



# University of Rajasthan Jaipur

## SYLLABUS

(Three/Four Year Under Graduate Programme)

**B.Sc. - Zoology**

**I & II Semester**

**Examination-2023-24**

*Rj/Tain*  
By Registrar (Acad.)  
University of Rajasthan

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Honours

University of Rajasthan

UG0812 Four- Year Bachelor of Science (B.Sc.)-(Zoology)

Subject/Discipline-Zoology

Syllabus: B.Sc. Semester I

(2023-2024)

ZOO-51T-101	: 3 Hrs duration : 20+80 Marks	: 8+32 Marks
ZOO-51T-102	: 3 Hrs duration : 20+80 Marks	: 8+32 Marks
ZOO- 51P-103	: 4 Hrs. duration : 10+40 Marks	: 4+16 Marks
ZOO-51P-104	: 4 Hrs. duration : 10+40 Marks	: 4+16 Marks

Code of the Course	Title of the Course	Level of the Course	Credits of the Course
ZOO- 51T-101	Lower Invertebrates	5	4
ZOO-51T-102	Higher Invertebrates	5	4
Type of Course		Delivery Type of the Course	
Major		Lectures: 60+60 (120) lectures including diagnostic and informative assessments during lecture hours	
Prerequisites	Biology courses of Central Board of Secondary Education or equivalent		
Objectives of the Course	The main purpose of introducing this course is to teach the students the Morpho-taxonomy, and evolutionary relationships among and between lower and higher invertebrates along with creating awareness and concern towards importance of animal diversity for human survival and its socioeconomic significance. In addition to this, the course is aimed at nurturing skills of conducting scientific inquiry and experimentation in the field of animal diversity to acquire knowledge of fundamental concepts and theories of animal diversity.		

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2024

## Syllabus

### ZOO- 51T-101: LOWER INVERTEBRATES

#### Section – A

15 Hrs

1. General principles of taxonomy, concept of five kingdom schemes, international code of nomenclature.
2. Concept of Protozoa and Metazoa, and levels of organization.
3. Basis of classification of non-chordata: symmetry, coelom, segmentation and embryogeny.
4. Detailed classification of lower invertebrates (up to Annelida; up to suborders with examples).

#### Section – B

15 Hrs

Habitat, Habit, Morphology, Structure and Life Cycle of:

1. Protozoa : *Amoeba*, *Paramecium*, *Euglena*, *Plasmodium*, and *Leishmania*.
2. Porifera : *Sycon* and *Leucosolenia*.
3. Coelentrata: *Obelia* and *Aurelia*.

#### Section –C

15 Hrs

Habitat, Habit, Morphology, Structure and Life Cycle of

1. Ctenophore : *Beroe*
2. Platyhelminthes ; *Fasciola hepatica* and *Taenia solium*.
3. Aschelminthes : *Ascaris*, *Dracunculus* and *Wuchereria*.
4. Annelida : *Neanthes (Nereis)* and Leech.

#### Section –D

15 Hrs

1. Economic importance of Protozoa
2. Evolution of canal system of sponges.
3. Corals and Coral reefs
4. Polymorphism in coelenterate
5. Parasitic adaptations in Helminthes

### ZOO-51T-102: HIGHER INVERTEBRATES

#### Section – A

15 Hrs

1. Detailed classification of higher invertebrates (up to suborders with examples).
2. Habitat, Habit, Morphology, Structure and Life Cycle of:
  - a) Arthropoda: *Palaemon* (Indian Fresh Water Prawn), Scorpion, *Periplaneta* and Grasshopper.
  - b) Onychophora : *Peripatus*.

#### Section – B

15 Hrs

1. Habitat, Habit, Morphology, Structure and Life Cycle of:
  - a) Mollusca: *Pila, Unio, Sepia*
  - b) Echinodermata: *Asterias, Echinus, Cucumaria*.

**Section – C**

**15 Hrs**

1. Social organization in termites and honey bees.
2. Direct and indirect development in insects.
3. Mouth parts of insects.
4. Parasitism in Crustacea.
5. Larval forms in Crustacea

**Section – D**

**15 Hrs**

1. Torsion and detorsion in Gastropoda
2. Larval forms in Mollusca
3. Water Vascular system of Starfish
4. Balanglossus and its phylogenetic significance
5. Salient features of Hemichordata

**Recommended Books:**

1. Barnes, R.D. (2006) Invertebrate Zoology. VII Edition, Cengage Learning, India.
2. 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
3. Jordan E.L., Verma P. S.(2022): Invertebrate Zoology. S. Chand and Company

**Suggested Readings**

1. Kachhwaha, N and Kaushik, P (2019): Freely online available gaming website- innovativezoology.com to study vertebrate and invertebrate classification.
2. Ruppert, E.E., Fox, R.S., Barnes, R. D. (2003) Invertebrate Zoology: A Functional Evolutionary Approach. VII Edition, Cengage Learning, India
3. Pechenik, J. A. (2015) Biology of the Invertebrates. VII Edition, McGraw-Hill Education
4. Barrington, E.J.W. (2012) Invertebrate Structure and Functions. II Edition, EWP Publishers

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

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

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**B.Sc. Semester I (2023-2024)**  
**Practical-Zoology I (ZOO- 51P-103)**

ZOO- 51P-103 : 4 Hrs. duration : 10+40 Marks : 4+16 Marks

**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.
4. Collection and Culture Methods:
  - (i) Collection of animals from their natural habitat during field trips such as *Amoeba*, *Paramecium*, *Euglena*, *Daphnia*, *Cyclops*, etc.
  - (ii) Culture of *Paramecium* in the laboratory and study of its structure, life – processes and behavior in live state.

**II. Study of Microscopic Slides and Museum Specimens:**

**Protozoa:** *Amoeba*, *Euglena*, *Elphidium* (*Polystomella*), *Plasmodium*, *Paramecium*, *Leishmania*, *Paramecium* showing binary fission and conjugation, *Balantidium*, *Vorticella*.

**Porifera:** *Leucosolenia*, *Euplectella*, *Spongilla*, T. S. Sycon, Gemmules.

**Coelenterata:** *Millepora*, *Physalia*, *Aurelia*, *Alcyonium*, *Gorgonia*, *Pennatula*, Sea anemone, *Obelia* colony and medusa.

**Ctenophora:** Any Ctenophore

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

**Aschelminthes** : *Ascaris*, *Wuchereria*, *Dracunculus*

**Annelida** : *Neries*, *Heteroneries*, *Arenicola*, *Aphrodite*, *Chaetopterus*, *Glossiphonia*, *Pontobdella*, *Polygordius*.

**III. Anatomy:**

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

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

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**B.Sc. Semester I (2023-2024)**  
**Practical-Zoology II (ZOO-51P-104)**

ZOO-51P-104 : 4 Hrs. duration : 10+40 Marks :4+16 Marks

**Onychophora** : *Peripatus*

**Arthropoda** : *Limulus*, Spider, Scorpion, Centipede, Millipede, *Lepas*, *Balanus*, *Eupagurus*, Crab, *Mantis*, Honey-bee, (queen, king, worker) Locust, Silkworm Moth, Beetle, White grub. *Pediculus*, Bedbug, Termite and its castes, *Cyclops*, *Daphnia*, crustacean larvae (Nauplius, Metanauplius, Zoea, Mysis, Megalopa, Phyllosoma),

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

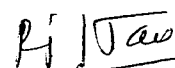
**Echinodermata** : *Pentaceros*, *Echinus*, *Ophiothrix*, *Cucumaria*, *Antendon*.

**Hemichordata** : *Balanoglossus*.

III. **Anatomy:**

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

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

  
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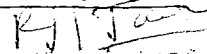
**Subject/Discipline-Zoology**

**Syllabus: B.Sc. Semester II**

(2023-2024)

ZOO-51T-201	: 3 Hrs duration : 20+80 Marks	: 8+32 Marks
ZOO-51T-202	: 3 Hrs duration : 20+80 Marks	:8+32 Marks
ZOO- 51P-203	: 4 Hrs. duration : 10+40 Marks	:4+16 Marks
ZOO-51P-204	: 4 Hrs. duration : 10+40 Marks	:4+16 Marks

Code of the Course	Title of the Course	Level of the Course	Credits of the Course
ZOO- 51T-201	Chordates	5	4
ZOO-51T-202	Comparative Anatomy and Developmental Biology of Vertebrates	5	4
<b>Type of Course</b>		<b>Delivery Type of the Course</b>	
Major		Lectures: 60+60 (120) lectures including diagnostic and informative assessments during lecture hours	
<b>Prerequisites</b>	B.Sc. Semester I Zoology		
<b>Objectives of the Course</b>	The main purpose of introducing this course is to teach the students the Morpho-taxonomy, and evolutionary relationships among and between different classes of chordates along with creating awareness and concern towards importance of animal diversity for human survival and its socioeconomic significance. The course also offers a complete understanding about anatomy of vertebrate animals. It educates the students regarding derivatives of integuments, skeletal system and visceral arches, anatomy of digestive system and associated glands, different respiratory organs, urinogenital organs, components of nervous system and receptors in vertebrates. Thorough understanding of essential and evolutionary aspects of		

  
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	comparative anatomy will be developed through pictorial presentation of different anatomical details. The course will also provide a glimpse of 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.
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## Syllabus

### ZOO-51T-201: CHORDATES

#### Section- A

15 Hrs

1. General Characteristics and detailed classification of Chordates (up to suborders with examples).
2. Habitat, Habit, Morphology and Anatomy of *Herdmania* and *Amphioxus* (Excluding development).
3. Ascidian tadpole larva and its metamorphosis.
4. Affinities of Hemichordata, Urochordata and Cephalochordata
5. Habit, habitat and salient features of *Petromyzon*, Ammocoete larva.

#### Section – B

15 Hrs

Habitat, Habit, Morphology and Anatomy of:

- a) Pisces- Chondrichthyes- Scoliodon
- b) Pisces- Osteichthyes- Labeo
- c) Amphibian-Frog

#### Section C

15 Hrs

Habitat, Habit, Morphology and Anatomy of:



- a) Reptile-Varanus
- b) Aves-Pigeon
- c) Mammal- Rat

#### Section – D

15 Hrs

#### Chordate Adaptations

1. Pisces: Scales and fins, migration and parental care.
2. Amphibia: Neotany, Parental care.
3. Reptilia: Poisonous and non poisonous snakes, poison apparatus.
4. Aves: Flight adaptations, types of feather, bird migration.
5. Mammals: Adaptive radiation, dentition.

  
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**ZOO-51T-202: Comparative Anatomy and Developmental Biology of Vertebrates**

**Section- A**

**15 Hrs**

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

**Section – B**

**15 Hrs**

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

**Section C**

**15 Hrs**

- Unit 1: Scope and History of Developmental Biology; Concepts of Epigenesis, Preformation, Specification, Determination, Differentiation, Morphogenesis, Embryonic induction.  
Unit 2: Early Embryonic Development: Gametogenesis: Spermatogenesis and Oogenesis in mammals; parthenogenesis; Fertilization: External (amphibians), Internal (mammals), blocking mechanisms to Polyspermy.  
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.

**Section – D**

**15 Hrs**

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

**Recommended Books:**

1. Young, J. Z. (2004) The Life of Vertebrates. III Edition. Oxford university press.
2. Jordan E.L., Verma P. S.(2022): Chordate Zoology. S. Chand and Company Limited.

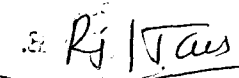
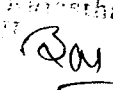
3. Kent, G.C. and Carr R.K.(2000): Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-Hill Companies
4. Kardong, K.V.(2005): Vertebrates' Comparative Anatomy, Function and Evolution. IV Edition. McGraw-Hill Higher Education 29
5. Gilbert, SF (2014): Developmental Biology. X Edition. Sinauer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

**Suggested Readings:**

1. Weichert C.K and William Presch (1970). Elements of Chordate Anatomy. Tata McGraw Hills
2. Hilderbrand, M and Gaslow G.E. Analysis of Vertebrate Structure. John Wiley and Sons
3. Wolpert, L & Tickle, C (2011) Principles of Developmental Biology (4th edition). Oxford University Press, ISBN: 9780198792918
4. Carlson, Bruce M (1996). Patten's Foundations of Embryology, McGraw Hill, Inc. ISBN: 9780
5. Pough H. Vertebrate Life, VIII Edition, Pearson International
6. Kachhwaha, N and Kaushik, P (2019): Freely online available gaming website- [innovativezoology.com](http://innovativezoology.com) to study vertebrate and invertebrate classification.

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

1. Learn Morpho-taxonomy and structural organization chordate groups.
2. Acquire knowledge of diversity of chordate groups.
3. Learn evolutionary relationships and phylogeny of chordates through functional and structural similarities.
4. Understand the economic importance of chordates and their significance in the ecosystem.
5. Know about the levels of organization among different groups of vertebrates.
6. Understand that different organs and organ systems integrate with each other to impart proper regulation of a particular function.
7. Understand how the various organs evolved during the course of evolution through succession.
8. Know the evolution of different concepts in developmental biology.
9. Be able to understand the process of gamete formation from stem cell population to mature ova and sperm.
10. Be able to comprehend the sequence of steps leading to the formation of gametes and development of embryo..
11. Study the methods and tools related to developmental biology which help to understand different processes of embryogenesis.

  
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**Practical I-Zoology (ZOO- 51P-203)**

ZOO- 51P-203 : 4 Hrs. duration : 10+40 Marks :4+16 Marks

- I. Study of Microscopic Slides: Whole mounts of oral hood, velum and pharyngeal wall of *Amphioxus*; T. S. of *Amphioxus* through various regions; tadpole larva of *Ascidia*; whole mounts of *Salpa*, *Doliolum* and *Oikopleura*.
- II. Study of Museum Specimens:  
Potochordata: *Ascidia*, *Ciona*, *Botryllus*.  
Agnatha: Ammocoete larva, *Petromyzon*, *Myxine* or *Bdellostoma*.  
Pisces: *Zygaena (Sphyrna)*, *Torpedo*, *Chimaera*; *Acipenser*, *Amia* or *Lepidosteus*, *Labeo*, *Clarias*, *Anguilla*, *Hippocampus*, *Exocoetus*, *Echeneis*, any flat-fish, Protopterus.  
Amphibia: *Ichthyophis* or any blind-worm, *Proteus*, *Ambystoma*, Axolotl, Siren, *Alytes*, *Hyla*.  
  
Reptilia: *Testudo*, *Chelone*, and Fresh Water Tortoise, *Sphenodon*,  
*Hemidactylus*, *Phrynosoma*, *Draco*, Chameleon; *Eryx*, *Hydrophis*,  
*Naja*, *Viper*, *Crocodilus*, *Alligator*,  
Aves: *Archaeopteryx*, any Running Bird, *Pavo cristatus*, *Choriotis*  
Mammals: *Ornithorhynchus*, *Tachyglossus*, *Didelphys*, *Macropus*, Bat, *Loris*, *Manis*
- III. Study of the following through Permanent Slide preparations:  
Striped muscle fibers; Smooth muscle fibers, scales of edible fish, feather of birds, hair of different animals, blood film of any vertebrate.

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**Practical II-Zoology (ZOO-51P-204)**

ZOO-51P-204 : 4 Hrs. duration : 10+40 Marks :4+16 Marks

I. Anatomy

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

II. Osteology: a) Disarticulated skeleton of Frog, Varanus, Fowl and Rabbit

b) Carapace and plastron of turtle/tortoise

c) Mammalian skulls: one herbivorous and one carnivorous animal.

### III. Exercises on Developmental Biology

1. Frog - Study of developmental stages - whole mounts and sections through permanent slides – cleavage stages, blastula, gastrula, neurula, tail bud 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.
  - (ii) Study of various fetal membranes in a 10-12 day old chick embryo.
3. Study of the different types of placenta- histological sections through permanent slides or photomicrograph.
4. Temporary/permanent mounts of sperm (rat)

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