

Tribhuvan University
Institute of Science and Technology
M Sc Zoology
Semester System
2070

General Objectives

- To make the M. Sc. Programme in Zoology more practical and relevant to the professional needs as required by the country.
- To provide the students with advanced knowledge in the area of specialization and upgrading the quality so that M.Sc. students in Zoology could compete academically with other universities of the international level.

Semester I

Course Title: Taxonomy & Lower Non-Chordates

Course No: Zoo 501

Nature of the course: Theory

Credits: 3

Lecture hrs: 45

Full marks: 75

Pass marks: 37.5

Objectives

- To help knowing the basic concept of biosystematics and procedures in taxonomy.
- To know about some of the important and common protozoans and helminthes of parasitic nature causing diseases in Nepal.
- To make able to discuss some of the important phenomena in Lower-chordates.

Course Contents

Taxonomy: History and importance. Species concept, Intraspecific categories and terms, Origin of new species taxa. Taxonomic characters: Kind and weighting of characters, Cladistics. Overview of character based methods. Systematic collection, curation, identification and taxonomic publication. Taxonomic keys and types. International Codes of Zoological Nomenclature (ICZN). **12 hrs**

Protozoology: Classification. General characters of Radiolaria and Suctoria. Skeleton. Osmoregulation. Reproduction. Parasitism. Life-cycle, pathogenicity, prevention and control of – *Trypanosoma cruzi*, *Entamoeba coli*, *Isospora belli* and *Cyclospora cayetanensis*. **11 hrs**

Porifera: Classification. Origin. Affinities. **3 hrs**

Cnidology: Classification. Nematocysts. Mesenteries in Anthozoa. Corals: Growth, theories of formation and importance. **6 hrs**

Helminthology: Classification. Host and parasite relationships. Larval forms. Structure, life-cycle, pathogenicity, prevention and control of – *Paragonimus westermani*, *Schistosoma* spp., *Echinococcus granulosus*, *Hymenolepis nana*, *Trichinella spiralis*, *Ascaridia galli* and *Enterobius vermicularis*. Common plant parasitic nematodes of citrus and potato with reference to Nepal. **13 hrs**

References

- Baker, J. R. (1969). Parasitic Protozoa, Hutchinson, London.
- Borradaile, L.A., Potts, F.A. and Eastham, L.E.S. (1958). The Invertebrates, Cambridge Univ. Press, New York.
- Chandler, A.C. and Read, C.P. (1961). Introduction to Parasitology, John Wiley and Sons. Inc.
- Cheng, T.C. (1964). The Biology of Animal Parasites, W.B. Saunders Co., Philadelphia and London.
- Dogiel, V.A. (1965). General Protozoology, Oxford Univ. Press, New York.
- ISZN. (1999). International Code of Zoological Nomenclature 4th Ed., Adapted by the I.U.B.S. The Internal Trust for Zoological Nomenclature, London (International Commission on Zoological Nomenclature, 1999).
- Larrington, E.J.W. (1969). Invertebrate Structure and Function, Thomas Nelson & Sons, Ltd. London.
- Littles, C. (1984). The Colonization on land: Origins and Adaptations of Terrestrial Animals, Cambridge University Press.
- Marzano, R.J. and Kendall, J.S. (2006). The New Taxonomy of Educational Objectives, Corwin Press. 2nd Ed.
- Mayr, E. and Ashlock, A.D.(1991). Principles of Systematic Zoology, McGraw-Hill, Inc. 2nd Ed.
- Monks, N., Palmer, P and R, Harman. (2002). Ammonites (Living Past). The Natural History Museum. London
- Parker, T.J. and Haswell, W.A. (1972). A Text Book of Zoology, Vo. I. The MacMillan Press Ltd., London UK.
- Pechenik, J.A. (2004). Biology of the Invertebrates. McGraw-Hill Higher Education; 5th Edition.
- Simpson, G.G. (1961). Principles of Taxonomy, Columbia University Press, New York/Oxford Book Company, Kolkata/Delhi
- Winston, J. (1999). Describing Species, Columbia University Press, 1st Edition.

Course Title: Higher Non-Chordates and Lower Chordates
Course No: Zoo 502
Nature of the course: Theory

Credits: 3
Lecture hrs: 45
Full marks: 75
Pass marks: 37.5

Objectives

- To identify the taxonomic status of the higher non-chordates and discuss the evolutionary model of the group.
- To describe the general biology of a few selected non-chordates useful to mankind.
- To make able to discuss some of the important phenomena in higher non-chordates.

Course Contents

Annelida: Classification. Structure and affinities of Archannelida. Adaptive radiation in Polychaeta. Earthworms in soil and nutrient dynamics. Earthworms in waste management. **7 hrs**

Arthropoda: Classification. Diversity. Characteristics and affinities of - Onychophora. Economic importance of Crustacea. Metamorphosis and Diapause in Insects. Insect Hormones and Pheromones. Insect control. Arthropods of public health and medical importance. **12 hrs**

Malacology: Classification. Shell and Foot in molluscs. Larval forms. Digestion, Respiration and Reproduction in Gastropods. Torsion and Detorsion in Gastropoda. Diversity of molluscs in Nepal. Snails as vectors of diseases. Invasive and pest species with reference to Nepal. Ammonites and their extinction. **10 hrs**

Echinodermata: Classification. Larval forms and symmetry. Skeletal system. Origin and Evolution. **5 hrs**

Minor Phyla: Salient features of Acanthocephala, Nemartina, Nematomorpha, Rotifera, Gastrotricha, Bryozoa (Ectoprocta), Entoprocta, Mesozoa, Ctenophora and Brachiopoda. **6 hrs**

Lower Chordata. Origin, evolution and phylogeny of lower chordate to higher chordate. **5 hrs**

References

Barker, G.M. (2001). The Biology of Terrestrial Mollusks, CABI Pub.

----- (2002). Molluscs as Crop Pests, CABI Pub.

Cloudsley, J.L. and Thomson, S. (1988). Evolution and Adaptation of Terrestrial Arthropods, 1st Ed.

Dales, R.P. (1967). Annelida. Hutchinson Univ. Library., London

Fretter, V. and Peake, J. (Eds1975). Pulmonates: Functional Anatomy and Physiology, Vol. I, Academic Press.

----- (1978). Pulmonates: Systematic Evolution and Ecology, Vol. II, Academic Press.

Hyman, L.H. (1940). The Invertebrates, Vol. I Protozoa through Ctenophora, McGraw-Hill, New York.

----- (1951). The Invertebrates, Vol. II Platyhelminthes and Rhynchocoela, McGraw-Hill, New York.

-----(1951). The Invertebrates, Vol. III. Acanthociphala, Aschelminthes and Entoprocta, McGraw-Hill, New York.

-----(1955). The Invertebrates, Vol. IV Echinodermata, McGraw-Hill, New York.

-----(1959). The Invertebrates, Vol.V. Smaller Coelomate Groups, McGraw-Hill, New York

----- (1967). The Invertebrates, Vol. VI Mollusca I, McGraw Hill, New York.

Kettle, D.S. (1995). Medical and Veterinary Entomology, CABI 2nd Ed.

Morton, J.E. (1967). Mollusca, Hutchinson Univ. Library, London.

Runham, N.W. and Hunter, P.J. (1970). Terrestrial Slugs, Hutchinson Univ. Lib., London.

Course Title: Higher Chordates

Course No: Zoo 503

Nature of the course: Theory

Credits: 3

Lecture hrs: 45

Full marks: 75

Pass marks: 37.5

Objectives

- To identify the taxonomic status of the chordates and discuss the evolutionary model of the group.
- To impart knowledge on ecology of some important fishes, amphibians, reptiles, birds and mammals of Nepal.
- To make able to discuss some of the important phenomena in chordata.
- To know about the conservation and management strategies of the chordate fauna in Nepal.

Course Contents

Ichthyology: Origin, Evolution and Adaptive radiation. Classification. Distribution and conservation status in Nepal. Fish sampling techniques. Coloration. Ecology and importance of fishes (Eel and Snow trout). **9 hrs**

Herpetology:

- Amphibia:** Origin, Evolution and Adaptive radiation. Classification, Distribution and conservation Status of amphibian in Nepal. Amphibian sampling techniques. Affinities of Gymnophiona. Ecology and importance of amphibian (Himalayan newt and Paha). **9 hrs**
- Reptilia:** Origin, Evolution and Adaptive radiation. Classification, Distribution and conservation Status of reptiles in Nepal. Reptile sampling techniques. Ecology and importance of reptiles (Mugger and Cobra). **9 hrs**

Ornithology: Origin, Evolution and Adaptive radiation. Classification, Distribution and conservation Status of avian fauna in Nepal. Palates in birds. Bird sampling techniques. Bird hazards. Ecology and importance of birds (Pheasants and Birds of prey). **9 hrs**

Mammology: Origin, Evolution and Adaptive radiation. Classification, Distribution and conservation Status of mammalian fauna in Nepal. Dentition and stomach. Mammal sampling techniques. Ecology and importance of wild animals (Snow leopard and Elephant). **9 hrs**

References

- Ali, S. and Ripley, S.D. (2001). Hand-book of the birds of India and Pakistan Vol. 1-10, Oxford Univ. Press, Delhi.
- Ballaires, A.D. (1968). Reptiles Vol. I &II, Hutchison Univ. Library, London.
- Berg, L.S. (1974). Classification of fishes, both living and fossils, Edward Brothers Inc. Ann. Arb., Michigan (USA).
- Carl, G. and Frank, B. (1985). Biology of the Reptilia Vol. 15, Development B. A. Wiley – Interscience Pub. John Wiley and Sons, New York.
- Colbert, E.H. (1969). Evolution of Vertebrates, Wiley Eastern Pub., New Delhi.
- Daniel, J.C. (1989). The book of Indian Reptiles, Bombay Natural History Society.

- Flemming, R.L. and Flemming, J.R. (2001). Birds of Nepal, 4th Impression Adrash Books, Delhi India.
- Goodrich, E.S. (1958). Structure and Development of Vertebrates, Dover, New York.
- Grimmett, R., Inskipp, C. and Inskipp, T. (2000). Birds of Nepal. Prakash Books.
- Grizmek's Animal life Encyclopedia (1995). Mammals I to V (and No. 4-13), Van Nastrand Rainhala Company, New York.
- Shah, K.B. and Tiwari, S. (2004). Herpetofauna of Nepal: A Conservation Companion. IUCN Nepal.
- Shrestha, T.K. (1997). Mammals of Nepal, B. Shrestha, Kathmandu.
- (2001). Birds of Nepal Vol. I & II, B. Shrestha Kathmandu.
- (2001). Herpetology of Nepal, B. Shrestha, Kathmandu.
- (2003). Wildlife of Nepal, B. Shrestha, Kathmandu.
- (2008). Ichthyology of Nepal, Himalayan Ecosphere, Kathmandu.
- Snow Leopard Network websites
- Van Tyne and Berger (1959). Fundamental of Ornithology, McGraw-Hill Book Comp.

Course Title: Comparative Anatomy & Physiology

Course No: Zoo 504

Nature of the course: Theory

Credits: 3

Lecture hrs: 45

Full marks: 75

Pass marks: 37.5

Objectives

- To impart knowledge in comparative anatomy and development systems of chordates.
- To make familiar with the functions of different organs of human body.
- To provide an understanding of currently established interdisciplinary approaches used in the study of animal physiology.

Course Contents

Comparative Anatomy: Integument, Digestive organs, Respiratory organs, Heart, Aortic Arches, Brain and Urinogenital organs of Vertebrates. **12 hrs**

Animal Physiology:

Gastro-intestinal: Principles of digestion and absorption of nutrients. Gastro-intestinal disorders. **3 hrs**

Respiratory: Respiratory pigments- structure, properties and functions. Regulation of respiration. Respiratory abnormalities (Hypoxia, Dyspnoea, Asthma, Edema, Emphysema). **7 hrs**

Cardio-vascular: Cardiac cycle. Cardiac output. Regulation of heart pumping and pacemaker. Heart valves and valvular diseases. Regulation of arterial and venous blood flow. Regulation of blood pressure. **5 hrs**

Neuro-physiology: Functional evolution of Fore, Mid and Hind brains. Motor areas of brain. Vision: Photochemistry. Dark and Light adaptations. Colour vision. Neuronal pathways of hearing and vision. Thermal regulation. Acclimatization. **6 hrs**

Excretory and Osmoregulatory: Homeostatic and Osmoregulatory functions of the vertebrate kidney. Abnormalities of micturition. Diuretic and Kidney diseases (Acute Renal Failure). **3 hrs**

Reproductive: Gametogenesis. Hormones in Ovulation (Ovarian cycle) and Menstruation (Uterine cycle). **3 hrs**

Endocrinology: Endocrine glands and their hormones. Hypothalamo-hypophysial system. Regulation of hormone. **6 hrs**

References

- Babsky, E. B. (1970). Human Physiology, Mir Publishers.
- Chatterjee, C.C. (1998). Human Physiology Vol. I & II. Medical Allied Agency, Calcutta.
- Echert, R. and Randall, D. (1987). Animal Physiology CBS Pub. & Distributors, Delhi.
- Gorbman and Bern (1974). A Text Book of Comparative Endocrinology, Wiley Eastern Ed., New Delhi.
- Goodrich, E.S. (1958). Structure and Development of Vertebrates, Dover, New York.
- Guyton, A.C. and Hall, J.E. (2003). Medical Physiology (Last Ed.), Indian Print. Saunders.

Hurkat, P.C. and Mathur, P.N. (1976). Textbook of Animal Physiology, S. Chand & Co. (P.) Ltd., New Delhi
Langley, L.L. (1971). Physiology of Man, Vanmost and Reinhold, New York.
Prosser, C.L. and Brown, F.A. (1965). Comparative Animal Physiology W. B. Saunders, Philadelphia
Seelay, R.R: Stephens, T.D. and Tate P. (1992). Anatomy and Physiology, Mosby-year book, Inc.(2nd Ed.)
Strand, F.L. (1965). Modern Physiology, MacMillan, New York.

Course Title: Non-Chordate & Lower Chordate
Course No: Zoo 505
Nature of the course: Practical

Credit: 2
No. of Practicals: 30
Full marks: 50
Pass marks: 25

Objective

For better understanding of the topics of Zoo 501 and 502.

Course Contents

Study of microscopic animals: Culture of different protozoans and preparation of their permanent slides. Identification, drawing of the prepared permanent and temporary slides.

Micrometry: Measurement of microscopic objects using micrometer.

Study of animal parasites of vertebrates (Ecto and Endo both): Ticks, mites, helminthes and their identification up to family level.

Insect rearing: Rearing of any member of a holometabolous and hemimetabolous insect in the laboratory and make recordings on their life cycle (a caterpillar/ a bug).

Extraction of soil fauna (using funnel method) and identification of any five soil arthropod and nematode species.

Dissection and Slide preparation: Dissection of annelids and arthropods (crustaceans, insects commonly available preferably pest species such as grasshoppers, beetles, etc.) - Alimentary Canal, Reproductive Organs, Nervous system. Preparation of permanent slides of at least two different mouth parts of insects.

Dissection of molluscs (slug species, terrestrial snails including pest species such as *Lissachatina fulica*, *Bensonia*, *Macrochlamys* etc) - Alimentary Canal, Reproductive Organs. Permanent slide preparation of jaws, radula of the dissected snail or slug.

Museum and Zoo visit: Study of animals in the museums (CDZ, NHM, NARC), learning techniques, prepare report on any one species or group of animals about current situation of that group or species.

Collection and Identification: Collection and Preservation techniques of different animals. Handling of specimens. Each student must follow the standard techniques provided by teachers. Collection, Curation, Identification and Deposition of the animals.

Course Title: Chordate, Comp.Anat.& Physio.

Course No: Zoo 506

Nature of the course: Practical

Credit: 2

No. of Practicals: 30

Full marks: 50

Pass marks: 25

Objective

For better understanding of the topics of Zoo 503 & 504.

Course Contents

Taxidermi: Study of preservation media and tools and materials for Taxidermi. Stuffing of (1) Frog, (2) Lizard, (3) Bird and (4) Mammal of any type.

Osteology: Preparation and study of bones of fish, amphibians, reptiles, birds, and small mammals.

Dissection: Fish - *Labeo*, *Channa*, or any common fish available to expose its alimentary canal and accessory organs, Afferent Vessel, Efferent Vessel, Cranial nerve and accessory respiratory organs. Birds - Pigeon: Alimentary Canal, Arterial and Venous System and musculature (pectin, flight muscles), air sacs. Mammal - Rat/Squirrel: Alimentary Canal, Arterial and Venous System, Nervous System and Reproductive Organs.

Histological Studies: Identification of cross sections of chick embryo through eye, ear, heart. Study of different types of placenta in mammals available in slides or others. Preparation of histological slides of tissues of different animals by using microtomy.

Comparative Anatomy: Comparative study of different organ-systems of different vertebrates.

Physiology: Test of carbohydrate (Mollisch's test, Barfoed's test, Benedict's tests, Fehling's test, Iodine test), protein (protein precipitation, ninhydrin reaction, biuret reaction, Xanthoproteic reaction) and lipids (solubility test, reaction with sudan IV, Saponification, Dunstan's test). Determination of the total number of human red and white blood cells in cubic millimeter. Estimation of urea, sugar, protein in urine. Glycogen estimation from animal tissues. Measurement of the rate of muscle contraction and relaxation using kymograph.

Museum visit: Preparation of report on the museum visit on any group of animal and species.

Wildlife surveys: Mist nets use in bird and bat study. Seasonal counting of bird species in TU garden. Study of rodents by setting traps in the garden.
