis and Solea. Dipnoi: Protopterus.* **16 hrs.**

**Amphibla:** External characters and organ system of frog. Origin evolution and parental care in amphibia. distinguishing

character and classifications upto orders and ecological notes on:- *Necturus*, *Amphiuma*, *Ambystoma* and its Axolotl larva, *Tylototriton*, *Salamandra*, *Hyla* and *Rachophorus*. **14 hrs.**

**Reptiles:** External character and functional anatomy of Uromastix, Identification of poisonous and non-poisonous snake. Biting mechanisms in snakes, Distinguishing characters and classification upto orders and ecological notes on:- *Chelone*, *Testudo*, *Hemidactylus*, *Calotes*, *Draco*, *Varanus*, *Phrynosoma*, *Chameleon*, *Typhlops*, *Python*, *Bungarus*, *Naja*, *Viper*, *Hydrophis*, *Crocodylus*, *Gavialis* and *Alligator*. **16 hrs.**

**Aves:** Functional anatomy of *Columba livia*. Bird migration. Pheasants of Nepal. Distinguishing characters and classification upto orders with ecology notes on:- *Ardea*, *Milvus*, *Pavo*, *Tyto*, *Eudynamus* and *Casuaris*. **15 hrs.**

**Mammalia:** Functional anatomy of rabbit. Distinguishing characters and classifications upto orders. Characters and affinities of Prototheria, Metatheria and Eutheria. **10 hrs.**

**Ecological notes on:** *Ornithorhynchus*, *Echidna*, *Didelphys*, Kangaroo, *Panthera leo*, *Manis* (Pangolin or scaly ant-eater), *Herpestes* (Mongoose), *Pteropus* (Flying fox and small bat) **7 hrs.**

### **Group B: Cell and Tissue Biology**

Histological study: Histological structure of skin, stomach, intestine, liver, pancreas, lung, kidney, spinal cord, ovary, and testes of Amphibia and Mammalia. **16 hrs.**



## **Physiology of mammalia with reference to man:**

**Digestion:** Composition, function and regulation of salivary, gastric, pancreatic, bile and intestinal fluids, Absorption. Nutrition (Balance diet including vitamins and minerals).

**Respiration:** Transport of Oxygen and carbon dioxide. Bohr effect. **Blood:-** Composition and functions of blood and lymph. Structure and functions of haemoglobin. **Heart:-** Origin, conduction and regulation of heartbeat. Blood pressure.

**Excretion:** Physiology of urine formation. **Nerve impulse:-** Origin and conduction of nerve impulse, synapse and myoneural functions. **20 hrs.**

**Endocrinology:** Structure and function of mammalian endocrine glands with particular reference to pituitary, thyroid, parathyroid, pancreas, adrenal and gonads. **8 hrs.**

**Cell Biology:** Cell structure and cell theory. **Enzymes:-** Classification, structure and functions of enzymes and co-enzymes. **Organelles:-** Plasma membrane, endoplasmic reticulum, ribosome, lysosome, golgi-complex, mitochondria, centrioles and basal granules, cilia and flagella, **Nucleus:-** nuclear membrane, nucleolus and chromatin. Cell Division. Structure, type and function of chromosome, polytene and lampbrush chromosome. Linkages, crossing over. **20 hrs.**

**Genetics:** Gene and gene concept, interaction of gene. Gene mutation. Sex determination and sex linked inheritance. Structure of nucleic acids, structure and function of RNZ and DNA, DNA replication, genetic code. **12 hrs.**

### **Text Books:**

1. Dhama & Dhama, *A Text Book of Zoology Vol. II & III*. Pradeep Publication, New Delhi, 1968.
2. Verma, P.S., *A Manual of Practical Zoology (Vertebrate)*. S. Chand & Co., New Delhi 1978.
3. Kotpal (retd.), R.L., *Modern Text Book of Zoology, Vertebrates*. 6<sup>th</sup> Edition, Sastogi Publication, Meerut, India, 1992.
4. Rastogi, S.C., *Text Book of Physiology*. Wiley Eastern Ltd.
5. Verma, P.S. and Agrawal, V.K., *Cell Biology Evolution and Ecology*. S. Chand & Co., New Delhi, 1978.

### **Reference Books:**

1. Rastogi, V. Nath, K. Nath, R., *Invertebrate Zoology*, Delhi.
2. Majupuria, T.C., *Introduction to Chordates*, Pradeep Publication, New Delhi, 1968.
3. Dhama & Dhama, *Vertebrate Zoology*, S. Chand & Co., New Delhi, 1978.
4. Shrestha, T.K., *Herpetology of Nepal*, B. Shrestha Publisher.
5. Shrestha, T.K., *Birds of Nepal Vol. I and II*, B. Shrestha Publisher.
6. Shrestha, T.K., *Mammals of Nepal*, B. Shrestha Publisher.

**Course Title:** Chordata, Cell and Tissue Biology      **Full Marks:** 50  
**Course No.:** ZOL 322 (major/minor)                      **Pass Marks:** 20  
**Nature of the course:** Practical                                      **Year:** II

### **Course Objectives:**

At the end of this course the students will be able:

- to identify and explain the structure of different organs in a body.
- to relate the shape and structure with the skeleton.
- to identify and study different animals in details.

**Dissections: *Scoliodon***:- Afferent and efferent, branch arteries. Cranial nerves. Internal ear. General anatomy, digestive, reproductive, artery and venous system of *Calotes*, *Columba*, Rat or rabbit (depending on availability).

**Study of permanent slides:** Sections of skin, stomach, intestine, liver, pancreas, lung, kidney, spinal cord, ovary and testis of frog and mammal.

**Study of skelton:** Dog fish (*Scoliodon*), Frog (*Rana*) Lizard (*Varanus*), Pigeon (*Collumba*), Fowl (*Gallus*) and Rabbit (*Lepus*)

**Study of chick cell:** Study of different types of cells. Study of cytoplasmic organelles through permanent slides. Permanent slides of mitosis and meiosis cell division.

Study of Museum specimen, Classification and characters mentioned in theory papers. Physiology- Study of the action of salivary amylase on starch.

**Preparation of permanent slides:** Placoid scales, Ampulla of Lorengini, Pecten of birds, striped and unstriped muscle.

### **Text Books:**

1. Verma P.S., *A Manual of Practical Zoology (Vertebrate)*, S. Chand & Co., New Delhi, 1968.

**Course Title:** Ecology, Fish and Aquaculture  
**Course No.:** ZOL 331 (major)  
**Nature of the course:** Theory

**Full Marks:** 100  
**Pass Marks:** 35  
**Year:** III

### **Course Objectives:**

At the end of this course, the students will be able:

- to show the development in all groups follows the same basic pattern.
- to demonstrate the interdependence of animals and their interactions with the environment.
- to show familiarity with different kinds of habitats and their preservation.
- to demonstrate knowledge of the dynamic history of life.
- to list factors which contribute to fish production.
- to create environment for fish aquaculture.

### **Group A: Developmental Biology Ecology and Evolution**

**Development Biology:** Gametogenesis, Fertilization and Parthenogenesis. Types of animal eggs. Patterns of cleavage and gastrulation. Germ layers and their derivatives and homologies. Cell cleavage and fate maps. Development of *Amphioxus*, Chick and mammals. Type of placenta and their functions. **22 hrs.**

**Ecology:** Components of ecosystem. Ecosystem energetics (Energy flow through trophic levels, food web and food pyramid). Ecosystem managements. Biochemical cycles (Nitrogen, Carbon and Phosphorus). **Population:-** Population density, natality, mortality, immigration, emigration, pyramid, sex-ratio, dispersal and population, growth including potential, human population and its impacts on eco-degradation' **Pollution:-** Water, air, noise and their control-measures. Wild Life management in Nepal. Introduction to Biodiversity

Endangered species in Nepal Conservation of endangered species. National Park wild life Reserves and their representative fauna. **30 hrs.**

Short history of evolutionary thought. Evidences in favour of evolution, Darwinism and neo-Darwinism. Evolution of horse. **8 hrs.**

**Zoo-geography:** Brief account of Zoo-geography realms, Oriental fauna its boundaries and important fauna. **5 hrs.**

**Animal Behaviour:** Learning and innate behaviour, territorial, relationship and mating behaviour. **6 hrs.**

### **Group B: Fish and Aquaculture**

**Fish and Aquaculture: *Fishes of Nepal***:- @ Occurrence, distribution and morphology of *Labeo*, *Cirrihina*, *Catla*, *Mystus*, *Channa (Ophiocephalus)*, *Schizothorax*. Diagnostic characters and distribution of Dipnoi. Scales and fins in fishes. Migration in fishes. Aquarium and its maintenance. Economic importance of fishes. **17 hrs.**

**Hill stream fishes in Nepal:** Sound-producing organs. General introduction to aquaculture/pond culture in Nepal. ***Water resources of Nepal***:- rivers, lakes, ponds and reservoirs. Construction and preparation of ponds in general. Induced breeding of cultivated fishes. **17 hrs.**

**Exotic fishes in Nepal:** Abiotic factors in water: ***Physical factors***:- Temperature, light and water current. Chemical factors:- pH, dissolved oxygen, carbon dioxide, alkalinity, nutrients (phosphates and nitrates). ***Biotic factor in water***:- Plankton, fish diseases. **17 hrs.**

**Text Books:**

1. Khanna, S.S., *An Introduction to Fishes*, S. Chand and Co., New Delhi, 1966.
2. Dhama & Dhama, *A Text Book of Zoology Vol III*. Pradeep Publication, New Delhi, 1968.

**Reference Books:**

1. Nichol sky, G.V., *The Ecology of Fishes*. Academic Press, London, 1965.
2. Shrestha, J., *Fishes of Nepal*.
3. Sharma, L.K., *Water Resources of Nepal*.
4. Campbell, N.A., *Biology*, Benjamin Cimming, USA.
5. Shrestha, T.K., *Resource Ecology of the Himalayan Water*, 1990.
6. Shrestha, T.K., *Fish Catching in Nepal*.
7. Shrestha, T.K., and Jha, D.K., *Introduction to Fish Culture*, 1990.
8. Shrestha, T.K., *Wildlife of Nepal*.
9. Shrestha, T.K., *Herpetology of Nepal*.

**Course Title:** Medical Zoology,  
Applied Entomology

**Course No.:** ZOL 331 (major)

**Nature of the course:** Theory

**Full Marks:** 100

**Pass Marks:** 35

**Year:** III

**Course Objectives:**

At the end of this course, the students will be able:

- to state disease causing agents.
- to describe immune system and resistance in the body.
- to enlist method to find out the causes of disease.
- to describe the importance of insects to mankind.
- to explain various measures to control these insects.
- to create understanding and appreciation of Wild Life.

To explain the necessity of presenting Wild Life.

**Group A: Medical Zoology**

**Introduction to parasitology:** Terminology.

**Pathogenic microbes:** Viruses, Rickettsia, Spirochetes and Bacteria.

**Protozoan parasites:** Brief account of life histories, mode of infestation, pathogenicity, prophylaxis and treatment of pathogens with reference to human parasitic protozoa:- *Trypanosoma*, *Leishmania*, *Giardia*, *Plasmodium*, *Entamoeba* and *Trichomonas*. **17 hrs.**

**Helminths:** *Fasciolopsis*, *Schistosoma*, *Echinococcus*, *Trichiella*. Phyto and entomopathogenic nematodes:- *Meloidogyne* and *Heterorhabditis*. Arthropods as direct agents of disease and discomforts and vectors of human diseases:- *Anopheles* (*Malaria*), *Culex pipiens* (*Filariasis*) *Culex* (*Encephalitis*), *Ctenocephalides* (dog flea), *Xenopsylla*

(plague flea), *Pediculus* (epidemic typhus). Distribution, biology and control of the above mentioned vectors. **18 hrs.**

**Short Informations about:** Histopathological Changes in related organs with diseases such a cirrhosis, nephrosis, tumors and cancer. Occurrence and eradication of epidemic diseases such a typhoid, cholera, smallpox, meningitis, tuberculosis and zoonotic diseases:- Rabies and Echinococcus. Brief account of human defense mechanism:- the immune system, origin and role of immune system.

**Antibodies:** Structure, function, immunoglobulins, antigens, vaccines, T-lymphocytes, cellular immune response, compatibility antigen, cellular interactions in immunity-monophagus, T-helper and T-suppressor cells, the AIDS virus. **20 hrs.**

### **Group B: Applied Entomology:**

**Classification of insects upto order.** Elementary knowledge of collection, preservation and culture of insects. Bionomics of the insect pests:- Cotton-*Earias vittella*, (pedtinophoro) g,ssypiella. **15 hrs.**

**Crop Pests:** Wheat:- *Sesamia inferens*. Paddy- *Tryporyza incertulaus*, *Leptocorisa acuta*, Pluses:- *Heliothis armigera*. Cash crop Pests. Sugarcane:- *Scirpophaga nivella*, *Pyrill perpusilla*. Vegetable Pests:- *Raphidopalpa foveicollis* *Leucinodes orbonalis*. Stored grain Pests:- Rice *Sitophilus oryzae*, *Corcyra cephalonica*, Wheat:- *Trogoderma Granariu.*, Pluses:- *Callasobruchus chinensis*. **20 hrs.**

**Safe Storage of food grains:** Introduction Damage by insect requirement of safe storage. Types of storage. Storage for



different periods: (a) Transit (b) short-term (c) long-term storage structure and godowns. Transit storage structure. Short term storage structure. Long term storage structure. *Household* pests:- Fleas, mosquitoes, Bedbugs, human lice, sandflies, houseflies, cockroaches and white ants. Economic importances of above insects. Out lines of sericulture, apiculture, lac culture. *Principle* of insect control:- Mechanical, cultural, chemical, biological, sterile male technique, genetic. quarantine-integrated approach to pest management. **20 hrs.**

### **Group C: Wild Life Management**

**Wild Life and its Management:** Wild Life, National Parks and Reserves of Nepal. Wild life distribution in ecological zones. Wild life- values. Economics Exploitation and its impact in nature. Endangered animals of Nepal. Definition of endangers. Vulnerable rare and threatened animals. Conservation of Wild life in Nepal. Importance of Wild life management. Predator-Prey relationship and competition. **40 hrs.**

#### **Text Book:**

1. Fenemure, P.G., *Applied Entomology*, Willy Eastern, Co., New York.
2. R.C., Sobti, *Text book of Medical Zoology*. Central Publication Allahbad, 1966.
3. Majupuria, T.C., *Wild Life and Management*.
4. Shrestha, T.K., *Wild Life of Nepal*, 2003.

#### **Reference Books:**

1. Chandler and Read, *A Text Book of Zoology*. Willey Eastern, New York, 1967.
2. Grove, A.J., and Newell, G.E., *Animal Biology*, University Tutorial Press Ltd., UK.

**Course Title:** Zoology Specialisation

**Full Marks:** 100

**Course No.:** ZOL 333 (major)

**Pass Marks:** 35

**Nature of the course:** Practical

**Year:** III

**Course Objectives:**

At the end of this course, the students will be able:

- to maintain aquariums.
- to carry out experiments related to evolutionary biology, Zoo-geography.
- to understand animal behaviour.
- to understand some pathological changes in tissues caused by small parasites.
- To understand wild life and its management.

**Developmental Biology:** Stages of gametogenesis:- structure of egg and sperm. Section of whole mounts of: early developmental stages of chicks, *Amphioxus* and mammals.

Evolution, Zoo-geography and behaviour:- Zoo-geographical studies with the help of maps.

**Statistical Methods:** Sampling, data collection, data analysis, measurement of density, student's t-test, Chi-square test.

**Medical Zoology:** Preparation of blood film. Blood group analysis. ABO and study of permanent slides of Plasmodium (microfilaria). Preparation of permanent stained mounts of rectal ciliates of frog. Study of permanent slides and specimens of parasitic protozoans, helminthes and arthropods mentioned in the theory course. Collection, preservation and identification of parasites from the vertebrates. Study of permanent slides showing histopathological changes in liver and kidney in relation to cirrhosis and nephrosis. Pathological examination of sputum, blood, urine, and stool. Blood:- erythrocytes.

**Applied Entomology:** Collection and preservation of insects. Classification of insects upto order. Identification and life histories of economically important insects listed in the theory course. Study of mouth parts, legs and antennae. Study of damage caused by insects. Rearing and culture of any one insects of economic importance. Insecticide dusting and important equipments Bee Culture techniques.

**Wild Life of its Management:** Survey of wild animal species in an area by study of animal signs such as food cutting, claw marks, foot-prints, nests, food remains, pellets etc., and a social behaviour. Study of wild animals by marking technique such as banding, ringing etc. Study of habits and habitats of birds by use of binoculars in the field. Field survey of animal populations of an area by setting trapping. Measuring the populations and listing the species in order of abundance.

**Fish Aquaculture Collection and Preserve of Fish:** Identification and classification of fishes listed in the syllabus, Study of maturity stages. Estimation of fertility in *Heteropneustes fossilis*, *Labeo rohita*, *Catla catla*. Demonstration of artificial induction of spawning with fish pituitary extract. Demonstration and preparation and maintenance of aquarium. Physico- Chemical analysis of following parameters from ponds:- Temperature, pH, Dissolved Oxygen, Free carbon dioxide, Alkalinity and Hardness. Identification of the following specimens of phytoplankton, Zooplankton and aquatic insects:-  
*Phytoplanktons*- *Synadra*, *Fragilaria*, *Navicula*, *Cyclotella*, *Pimularia*, *Oscillatoria*, *Microcysts*, *Anabaena*, *Scenedesmus*, *Pdesirsprum*. *Zooplanktons*- Nauplius larva, *Daphnia*, *Cyclops*, *Simiephalus*, *Bosmina*, *Asplanchna*, *Keratella*, *Philodina*, *Branchiones*, Aquatic insects.

**Text Books:**

1. Verma, P.S., *A Manual and Practical Zoology*, S. Chand & Co., New Delhi, 1978.

**Reference Books:**

1. Werse, P.B., *Science and Biology*, McGraw Hill, London.