



**PANDIT DEENDAYAL UPADHYAYA SHEKHAWATI
UNIVERSITY, SIKAR (RAJ.)**

SYLLABUS

ZOOLOGY

(Three/Four Year Under Graduate Programme in Science)

I & II Semester

Examination -2023-24

21
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Pandit Deendayal Upadhyaya
Shekhawati University,
Sikar (Rajasthan)

AIMS AND OBJECTIVES OF UNDERGRADUATE PROGRAM IN ZOOLOGY

The Programme offers both classical as well as modern concepts of Zoology in higher education. It enables the students to study animal diversity in both local and global environments. To make the study of animals more interesting and relevant to human studies, more emphasis is given to branches like animal diversity, economic Zoology, physiology, genetics, ecology and environment, behavioural biology, and evolutionary biology. More upcoming areas in cell biology, molecular biology, biochemistry, biotechnology, microbiology and immunology have also been included. Equal importance is given to the practical learning and presentation skills of students. The lab courses provide the students necessary skills required for their employability. Skill enhancement courses in classical and applied branches of Zoology enhance the enterprising skills of students.

Pandit Deendayal Upadhyay Shekhawati University Sikar.

B.Sc. I Year (I and II Semester)

I Semester, Total Credits= 6 (1 Theory= 4 credits; 1 Practical= 2 credits)

Syllabus: B.Sc. Semester I Zoology

(2023-2024)

Paper I	: 3 Hrs duration	100 M
Practical	: 4 Hrs. duration	50M


PAPER I 4 Credits 60 hours

Animal Diversity

Course Learning Objective: The main purpose of introducing this course is to teach the students the Morpho-taxonomy and evolutionary relationships among and between non-chordates and chordates, along with creating awareness and concern towards the importance of animal diversity for human survival and its socioeconomic significance. In addition to this, the course is aimed at nurturing skills in conducting scientific inquiry and experimentation in the field of animal diversity to acquire knowledge of fundamental concepts and theories of animal diversity.

Course Learning Outcome: Upon completion of the course, students will be able to:

- Learn Morpho-taxonomy and structural organisation of non-chordate and chordate groups.
- Acquire knowledge of the diversity of non-chordate and chordate groups.
- Learn evolutionary relationships and phylogeny of non-chordates and chordates through functional and structural similarities.
- Understand the economic importance of non-chordates and chordates and their significance in the ecosystem.
- Promote shared learning through practical classes, class room presentations and projects.


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Section – A

LOWER INVERTEBRATES

- Unit 1: Protista/Protozoa: General Characteristics and Classification up to classes; Locomotory Organelles and locomotion in Protozoa. 3 hrs
- Unit 2: Porifera: General characteristics and Classification up to classes; Canal system in Porifera. 3 hrs
- Unit 3: Coelenterata (Cnidaria): General characteristics and Classification up to classes; Polymorphism in Hydrozoa. 3 hrs
- Unit 4: Helminthes: Platyhelminthes: General characteristics and Classification up to classes; Lifecycle of *Taeniasolium* and its parasitic adaptations.
Nemathelminthes: General characteristics and Classification up to classes; Life cycle of *Ascarislumbricoides* and its parasitic adaptations. 6hrs

Section – B

HIGHER INVERTEBRATES

- Unit 1: Annelida: General characteristics and Classification up to classes; Formation of Coelom; Metamerism in Annelida. 3 hrs
- Unit 2: Arthropoda: General characteristics and Classification up to classes; Larval forms in Arthropoda, Metamorphosis in Insects. 5 hrs
- Unit 3: Mollusca: General characteristics and Classification up to classes; Torsion and detorsion in Gastropoda; Pearl Formation. 4hrs
- Unit 4: Echinodermata: General characteristics and Classification up to classes; Water-vascular system in Asteroidea. 3 hrs

Section – C

LOWER VERTEBRATES

- Unit 1: Protochordata: General characteristics and Classification of Protochordata up to orders; Retrogressive metamorphosis. 3 hrs
- Unit 2: Agnatha: General characteristics and outline classification of cyclostomes up to classes; Ammocoete larva 3 hrs
- Unit 3: Pisces: General characteristics and Classification up to order. Parental care in fishes and Migration in fishes. 5 hrs
- Unit 4: Aquatic adaptation in fishes; Origin fins; Scales of fishes; Osmoregulation in Fishes. 4 hrs

21
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Section –D

HIGHER VERTEBRATES

Unit 1: Amphibia: General characteristics and classification up to order; Neotony; Parental care in Amphibians. 3 hrs

Unit 2: Reptilia: General characteristics and classification up to order; Identification of Poisonous and non-poisonous snakes; Biting mechanism in Snakes. 4 hrs

Unit 3: Aves: General characteristics and classification up to order; Types of feathers; Flight adaptations and Migration in birds. 4 hrs

Unit 4: Mammals: General characteristics and classification up to orders; Dentition in Mammals: Adaptive radiation in mammals. 4hrs

Recommended Books:

- Barnes, R.D. (2006) Invertebrate Zoology. VII Edition, Cengage Learning, India.
- Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002) The Invertebrates: A New Synthesis. III Edition, Blackwell Science
- Young, J. Z. (2004) The Life of Vertebrates. III Edition. Oxford University Press.
- Jordan E.L., Verma P. S. (2022): Invertebrate Zoology. S. Chand and Company Limited.
- Jordan E.L., Verma P. S. (2022): Chordate Zoology. S. Chand and Company Limited.

Suggested Readings:

- Barrington, E.J.W. (2012) Invertebrate Structure and Functions. II Edition, EWP Publishers
- Ruppert, E.E., Fox, R.S., Barnes, R. D. (2003) Invertebrate Zoology: A Functional Evolutionary Approach. VII Edition, Cengage Learning, India
- Pechenik, J. A. (2015) Biology of the Invertebrates. VII Edition, McGraw-Hill Education
- Pough H. Vertebrate Life, VIII Edition, Pearson International

217
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**B.Sc. Semester I (2023-2024)
Practical-Zoology**

Min. Marks: 18

4Hrs/Week

Max. Marks: 50

I. Microscopic Techniques:

1. Organization and working of Optical Microscope: Dissecting and compound microscopes.
2. General methods of microscopic slide preparations: Narcotization; fixing and preservation; washing; staining; destaining; dehydration; clearing and mounting.
3. General idea of composition, preparation and use of:
 - (i) Fixatives: Formalin, Bouin's fluid.
 - (ii) Stains: Aceto-carmin, Aceto-orcin, Haematoxylin, Eosin.
 - (iii) Common reagents: Normal saline, Acid water, Acid alcohol and Mayer's albumin.

II. Study of Microscopic Slides and Museum Specimens:

Protozoa: *Euglena, Trypanosoma, Amoeba, Plasmodium, Paramecium, Vorticella.*

Porifera: *Leucosolenia, Euplectella, Spongilla,*

Coelenterata: *Physalia, Aurelia, Alcyonium, Sea anemone,*

Platyhelminthes : *Taenia, Planaria, Fasciola (WM), Miracidium, Sporocyst, Redia and Cercaria Larvae of Fasciola, Cysticercus larva.*

Aschelminthes : *Ascaris, Wuchereria.*

Annelida : *Neanthes (Nereis), Arenicola, Pheretima, Glossiphonia, Hirudo, Polygordius.*

Onychophora : *Peripatus*

Arthropoda : *Limulus, Spider, Scorpion, Centipede, Millipede, Lepas, Balanus, Eupagurus, Crab, Mantis, Pediculus, Bedbug, Termite, Cyclops, Daphnia, crustacean larvae (Nauplius, Metanauplius, Zoea, Mysis, Megalopa, Phyllosoma),*

Mollusca : *Chiton, Aplysia, Cypraea, Mytilus, Loligo, Nautilus. Glochidium larva*

Echinodermata : *Asterias, Echinus, Ophiothrix, Cucumaria, Antendon.*

Protochordates : *Balanoglossus, Hedmania, Amphioxus, Doliolum, Oikopleura.*

Agnatha : *Ammocoete larva, Petromyzon,*

Pisces : *Zygaena (Sphyrna), Torpedo, Chimaera; Acipenser, Clarias, Anguilla, Hippocampus, Exocoetus, Echeineis, any flat-fish, Protopterus.*

21-
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Amphibia : *Icthyophis Proteus, Ambystoma, Axolotl, Alytes, Hyla.*

Reptilia : *Chelone, and Fresh Water Tortoise, Sphenodon, Hemidactylus, Phrynosoma, Draco, Chameleon; Hydrophis, Naja, Viper, Crocodilus, Alligator.*

Aves : *Pavo cristatus, Choriotis.*

Mammals : *Ornithorhynchus, Kangaroo, Bat, Manis.*

III. Anatomy:

Earthworm: External features, general viscera, alimentary canal, reproductive system and nervous system.

Prawn/Squilla : External features, appendages, alimentary canal and nervous system; Hastate Plate

Pila : External features, pallial organs and nervous system; osphradium, radula.

IV. Study of the Following Through Permanent Slide Preparation: Foraminiferous shells, Sponge spicules, Spongin fibres, Gemmule, *Hydra, Obelia* colony and Parapodium of *Nereis*,

V. Study of local fauna such as insects, molluscs, fishes, amphibians, reptiles, birds, mammals, etc., and prepare a report on it.

21-
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B.Sc. Part – I

Semester I

Scheme of Practical Examination and Distribution of Marks

Time: 4 Hrs. Min Pass Marks: 18 Max. Marks: 50

	Regular	Ex. /N.C. Students
1. Anatomy (any system)	8	10
2. Permanent Preparation	7	10
3. Identification and comments on Spots (1 to 10)	25	20
4. Viva Voce	5	10
5. Class Record	5	-
	50	50

Notes:

1. Anatomy: Study of systems of the prescribed types with the help of dissection.
2. With reference to microscopic slides, in case of non-availability, the exercise should be **substituted with diagrams/photographs.**
3. Candidates must keep a record of all work done in the practical class and submit the same for inspection at the time of the practical examination.
4. The candidates may be asked to write detailed methodology wherever necessary, and separate marks may be allocated for the same.
5. Mounting material for permanent preparations would be as per the syllabus or as available through collection and culture methods.
6. **It should be ensured that animals used in the practical exercises are not covered under the Wildlife Act 1972 and amendments made subsequently.**


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Syllabus: B.Sc. Semester II Zoology

(2023-2024)

II Semester, Total Credits= 6 (1 Theory= 4 credits; 1 Practical= 2 credits)

Paper I	: 3 Hrs duration	100
Practical	: 4 Hrs. duration	50

PAPER I 4 Credits 60 hours

Comparative Anatomy and Developmental Biology of Vertebrates

Course Learning Objective: The course offers a complete understanding of the anatomy of vertebrate animals. It educates the students regarding derivatives of integuments, skeletal system and visceral arches, anatomy of the digestive system and associated glands, different respiratory organs, urinogenital organs, components of the nervous system and receptors in vertebrates. Thorough understanding of essential and evolutionary aspects of comparative anatomy will be developed through pictorial presentation of different anatomical details. The course will also provide a glimpse of the scope and historical background of developmental biology to the students, impart knowledge regarding basic concepts of differentiation, morphogenesis and pattern formation and insight into IVF, stem cells and cloning. Detailed understanding of essential events of developmental biology will be imparted through proper explanation of gametogenesis and stages of embryonic development and foetal formation.

Course Learning Outcome: Upon completion of this course, students should be able to:

- Know about the levels of organisation among different groups of vertebrates.
- Understand that different organs and organ systems integrate with each other to impart proper regulation of a particular function.
- Understand how the various organs evolved during the course of evolution through succession.
- Know the evolution of different concepts in developmental biology.
- Be able to understand the process of gamete formation from stem cell population to mature ova and sperm.
- Be able to comprehend the sequence of steps leading to the formation of gametes and the development of embryos.
- Learn the mechanisms underpinning cellular diversity and specificity in animals.
- Study the methods and tools related to developmental biology, which help to understand different processes of embryogenesis.

21
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Section- A

- Unit 1: Integumentary System: Structure and function of integument, Derivatives of integument glands. 4hrs
- Unit 2: Skeletal System: Overview of skeleton; Brief account of jaw suspensorium and visceral arches. 4 hrs
- Unit 3: Digestive System: Brief account of alimentary canal and digestive glands. 3 hrs
- Unit 4: Respiratory System: Brief account of gills, lungs, air sacs and swim bladder. 4 hrs

Section – B

- Unit 1: Circulatory System: Evolution of heart and aortic arches. 3 hrs
- Unit 2: Urinogenital System: Succession of kidney, Evolution of urinogenital ducts. 4 hrs
- Unit 3: Nervous System: Comparative account of brain. 4hrs
- Unit 4: Sense Organs: Types of receptors, Visual receptors in man. 4 hrs

Section C

- Unit 1: Scope and History of Developmental Biology; Concepts of Epigenesis, Preformation, Specification, Determination, Differentiation, Morphogenesis, Embryonic induction. 5hrs
- Unit 2: Early Embryonic Development: Gametogenesis: Spermatogenesis and Oogenesis in mammals; parthenogenesis; Fertilization: External (amphibians), Internal (mammals), blocking mechanisms to Polyspermy. 5 hrs
- Unit 3: Types and Patterns of cleavage; Types of morphogenetic movements; Early development of frog (up to gastrula) and chick (up to 96 hrs); Fate maps, Fate of germ layers. 5hrs

Section – D

- Unit 1: Late Embryonic Development: Metamorphic events in life cycle of frog and its hormonal regulation. 5 hrs
- Unit 2: Extra embryonic membranes in chick; Formation, types and functions of placenta in mammals. 5hrs
- Unit 3: Applied Aspects of Developmental Biology: Stem cells, Cloning, Assisted Reproductive Techniques (ART). 5 hrs

Recommended Books:

- Weichert C.K and William Presch (1970). Elements of Chordate Anatomy. Tata McGraw Hills
- Hilderbrand, M and Gaslow G.E. Analysis of Vertebrate Structure. John Wiley and Sons
- Wolpert, L & Tickle, C (2011) Principles of Developmental Biology (4th edition). Oxford University Press, ISBN: 9780198792918
- Carlson, Bruce M (1996). Patten's Foundations of Embryology, McGraw Hill, Inc. ISBN: 9780070634275

21-
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Suggested Readings:

- Kent, G.C. and Carr R.K.(2000)Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-Hill Companies
- Kardong, K.V.(2005) Vertebrates' Comparative Anatomy, Function and Evolution. IV Edition. McGraw-Hill Higher Education 29
- Gilbert, SF (2014) Developmental Biology. X Edition. Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.ISBN: 9780878939787
- Balinsky, B.I. (2008). An Introduction to Embryology. International Thomson Computer Press.

Pandit Deendayal Upadhyay Shekhawati University Sikar.**B.Sc. Semester II (2023-2024)****Practical-Zoology****Min. Marks: 18****4 Hrs/Week****Max. Marks:50****1. Osteology:** a) Skull, Atlas and Axis of Frog, Varanus, Fowl and Rabbit

- b) 8th vertebrae of Frog, typical thoracic, Ist and IInd sacral and caudal vertebrae, of Varanus, fused thoracic and Synsacrum of Fowl, typical cervical vertebrae, anterior thoracic vertebrae, anterior lumber vertebrae and Sacrum of Rabbit.
- c) Pectoral and Pelvic girdle, Humerus and Femur, Radius-Ulna and Tibia-Fibula of Varanus, Fowl and Rabbit.

II. Anatomy:

Any edible fish (*Wallago, Labeo*): External features, general viscera, afferent and efferent branchial blood vessels, eye muscles and their innervations, brain, cranial nerves and internal ear.

III. Study of the following through Permanent Slide preparations:

Striped muscle fibres: Smooth muscle fibres, scales of edible fish, feathers of birds, hair of different animals, blood film of any vertebrate.

IV. Exercises in Developmental Biology

1. **Frog** - Study of developmental stages - whole mounts and sections through permanent slides – cleavage stages, blastula, gastrula, neurula, tailbud stage, tadpole external and internal gill stages.
2. **Study of Chick Embryo:** 18 hrs, 21 hrs, 24 hrs, 33 hrs, 48 hrs, 72 hrs and 96 hrs of incubation.
 - (i) Study of the embryo at various stages of incubation *in vivo* by making a window in the egg-shell may also be demonstrated.

21-
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B.Sc. Part – I

Semester II

Scheme of Practical Examination and Distribution of Marks

Time: 4 Hrs. Min Pass Marks: 18 Max. Marks: 50

	Regular	Ex. /N.C. Students
1 Anatomy (any system)	6	10
2 Permanent Preparation	4	10
3 Developmental Biology	5	6
4 Identification and comments on Spots (1 to 10)	25	14
5 Viva Voce	5	10
6. Class Record	5	-
	50	50

Notes:

1. Anatomy: Study of systems of the prescribed types with the help of dissection.
2. With reference to microscopic slides, in case of non-availability, the exercise should be **substituted with diagrams/photographs.**
3. Candidates must keep a record of all work done in the practical class and submit the same for inspection at the time of the practical examination.
4. The candidates may be asked to write detailed methodology wherever necessary, and separate marks may be allocated for the same.
5. Mounting material for permanent preparations would be as per the syllabus or as available through collection and culture methods.
6. **It should be ensured that animals used in the practical exercises are not covered under the wild life act 1972 and amendments made subsequently.**

21
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