

Outline of NEP 4-year undergraduate syllabus: Department of Zoology, University of Lucknow

Year	Semester	Paper	Paper Type	Major Subject 1 (Zoology) @4 credits	Major Subject 2 (Another subject from any faculty) @4 credits	Minor 1 @4 credits (from another department)	@4 credits
CERTIFICATE COURSE IN ANIMAL DIVERSITY							
Year 1	Sem 1	P1	Compulsory (Theory)	Diversity and Biology of Non-Chordata		Diversity of Non-Chordata	Curricular course 1
		P2	Compulsory (Practical)	Theory based practical			
	Sem 2	P3	Compulsory (Theory)	Diversity and Biology of Chordata		Diversity of Chordata	Vocational course 1
		P4	Compulsory (Practical)	Theory based practical			
DIPLOMA IN APPLIED ZOOLOGY AND ANIMAL CONSERVATION							
Year 2	Sem 3	P5	Compulsory (Theory)	Environmental Biology and Wildlife		Environmental Biology and Wildlife	Curricular course 2
		P6	Compulsory (Practical)	Theory based practical			
	Sem 4	P7	Compulsory (Theory)	Applied Zoology		Applied Zoology	Vocational course 2
		P8	Compulsory (Practical)	Theory based practical			
BACHELOR IN SCIENCE							
Year 3	Sem 5	P9	Compulsory (Theory)	Animal Physiology and Biochemistry			Internship/ Term paper
		P10	Compulsory (Practical)	Theory based practical			
		P11X	Optional (Theory)	Biosystematics			
		P11Y	Optional (Theory)	Evolutionary Biology			
	Sem 6	P12	Compulsory (Theory)	Cytogenetics and Molecular Biology			Minor project
		P13	Compulsory (Practical)	Theory based practical			
		P14X	Optional (Theory)	Toxicology			
		P14Y	Optional (Theory)	Biotechnology			
HONOURS IN ZOOLOGY							
Year 4	Sem 7	P15	Compulsory (Theory)	Developmental Biology and Immunology			Research Methodology
		P16	Compulsory (Theory)	Animal Behaviour and Chronobiology			
		P17	Compulsory (Practical)	Theory based practical			
		P18X	Optional (Theory)	Endocrinology			
		P18Y	Optional (Theory)	Entomology			
		P19X	Optional (Theory)	Fisheries			
		P19Y	Optional (Theory)	Parasitology			
	Sem 8	P20	Compulsory	Major Project (24 credits)			

B. Sc. in Zoology

Program Objectives (POs):

Zoology as one of the subjects at undergraduate level, should be studied in an integrated and cross-disciplinary manner with a comprehensive understanding of all living systems and their relationship with the ecosystem. Within the broad-range skill sets related to the discipline, it is required to impart and assess the quality of critical thinking, analytical and scientific reasoning, and problem-solving capacity.

Our undergraduate program in Zoology is designed to prepare students to have:

Degree in Bachelor of Science		
Programme Outcomes (POs)		
PO 1	Academic competence:	Develop deeper understanding of key concepts of Zoology at biochemical, molecular, cellular, physiological, histological and systematic level.
PO 2	Inspire Knowledge:	From classical descriptive to modern analytical disciplines of Zoology.
PO 3	Impart Science-based Entrepreneurship:	Impart knowledge and skills through applied disciplines like Sericulture, Apiculture, and Aquaculture etc.
PO 4	Develop Competency:	To make our students competent to excel in competitive examinations.
PO 5	Research Competence:	Integrate and explore biological data. Use current laboratory setup, instrumentation, statistical and biological techniques in the collection, organization, analysis, interpretation and manipulating the data related to Zoology discipline and allied branches.
PO 6	Entrepreneurial and Social competence:	Empower the students by enhancing their self-sustainability capabilities through a thorough understanding of skill-based subjects and techniques by learning. Develop social competence including listening, speaking, observational, effective interactive skills and presenting skills to meet global competencies.
PO 7	Environment and Sustainability:	Understand the issues of environmental contexts and sustainable development.
PO 8	Ethics:	Aware students about ethical principles and commit to professional ethics and responsibilities.

B. Sc. I (Semesters I and II)

Degree in Bachelor of Science	
B.Sc. I (Semesters I and II) Programme Specific Outcomes (PSOs)	
PSO 1	Students will have a comprehensive knowledge of the Kingdom Animalia.
PSO 2	Students will learn the distribution, diversity, classification, physiology, and form and function of each major animal lineage within Non-chordates and Chordates.
PSO 3	Students will be able to apply fundamental principles of Zoology to make informed decisions on socio-scientific issues.
PSO 4	Students will be able to apply for various positions in museums, wildlife/ biodiversity data collection, conservation programs, health care, and zoos etc. in both government and private labs/institutes including NGOs. The student will be offered 'CERTIFICATE COURSE IN BIODIVERSITY' after completing 1st year or two semesters.

B. Sc. II (Semesters III and IV)

Degree in Bachelor of Science	
B.Sc. II (Semesters III and IV) Programme Specific Outcomes (PSOs)	
PSO 1	Students will gain knowledge of Agro based Small Scale Industries like sericulture, fish farming, apiculture, etc., which will help them in finding carrier opportunities.
PSO 2	Students will be able to analyse complex interactions among the various animals of different phyla, their distribution and their relationship with the environment.
PSO 3	Students will be able to develop understanding of environmental conservation processes and its importance, pollution control and biodiversity and protection of endangered species.
PSO 4	The inclusion of environmental biology and wildlife will help students to understand the importance of the environment and how to conserve it.
PSO 5	Students will understand the basic biology and life cycles of vectors, pests and parasites including epidemiology, diagnosis and treatment.
PSO 6	The basic concepts of biosystematics, evolutionary biology and biodiversity will enable students to solve the biological problems related to environment.
PSO 7	At the end of the course the students will be able to comprehend the reason behind maintaining the equilibrium between flora and fauna on earth. Will be able to appreciate the environment and the interdependence between human, wildlife and nature for food production, maintaining clean air and water and sustaining biodiversity in a changing climate.
PSO 8	Students can get subsidy and loan from state government to start Poultry, Pisciculture and Apiculture, under various schemes run by state govt. and become " AATMNIRBHAR" and generate jobs for others.
PSO 9	This Diploma course will enable students to apply for various positions in museums, wildlife/biodiversity data collection, conservation programs, health care, and zoos etc. in both government and private labs/institutes including NGOs as environmental consultants, manager, educator, outreach specialist, wildlife law enforcement officer, zoo curator, museum curator. Besides this, the students can also take up higher studies and research as their career. The student will be offered 'DIPLOMA IN APPLIED ZOOLOGY AND ANIMAL CONSERVATION' after completion of 2 years of the programme or 4 semesters.

B. Sc. III (Semesters V and VI)

Degree in Bachelor of Science	
B.Sc. III (Semesters V and VI) Programme Specific Outcomes (PSOs)	
PSO 1	This programme aims to develop an understanding of structural, functional, biochemical and behavioral aspects of life.
PSO 2	The course in biosystematics is an integrative and unifying science and will help the students in studying the genotypic and phenotypic variation of species in relation to the environments in which they occur.
PSO 3	This course will provide students with the basic knowledge of evolutionary biology, both presenting the general principles of the discipline and exploring in details theoretical problems and case studies.
PSO 4	The students will understand the structure and function of the cell and the principles of genetics.
PSO 5	The course will provide an insight into the life processes at the subcellular and molecular levels
PSO 6	This course will provide theoretical and applied knowledge on the effects of chemical substances on human health.
PSO 7	The principles of genetic engineering, gene cloning and related technologies will enable students to play an important role in applications of biotechnology in various fields.
PSO 8	After completion of 3 years of the programme or 6 semesters, the student will be offered the 'BACHELOR DEGREE IN ZOOLOGY'. This programme will make our students competent to excel in competitive examinations. Also, will enable the students to go for higher studies like Masters and then pursue Ph.D. in Zoology and allied subjects.

B. Sc. IV (Semesters VII and VIII)

Degree in Bachelor of Science	
B.Sc. III (Semesters V and VI) Programme Specific Outcomes (PSOs)	
PSO 1	This course will provide insight on embryonic development of animals. It will also develop understanding of the basic immune mechanism related to different Immunological diseases & disorders
PSO 2	The students will be introduced with intricacies of animal behavior in the context of evolution and ecology. Also the students will learn how the biological clock helps the organisms to perceive environmental cues that modulate the circadian physiology at molecular, cellular and systems levels.
PSO 3	The course in Endocrinology aims to develop an understanding of the endocrine glands; their structure, function, disorders and pathophysiology, which will be helpful for the student to pursue research and higher academic pursuits.
PSO 4	The course in Entomology will help the students to contribute in diverse fields as agriculture, biology, human/animal health, molecular science, criminology, and forensics and will also help him to pursue research and higher studies.
PSO 5	The course in Fisheries has been designed in such a way that the student will get the knowledge of both theory and practical. It aims to enable the students to study about Fish and Fisheries as an entrepreneur.
PSO 6	The course in parasitology has been designed in such a way that the student gets a basic understanding of the diversity of parasites of medical and veterinary importance which will be helpful for further research and higher studies.
PSO 7	Hands on training in the prospective field of interest/ employment
PSO 8	The Honours course will enable students to go for higher studies and research (Ph.D) in specialized fields of Zoology and allied subjects.

Semester I

P1: Diversity and Biology of Non-Chordata

Total Credits: 04

Teaching Hours: 60

Course objectives

- To create in the student an appreciation of non-chordate diversity
- To develop in the student an understanding of structural and functional diversity
- To develop in the student the understanding of evolutionary relationship amongst non-chordate groups

Classification relationship of various phyla up to order.

Unit I

Protozoa

General features and life history of: *Paramecium*, *Plasmodium* and *Leishmania* 10

Porifera

Skeleton, canal system, and reproduction in Porifera 5

Unit II

Cnidaria

General features and life history: *Obelia* 5
Polymorphism
Coral reefs and their formation

Platyhelminthes

General features and life history: *Fasciola hepatica* 5
Parasitic adaptations

Aschelminthes

General features and life history of *Wuchereria bancrofti* 5
Parasitic adaptations

Unit III

Annelida

General features and life history: *Earthworm*, *Nereis* and *Hirudinaria* 7
Coelom and metamerism

Arthropoda

General features and life history: *Palaemon* 8
Mouth parts, vision, respiration, larval forms, metamorphosis and its hormonal regulation, parasitic crustaceans, social organization in honey bee and termites

Unit IV

Mollusca

General features and life history: *Pila* and *Lamellidens* 7
Torsion and detorsion

Echinodermata

General features and life history: *Asterias* 5
Larval forms of Echinodermata
Water-vascular system

Hemichordata

3

General characters, life history: *Balanoglossus*

Affinities

Course Outcomes:

At the completion of the course, the student will be able to:

- understand and appreciate the diversity of life with respect to non-chordate animals.
- describe the general characters of non-chordate animals.
- identify and classify non-chordate animals on the basis of their form and structure and classification.
- understand the life cycle and control of various representatives of non-chordate animals.
- explain evolutionary relationship amongst different non-chordate groups.

Suggested Readings

1. Ruppert, EE, Fox R.S., Barnes R.D. (2004) *Invertebrate Zoology*, 7th Edition. Cengage Learning
2. Thomas Jeffrey Parker, William A. Haswell (2016). *Parker & Haswell's A Textbook of Zoology Volume 1*. WENTWORTH Press
3. Brusca (2016). *Invertebrates*. Sinauer
4. Pechenik Jan (2014). *Biology of the invertebrates*. McGraw Hill
5. Barnes R. S. K., Calow P. P., Olive P. J. W., Golding D. W., Spicer J. I. (2009). *The Invertebrates: A Synthesis*. Wiley Blackwell
6. Kotpal R.L. (2018) *Modern Text Book of Zoology: Invertebrates*. Rastogi Publications
7. Nigam H.C. (2013) *Biology of non-chordates*. Vishal Publishing Co

Assignments (any one)

1. Project (500 words)/ presentation based on the above course content
2. Analytical MCQ based questions
3. Biological Crosswords
4. Charts
5. 500 words answer to analytical questions
6. Study based report of animals in nature

Practical Syllabus Semester I

Course Code- P2

Practical 1: Diversity and Biology of Non-Chordata

Course outcome:

The student at the completion of the course will be able to:

- demonstrate comprehensive identification abilities of non-chordates diversity
- understand the taxonomic position and body organization of invertebrates
- make temporary and permanent preparations
- demonstrate various phenomenon

Protozoa

Observation and identification of common freshwater protozoans, with emphasis on *Amoeba*, *Arcella*, *Euglena*, *Paramecium*, *Vorticella*.

Demonstration of trichocyst discharge and cyclosis in *Paramecium*

Permanent preparation of *monocystis* to demonstrate its life history stages

Study of prepared slides

Porifera

Study of prepared slides and specimens

Glycerin preparation of spicules and spongin fibres

Permanent preparation of gemmules

Cnidaria

Study of prepared slides and specimens

Permanent preparation of *Hydra* and *Obelia*

Platyhelminthes

Study of prepared slides and specimens

Aschelminths

Study of prepared slides and specimens

Annelida

Study of prepared slides and specimens

Permanent preparation of parapodium of *Nereis*, ovary and septal nephridia of *Pheretima*

Glycerin preparation of setae *in situ* from *Pheretima*

Nerve ring of *Pheretima*

Arthropoda

Study of prepared slides and specimens

Glycerin preparation of mouth parts of housefly and mosquito (both sexes)

Permanent preparation of statocysts

Palaemon: Appendages, Hastate plate, Dissection of Central nervous system

Mollusca

Study of prepared slides and specimens

Permanent preparations of gill lamella of *Lamellidens* and *Pila*.

Pila: Dissection of Central nervous system

Echinodermata

Study of prepared slides and specimens

Hemichordata

Study of prepared slides and specimens

Semester II

P3: Diversity and Biology of Chordata

Course objectives

- To create in the student an appreciation of chordate diversity
- To develop in the student an understanding of structural and functional diversity
- To develop in the student the understanding of evolutionary relationship amongst chordates

Classification relationship of various phyla up to order.

Unit I

Protochordata 6

Origin of chordates

General features and life history: *Herdmania* and *Amphioxus*

Agnatha 3

General features: *Petromyzon* and *Myxine*

Pisces 6

Locomotion, respiration, osmoregulation and migration

General features and life history: *Scoliodon*

Unit II

Amphibia 3

Origin of tetrapods

Paedogenesis, Parental care

Reptilia 5

Origin of reptiles

Venomous & non-venomous snakes of India & their identification

Dinosaurs

Aves 4

Origin of birds

Flight adaptations and mechanism of flight

Mammalia 3

Origin of mammal

Dentition

Adaptive radiation

Unit III

Comparative functional anatomy: integument and its derivatives, endoskeleton, and locomotory organs 15

Unit IV

Comparative functional anatomy: digestive system, circulatory system, urinogenital system, nervous system and sense organs 15

Course Outcomes:

At the completion of the course, the student will be able to:

1. understand and appreciate the diversity of life with respect to chordate animals.
2. describe the general characters of chordate animals.
3. identify and classify chordate animals on the basis of their form and structure and classification.

4. explain evolutionary relationships amongst different chordate groups.
5. obtain an overview of economically important vertebrates.

Suggested Reading

1. Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford University Press.
2. Kenneth V. Kardong (2015). Vertebrates: Comparative Anatomy, Function, Evolution. McGraw Hill
3. Thomas Jeffrey Parker, William A. Haswell (2016) Parker & Haswell's A Textbook of Zoology Volume 2. WENTWORTH Press
4. Eroschenko, Victor P. (2008). diFiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott W. & Wilkins
5. Kotpal R.L. (2018) Modern Text Book of Zoology: Vertebrates. Rastogi Publications
6. Nigam H.C. (2017) Biology of Chordates. Vishal Publishing Co

Assignment (Any one)

1. Project (500 words)/ presentation based on the above course content
2. Analytical MCQ based questions
3. Biological Crosswords
4. Charts
5. 500 words answer to analytical questions
6. Study based report of animals in nature
7. Outreach activities promoting dissolution of superstitions associated with animals
8. Photography, identification and listing of local fauna

Practical Syllabus Semester II

Course Code- P4

Practical 1: Diversity and Biology of Chordata

Course outcome:

The student at the completion of the course will be able to:

- understand the vertebrate animal diversity around.
- understand the underlying principles of classification of vertebrates.
- identify the chordate specimen, their characteristics, modifications and adaptations
- make comparative analysis by studying the histological preparations of tissues of different class of vertebrates
- make comparative analysis of the endoskeleton of vertebrates

Protochordata

Study of prepared slides and specimens

Cyclostomata

Study of prepared slides and specimens

Pisces

Study of prepared slides and specimens

Permanent preparation of scales

Labeo rohita

Afferent branchial system

Efferent branchial system

V, VII, IX and X cranial nerves and their branches

Weberian ossicles

Air bladder

Amphibia

Study of prepared slides and specimens

Reptilia

Study of prepared slides and specimens

Study of carapace and plastron

Aves

Study of prepared slides and specimens

Beak modifications, feathers

Mammalia

Study of prepared slides and specimens

Comparative histology of Amphibia and Mammalia

Comparative endoskeleton of Reptilia, Aves and Mammalia.