

# University of Rajasthan Jaipur

## SYLLABUS

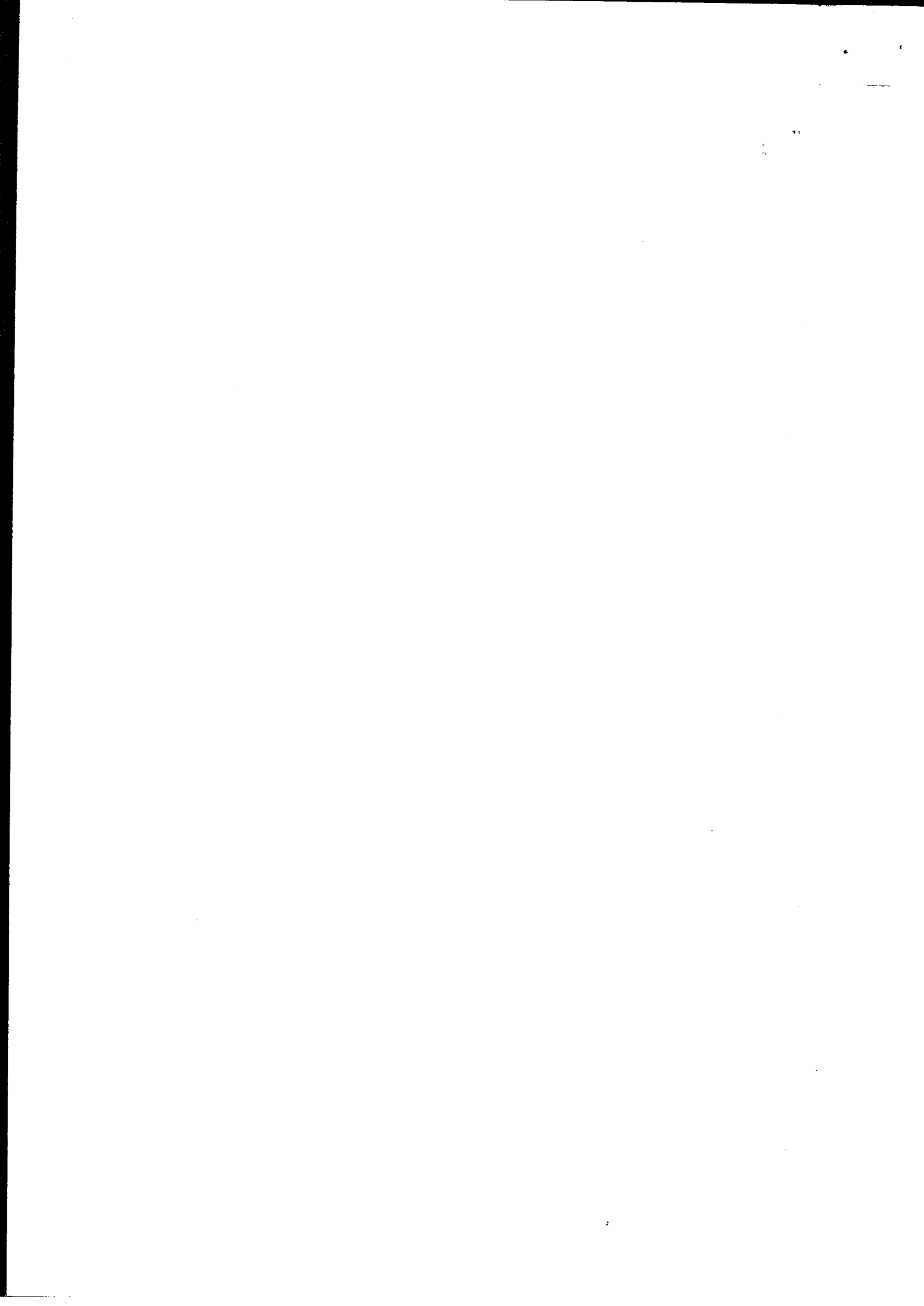
(Three/Four Year Under Graduate Programme in Science)

I & II Semester

Examination-2023-24

*P. S. Vas*  
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Pass course

**University of Rajasthan**

**UG0802 Four- Year Bachelor of Science (B.Sc.)**

**Subject/Discipline-Zoology**

**Syllabus: B.Sc. Semester I**

**(2023-2024)**

ZOO- 51T-101 : 3 Hrs duration 20+80 Marks 8+32 Marks  
ZOO- 51P-102 : 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	Animal Diversity	5	4
Type of Course		Delivery Type of the Course	
Major		Lectures: 60 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 non-chordates and chordates 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.		

**Syllabus**

**Animal Diversity**

**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

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- Unit 4: Helminthes: Platyhelminthes: General characteristics and Classification up to classes; Life cycle of *Taenia solium* and its parasitic adaptations.  
Nemathelminthes : General characteristics and Classification up to classes; Life cycle of *Ascaris lumbricoides* and its parasitic adaptations. 6 hrs

## 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

## Section –D

### HIGHER VERTEBRATES

- Unit 1: Amphibia: General characteristics and classification up to order; Neotany; 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. 4 hrs

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

**Suggested Readings:**

1. Barrington, E.J.W. (2012) Invertebrate Structure and Functions. II Edition, EWP Publishers
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. Pough H. Vertebrate Life, VIII Edition, Pearson International
5. 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 the course, students will be able to:

1. Learn Morpho-taxonomy and structural organization of non-chordate and chordate groups.
2. Acquire knowledge of diversity of non-chordate and chordate groups.
3. Learn evolutionary relationships and phylogeny of non-chordates and chordates through functional and structural similarities.
4. Understand the economic importance of non-chordates and 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 (ZOO- 51P-102)**

**ZOO- 51P-102**

**: 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.

## 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, Herdmania, Amphioxus, Doliolum, Oikopleura.*

**Agnatha** : *Petromyzon, Ammocoete larva.*

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

**Amphibia** : *Ichthyophis Proteus, Ambystoma, Axolotl, Alytes, Hyla.*

Reptilia : *Chelone*, and Fresh Water Tortoise, *Sphenodon*,  
*Hemidactylus*, *Phrynosoma*, *Draco*, *Chameleon*;  
*Hydrophis*, *Naja*, *Viper*, *Crocodylus*, *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, mollusks, fishes, amphibians, reptiles, birds mammals etc. and prepare a report on it.

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B.Sc. Semester I

Scheme of Practical Examination and Distribution of Marks

ZOO- 51P-102 : 4 Hrs. duration 10+40 Marks 4+16 Marks

	Regular	Ex. /N.C. Students
1. Anatomy (any system)	6	10
2. Permanent Preparation	4	10
3. Identification and comments on Spots (1 to 10)	20	20
4. Viva Voce	5	10
5. Class Record	5	-
	10+40=50	50

**Notes:**

**\*Internal marks for regular students only**

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.

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**UG0802 Four- Year Bachelor of Science (B.Sc.)**  
**Subject/Discipline-Zoology**  
**Syllabus: B.Sc. Semester II**  
**(2023-2024)**

ZOO- 51T-201 : 3 Hrs duration 20+80 Marks 8+32 Marks  
 ZOO- 51P-202 : 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	<b>Comparative Anatomy and Developmental Biology of Vertebrates</b>	5	4
<b>Type of Course</b>		<b>Delivery Type of the Course</b>	
<b>Major</b>		<b>Lectures: 60 lectures including diagnostic and informative assessments during lecture hours</b>	
<b>Prerequisites</b>	<b>B.Sc. Semester I: Animal diversity</b>		
<b>Objectives of the Course</b>	<p>The course 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 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. Detailed understanding of essential events of developmental biology will be imparted through proper explanation of gametogenesis, and stages of embryonic development and foetal formation.</p>		

## Syllabus

### Comparative Anatomy and Developmental Biology of Vertebrates

#### Section- A

- Unit 1: Integumentary System: Structure and function of integument, Derivatives of integument glands. 4 hrs
- 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. 4 hrs
- 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. 5 hrs
- 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. 5 hrs

#### 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. 5 hrs
- Unit 2: Applied Aspects of Developmental Biology: Stem cells, Cloning, Assisted Reproductive Techniques (ART). 5 hrs

#### Recommended Books:

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: 9780070634275

**Suggested Readings:**

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

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

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

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**B.Sc. Semester II (2023-2024)**

**Practical-Zoology (ZOO- 51P-202)**

**ZOO- 51P-202**

**: 4 Hrs. duration 10+40 Marks**

**4+16 Marks**

1. **Osteology:** a) Skull, Atlas and Axis vertebrae of Frog, Varanus, Fowl and Rabbit.  
b) 8th vertebrae of Frog, typical thoracic, 1st and 2nd sacral and caudal vertebrae of Varanus, fused thoracic and Synsacrum of Fowl, typical cervical vertebrae,

- anterior thoracic vertebrae, anterior lumbar 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, brain, cranial nerves.

**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.

**IV. 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.

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**B.Sc. Part – I**

**Semester II**

**Scheme of Practical Examination and Distribution of Marks**

ZOO- 51P-202

: 4 Hrs. duration 10+40 Marks

4+16 Marks

	Regular	Ex. /N.C. Students
6. Anatomy (any system)	6	10
7. Permanent Preparation	4	10
8. Developmental Biology	6	6
9. Identification and comments on Spots (1 to 7)	14	14
10. Viva Voce	5	10
11. Class Record	5	-
	<b>10+40=50</b>	<b>50</b>

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Notes:

**\* Internal marks for regular students only**

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.

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