



**BANGALORE UNIVERSITY**

**PROPOSED CURRICULUM IN ZOOLOGY FOR  
B.Sc. (UG)  
(I to VI SEMESTERS)**

**CBCS 2018-19 and Onwards**

**BANGALORE UNIVERSITY**

**PROPOSED CURRICULUM IN ZOOLOGY FOR B. Sc. (UG) 2018-19 Onwards****DEPARTMENT OF ZOOLOGY  
JNANABHARATHI CAMPUS, BANGALORE-56  
BANGALORE UNIVERSITY****THEORY**

Sem	Paper Code	Title of the paper	Total number Of hours	Hours /week	Marks	Internal Assessment*	Total Marks
I	Paper-I	Non Chordata-I	52	04	70	30	100
II	Paper-II	Non Chordata-II	52	04	70	30	100
III	Paper-III	Chordata	52	04	70	30	100
IV	Paper-IV	Comparative anatomy, Human anatomy, Cell Biology and Histology	52	04	70	30	100
V	Paper-V	Environmental Biology and Ethology	40	03	70	30	100
	Paper-VI	Genetics and Biotechnology	40	03	70	30	100
VI	Paper-VII	Developmental biology and Organic Evolution	40	03	70	30	100
	Paper-VIII	Animal Physiology and Techniques in Biology	40	03	70	30	100

Internal Assessment marks\*- 30

**PRACTICAL**

Sem	Paper Code	Title of the paper	Total number Of hours	Hours/ week	Marks	Internal Assessment*	Total Marks
I	Paper-I	Non Chordata-I	45	03	35	15	50
II	Paper-II	Non Chordata-II	45	03	35	15	50
III	Paper-III	Chordata	45	03	35	15	50
IV	Paper-IV	Comparative anatomy, Human anatomy, Cell biology and Histology	45	03	35	15	50
V	Paper-V	Environmental Biology and Ethology	45	03	35	15	50
	Paper-VI	Genetics and Biotechnology	45	03	35	15	50
VI	Paper-VII	Developmental biology and Organic Evolution	45	03	35	15	50
	Paper-VIII	Animal Physiology and Techniques in Biology	45	03	35	15	50

Internal Assessment marks\*- 15

## Zoology UG Credit System

### a) I/II/III/IV Semester B.Sc.

Subjects	Paper	Hours/week	Duration of Exam (hrs)	IA	Exam	Total	Credits
1 Optional papers with 1 practicals of 1 credit each	1 Theory	1 x 4	3	1 x 30	1 x 70	1 x 100	2
	1 Practical	1 x 3	3	1 x 15	1 x 35	1 x 50	1

### b) V/VI Semester B.Sc.

Subjects	Paper	Hours/week	Duration of Exam (hrs)	IA	Exam	Total	Credits
2 Optional papers with 2 practicals of 1 credit each	1 x 2 Theory	2 x 3	2 x 3	2 x 30	2 x 70	2 x 100	2 x 2 = 4 (2 + 2)
	2 Practical	2 x 3	2 x 3	2 x 15	2 x 35	2 x 50	2 x 1 = 2 (1 + 1)

Semester	Theory	Practical	Total Credits per Semester
I/II/III/IV Semester	2	1	3
V/VI Semester	4	2	6

**PROPOSED CURRICULUM IN ZOOLOGY FOR B.Sc.,(UG)  
CBCS 2018 – 19 ONWARDS**

**I SEMESTER  
PAPER – I: NON-CHORDATA: PART – I**

	<b>-52 hrs</b>
<b>Unit: I - Animal Architecture and Protozoa:</b>	<b>-13 hrs</b>
<b>a) Animal Architecture</b>	<b>-06 hrs</b>
(To be taught citing suitable examples and keeping in view the evolutionary trends and significance)	
1.1. <b>Body symmetry:</b> Definition and types – spherical, radial, biradial and bilateral symmetry	- 01 hr
1.2. <b>Body organisation:</b> Hierarchical organisation of animal complexity – protoplasmic level, cellular level, tissue level and organ level of organisation.	- 01 hr
1.3. <b>Germ layers:</b> Definition, types - diploblastic condition (apparent and absolute) and triploblastic condition.	- 01 hr
1.4. <b>Body coelom:</b> Definition, origin and types – acoelom, pseudocoelom, eucoelom (enterocoelom and schizocoelom).	- 01 hr
1.5. <b>Metamerism:</b> Definition and types – pseudometamerism, true metamerism - homonomous and heteronomous.	- 02 hrs
<b>b) Protozoa: The Animal-like Protista</b>	<b>-07 hrs</b>
1.6. General characters of the phylum up to classes with examples.	- 01 hr
1.7. <b>Nutrition:</b> Holozoic, holophytic, saprozoic, mixotrophic and parasitic with an example for each.	- 02 hrs
1.8. <b>Locomotion:</b> Locomotory organelle – Pseudopodia, cilia and flagella. Modes of locomotion – Amoeboid movement (walking movement and sol-gel theory), flagellar and euglenoid movement, ciliary movement (Paddle stroke theory).	- 03 hrs
1.9. <b>Reproduction:</b> Conjugation in <i>Paramecium caudatum</i> , significance of conjugation.	- 01 hr
<b>Unit: II – Porifera, Coelenterata and Ctenophora</b>	<b>- 14 hrs</b>
<b>a) Porifera: The Sponges – Nature’s dead end</b>	<b>- 06 hrs</b>
2.1. General characters of the phylum up to classes with examples.	- 01 hr
2.2. <b>Sycon:</b> Morphology, microscopic structure of body wall and sexual reproduction.	- 03 hrs
2.3. <b>Canal System and its evolution:</b> Asconoid, syconoid, leuconoid and rhagonoid types.	- 02 hrs
<b>b) Coelenterata and Ctenophora: The Radiate Animals</b>	<b>- 08 hrs</b>
2.4. General characters of the phylum Coelenterata up to classes with examples.	- 01 hr
2.5. <b>Aurelia:</b> Morphology, reproduction and life cycle	- 03 hrs
2.6. <b>Polymorphism:</b> Definition and significance. Example: <i>Halistema</i> .	- 01 hr
2.7. <b>Coral reefs:</b> Definition, types and theories of coral reef formation	- 01 hr
2.8. <b>Ctenophores:</b> General organisation and affinities.	- 02 hrs

### Unit: III – Helminthes and Annelida

<b>a) Helminthes</b>	<b>10 hrs</b>
	<b>- 05 hrs</b>
3.1. General characters of the phylum Platyhelminthes up to classes with examples.	- 01 hr
3.2. <b>Planaria:</b> Externals, digestive system, excretory system and nervous system.	- 03 hrs
3.3. General characters of the phylum Nematoda with examples.	- 01 hr
<b>b) Annelida</b>	<b>- 05 hrs</b>
3.4. General characters of the phylum up to classes with examples	- 01 hr
3.5. <b>Earth worm (<i>Pheretima</i>)</b> - Morphology, digestive system, excretory system, reproductive system and development.	- 04 hrs

### Unit: IV – Parasitology and Economic Importance of Annelids **-15 hrs**

<b>a) Parasitology:</b>	<b>-13 hrs</b>
4.1. i) Definition of parasitism and types with examples	- 01 hr
ii) Occurrence, disease caused, mode of transmission, life cycle and preventive measures of the following: <i>Entamoeba histolytica, Leishmania donovani, Fasciola hepatica, Taenia solium, Ascaris lumbricoides</i> and <i>Wuchereria bancrofti</i> .	- 10 hrs
iii) <b>Parasitic adaptations</b> - Flat worms and leech	- 02hrs
<b>b) Economic Importance of Annelida</b>	<b>- 02 hrs</b>
4.2. Leech - Economic Importance Earthworm - Vermiculture and Vermicompost	

### REFERENCES:

1. R.L.Kotpal. 1998. Volumes Protozoa to Echinodermata, Rastogi Publications.
2. E.L. Jordan and P.S. Verma. 2002. Invertebrate Zoology, S. Chand and Company limited.
3. P.S. Dhama and J.K Dhama. 1994. Invertebrate Zoology, R. Chand and Company limited.
4. A manual of Zoology by Ekambarnath and Vishwanathan (1971).
5. S.N. Prasad. Invertebrate Zoology(1995).
6. Parker and Haswel. Invertebrate Zoology(1995).
7. Marshall, A.J. and Williams, W.D. (Eds.). 1995. Text book of Zoology – Invertebrate VII Ed., Vol. I, A.I.T. B.S. Publishers.
8. Hymann, L.H. 1940-67. The Invertebrate, Vol. I-IV. Mc Graw- Hill, New York.
9. Barrington, E.J.W.1967. Invertebrate structure and function. Nelson, London.

10. Economic Zoology by Shukla and Upadayana(2016).  
 11. Economic Zoology by Reena and Mattur(2006)

## I SEMESTER B.Sc., ZOOLOGY PRACTICAL

### NON-CHORDATA: PART – I

**15 Units**

- |            |  |          |
|------------|--|----------|
| <b>1.</b>  | <b>Use of microscopes</b> – Simple, Compound, Oil immersion and 01 Unit Stereozoom   |          |
| <b>02.</b> | Preparation and observation of plankton culture (also Protozoans).   | 01 Unit  |
| <b>03.</b> | <b>Protozoa:</b> Study of permanent slides of <i>Amoeba</i> , <i>Euglena</i> , <i>Noctiluca</i> , <i>Paramecium</i> , <i>Vorticella</i> and <i>Radiolarian</i> - <i>Foraminiferon ooze (Elphidium)</i> | 01 Unit  |
| <b>4.</b>  | <b>Porifera:</b> <i>Sycon</i> , <i>Euplectella</i> , <i>Hyalonema</i> , <i>Spongilla</i> and <i>Euspongia</i> . Permanent slides of T.S. of <i>Sycon</i> , spicules and gemmule.                       | 01 Unit  |
| <b>05.</b> | <b>Coelenterata:</b> Hydra, T.S. of <i>Hydra</i> , <i>Obelia</i> colony, <i>Obelia</i> medusa, <i>Physalia</i> , <i>Aurelia</i> and <i>Ephyra</i> larva.   | 01 Unit  |
| <b>06.</b> | <b>Coelenterata and Ctenophora:</b> Corals– <i>Fungia</i> , <i>Corallium</i> , <i>Meandrina</i> , <i>Gorgonia</i> and <i>Pennatula</i> , Ctenophora – <i>Pleurobrachia</i> W.M.                        | 01 Unit  |
| <b>07.</b> | <b>Helminthes:</b> <i>Planaria</i> , <i>Liver fluke</i> and <i>Tape worm</i> . <i>Ascaris</i> – Male, female and T.S of male and female <i>Ascaris</i> .   | 01 Unit  |
| <b>08.</b> | <b>Annelida:</b> Types of Earthworm species, T.S of earthworm, <i>Nereis</i> and <i>Heteronereis</i> , T.S of parapodium.  | 01 Unit  |
| <b>09.</b> | <b>Observation of systems/ organs in earthworm</b> – Nervous system, ovary and setae (Use of permanent slides, models or photographs).   | 02 Units |
| <b>10.</b> | <b>Observation of systems/ organs in leech</b> – Digestive system, jaw and testicular nephridium (Use of permanent slides, models or photographs).   | 02 Units |
| <b>11.</b> | <b>Parasitology:</b> Permanent slides of <i>Entamoeba</i> , <i>Leishmania</i> , life history stages of liver fluke (Miracidium, Redia, and Cercaria) and tape worm (Bladder worm).                     | 03 Units |

**SCHEME OF PRACTICAL EXAMINATION  
I SEMESTER B.Sc ZOOLOGY; NON-CHORDATA – I**

**Duration: 3 hrs.**

**Max. Marks: 35**

01	<b>Systematics:</b> Identify, classify and comment on A to E with labelled diagrams	20marks
02	<b>Project Report:</b> Economic Zoology/ Parasitology*	05 marks
03	<b>Observation of systems/organs:</b> Identify and describe the given system or organ 'F' with a neat labelled diagram. <b>Or</b> Mount and stain the plankton (or protozoan) culture given, identify and comment on any one specimen.	05 marks
04	<b>Class Records</b>	05 marks
	Total	35 marks
<p><b>Note: Project topics - Economic Zoology:</b> Corals and Coral reefs, Parasitic adaptations and economic importance of Leech, Vermiculture and vermicomposting.</p> <p><b>Parasitology:</b> <i>Entamoeba histolitica, Leishmania donovani, Taenia solium, Fasciola hepatica, Ascaris lumbricoides, Wuchereria bancrofti</i></p>		

**II SEMESTER B.SC ZOOLOGY**  
**PAPER – II: NON-CHORDATA: PART – II** **52 hrs**

**UNIT: I – ARTHROPODA** **17hrs**

- |             |   |        |
|-------------|---|--------|
| <b>1.1.</b> | General characters of the phylum and classification upto classes with suitable examples   | 02 hrs |
| <b>1.2.</b> | <b>Peripatus</b> - Systematic position, unique features, affinities with Annelida and Arthropoda.   | 02 hrs |
| <b>1.3.</b> | <b>Prawn</b> ( <i>Palaeomon</i> ) - Morphology, structure of a typical appendage, structure and function of appendages, concept of serial homology, circulatory system, reproductive system and life cycle. | 08 hrs |
| <b>1.4.</b> | <b>Respiratory organs</b> – Gills, book gills, trachea and book lungs.  | 02 hrs |
| <b>1.5.</b> | <b>Sense organs</b> – Simple eye and compound eye.  | 01 hrs |
| <b>1.6.</b> | <b>Metamorphosis</b> – Definition and types with suitable examples.   | 02 hrs |

**10 hrs**

**UNIT: II - MOLLUSCA**

- |             |   |        |
|-------------|---|--------|
| <b>2.1.</b> | General characters of the phylum and classification upto classes with suitable examples   | 02 hrs |
| <b>2.2.</b> | <b>Unio</b> : Morphology, structure of shell (sectional view), digestive system, circulatory system, respiratory system, reproduction and life cycle. | 08 hrs |

**14hrs**

**UNIT: III – ECHINODERMATA AND HEMICHORDATA**

- |             |   |               |
|-------------|---|---------------|
| <b>A</b>    | <b>Echinodermata</b>  | <b>10 hrs</b> |
| <b>3.1.</b> | General characters of the phylum and classification upto classes with suitable examples.                                  | 02 hrs        |
| <b>3.2.</b> | <b>Sea Star</b> ( <i>Asterias</i> ) – Morphology, digestive system, water vascular system, reproduction and life history. | 06 hrs        |
| <b>3.3.</b> | <b>Echinoderm larvae</b> : Structure and significance of: Bipinnaria, Ophiopluteus, Echinopluteus and Auricularia.        | 02 hrs        |
| <b>B</b>    | <b>Hemichordata</b>   | <b>04 hrs</b> |
| <b>3.5.</b> | <b>Balanoglossus</b> – Morphology, coelom, and Tornaria larva.  | 03 hrs        |
| <b>3.6.</b> | Affinities and systematic position of Hemichordata.   | 01 hrs        |

**11 hrs**

**UNIT: IV - ECONOMIC ZOOLOGY - II**

- |             |   |        |
|-------------|---|--------|
| <b>4.1.</b> | <b>Sericulture</b> : Species of silk worm, rearing and management practices, pests of silkworm, by-products of sericulture. | 04 hrs |
| <b>4.2.</b> | <b>Apiculture</b> : Species of honeybee, bee keeping and management practices, bee products, pests of honey bees.           | 03 hrs |
| <b>4.3.</b> | <b>Prawn Fisheries</b> : Types of prawn fishery, prawn culture and farming, preservation and processing of prawn.           | 03 hrs |
| <b>4.4</b>  | <b>Pearl culture.</b>   | 01 hr  |

*Note: field visit recommended for all topics of economic zoology*



## REFERENCES:

1. R.L.Kotpal. 1998. Volumes Protozoa to Echinodermata, Rastogi Publications.
2. E.L. Jordan and P.S. Verma. 2002. Invertebrate Zoology, S. Chand and Company limited.
3. P.S. Dhama and J.K Dhama. 1994. Invertebrate Zoology, R. Chand and Company limited.
4. A manual of Zoology by Ekambarnath and Vishwanathan(1971).
5. S.N. Prasad. Invertebrate Zoology(1995).
6. Parker and Haswel. Invertebrate Zoology(1995).
7. Marshall, A.J. and Williams, W.D. (Eds.). 1995. Text book of Zoology – Invertebrate VII Ed., Vol. I, A.I.T. B.S. Publishers.
8. Hymann, L.H. 1940-67. The Invertebrate, Vol. I-IV. Mc Graw- Hill, New York.
9. Barrington, E.J.W.1967. Invertebrate structure and function. Neelson, London.
10. Economic Zoology by Shukla and Upadayana(2016).
11. Economic Zoology by Reena and Mattur(2006).

## II SEMESTER B.Sc., ZOOLOGY PRACTICAL PAPER – II : NON-CHORDATA: PART – II

	15 Units
<b>01. Arthropoda:</b> <i>Penaeus, Palaeomon</i> , lobster and crayfish. Crustacean larvae - Nauplius, Zoea, Mysis	01 Unit
<b>02. Arthropoda:</b> <i>Scorpion, spider, Limulus, Peripatus, Millipede &amp; Centipede.</i>	01 Unit
<b>03. Arthropoda:</b> Honey bee – Queen, drone and worker.	01 Unit
<b>04. Mounting:</b> Mounting of pollen basket and sting in Honey Bee.	01 Unit
<b>05. Silk worm:</b> Life history of <i>Bombyx mori</i> .	01 Unit
<b>06. Observation of systems or organs in Cockroach</b> (Use of permanent slides, models or photographs): a. Mouth parts, b. Salivary apparatus, c. Nervous System.	03Units
<b>07. Mollusca:</b> <i>Mytilus, Chiton, Aplysia, Octopus, Sepia</i> and Glochidium larva.	01 Unit
<b>08. Mollusca:</b> Shell pattern: <i>Unio, Pila, Ostrea, Cypraea, Murex, Nautilus and Dentalium</i>	01 Unit
<b>09. Observation of systems or organs in Unio</b> (Use of permanent slides, models or photographs): a. Digestive system, b. Pedal ganglion	02 Units
<b>10. Echinodermata:</b> <i>Asterias, Ophiothrix, Echinus, Cucumaria</i> and <i>Antedon</i> . Bipinnaria and Echinopluteus larva.	02Units
<b>11. Hemichordata:</b> <i>Balanoglossus</i> – Specimen, T.S through proboscis, Tornaria larva	01Unit

**SCHEME OF PRACTICAL EXAMINATION  
II SEMESTER B.Sc. ZOOLOGY  
NON-CHORDATA : PRACTICAL – II**

**Duration: 3 hrs.**

**Max. Marks: 35**

01	<b>Systematics:</b> Identify, classify and comment on A to E with labelled diagrams	20 marks
02	<b>Project Report:</b> Economic Zoology*	05 marks
03	<b>Mounting:</b> Honey bee – Mounting of pollen basket and sting apparatus or <b>Observation of systems/organs:</b> Identify and describe the given system or organ 'F' with a neat labelled diagram.	05 marks
04	<b>Class Records</b>	05 marks
	Total	35 marks
<p><b>Note: Project Topics</b>  <b>Economic Zoology-II:</b> Sericulture, Apiculture, Prawn fisheries, Pearl culture, Mytilus culture, Oyster culture</p>		

**III SEMESTER B.Sc ZOOLOGY  
PAPER - III: CHORDATA**

<b>UNIT: I</b>	<b>52 hrs</b>
<b>PROTOCHORDATA</b>	<b>12 hrs</b>
<b>1.1.</b> Basic Chordate characters and outline classification upto classes.	7 hrs
<b>1.2</b> <b>Urochordata:</b> Herdmania – Morphology, tadpole of Herdmania and retrogressive metamorphosis.	1 hr
<b>1.3.</b> <b>Cephalochordata:</b> Amphioxus – Morphology, feeding and circulatory system.	4 hrs
<b>AGNATHA – THE JAWLESS VERTEBRATES</b>	<b>2 hrs</b>
<b>1.4.</b> General characters of Agnatha	2 hrs
<b>1.5.</b> Ammocoete larva and its significance.	1 hr
<b>PISCES</b>	<b>3 hrs</b>
<b>1.6.</b> General characters and classification upto subclasses - Chondrichthyes and Osteichthyes	1 hr
<b>1.7.</b> <b>Dipnoi:</b> Interesting features and their evolutionary significance.	1 hr
<b>1.8.</b> <b>Migration in fishes:</b> Catadromous and anadromus	1 hr
<b>UNIT: II</b>	<b>19 hrs</b>
<b>AMPHIBIA</b>	<b>5 hrs</b>
<b>2.1.</b> General characters and classification of living Amphibians upto orders, with suitable examples	2 hrs
<b>2.2.</b> <b>Origin of Amphibia:</b> Transition from water to land.	1hr
<b>2.3.</b> <b>Frog Osteology:</b> Skull, lower Jaw, vertebral column, pectoral and pelvic girdles, limb bones(except bones of hand and foot)	2 hrs
<b>REPTILIA</b>	<b>7 hrs</b>
<b>2.4.</b> General characters and outline classification of modern reptiles with suitable examples	2 hrs
<b>2.5.</b> Adaptive radiation in extinct reptiles with suitable examples	2 hrs
<b>2.6.</b> Temporal fossae in reptiles	2 hrs
<b>2.7.</b> Interesting features of Sphenodon.	1 hr
<b>AVES</b>	<b>7 hrs</b>
<b>2.7.</b> General characters, differences between Ratitae and Carinatae.	2 hrs
<b>2.8.</b> Interesting features of Archaeopteryx.	1 hr
<b>2.9.</b> Flight adaptations in birds	2hrs
<b>3.0.</b> Migration in birds	2 hrs
<b>UNIT: III</b>	<b>11 hrs</b>
<b>MAMMALIA</b>	
<b>3.1.</b> General characters and classification upto subclasses (Prototheria, Metatheria and Eutheria) with suitable examples.	2 hrs
<b>3.2.</b> <b>Type study: Rat-</b> Morphology, digestive system, circulatory system (arterial and venous), brain and cranial nerves, urinogenital system (male and female).	9 hrs

**UNIT: IV**  
**ECONOMIC ZOOLOGY-III**

**10hrs**

**4.1. Pisciculture:**

3 hrs

- a. Definition of Aquaculture and Pisciculture, inland and marine fisheries, inland Pisciculture - Procedure, composite fish forming and significance.
- b. Fish processing and preservation.

**4.2. Poultry:**

4 hrs

- a. Definition, Breeds of Fowls – indigenous and exotic breeds (birds of American class, birds of English class, and birds of Mediterranean class).
- b. Diseases of poultry birds: Ranikhet, Fowl Pox, Fowl Cholera and Fowl Typhoid.
- c. Poultry products and bi-products.

**4.3. Dairy:**

3 hrs

- a. Breeds of cattle: Indigenous and Exotic breeds
- b. Improvements in cattle breeding – Artificial insemination, MOET.
- c. Milk and its bi-products, Pasteurization and Gobar gas.

(For all topics of Economic zoology, field visit is recommended)

**REFERENCES:**

1. Sedgwick Volumes(2010)
2. Parker and Haswel Vol. II(1995)
3. Kotpal Volume- Vertebrates(2016)
4. A manual of Zoology by Ekambarnath and Vishwanathan(1971)
5. Economic Zoology by Shukla and Upadayana(2016)
6. Economic Zoology by Reena and Mattur(2006)
7. Protochordata by Bhatia(1972)
8. Ascidiand by Kurian and Sebastian(1981)
9. Comparative Anatomy by Romer(1977)
10. Comparative Anatomy by Eten and Kent(1954)
11. Vertebrate by Young.(1962)

**III SEMESTER B.Sc., ZOOLOGY PRACTICAL**  
**CHORDATA: PAPER-III**

**15 Units**

01. a. **Protochordata:** *Herdmania* and *Amphioxus*, T.S. of *Amphioxus* through pharynx and intestine.

01 Unit

- b. **Cyclostoma:** *Petromyzon*, *Ammocoete larva* and *Myxine*.

02. **Pisces:**

03 Units

- a. Cartilaginous Fishes: *Narcine*, *Trygon*, *Pristis*, *Myolobatis* (any two)

- b. Bony Fishes: *Hippocampus*, *Muraena*, *Ostracion*, *Tetradon*, *Pleuronectus*, *Diodon*, *Echeneis* and *Angler fish* (any three).

- c. Accessory respiratory organs: *Saccobranthus*, *Clarias* and *Anabas*
03. **Amphibia:** 03 Units  
 a. *Bufo*, *Ambystoma*, *Axolotl* larva, *Necturus* and *Ichthyophis*.  
 b. **Endoskeleton of Frog:** Skull, lower jaw, vertebrae, pectoral and pelvic girdles, limb bones (except bones of hand and foot).
04. **Reptilia:** *Turtle*, *Varanus*, Poisonous snakes – *Cobra*, *Krait*, *Russell's viper* and *Hydrophis*. 01 Unit
05. **Aves:** 02 Unit  
 a. Endoskeleton – Heterocoelous Vertebra, Synsacrum, Sternum.  
 b. Types of feathers.
06. **Mammalia:** *Mongoose*, *Squirrel*, *Pangolin*, *Hedge Hog*, and *Loris*. 01 Units
07. **Mounting:** Preparation of whole mount of fish scale/ coelenterate colony/ mouth parts of insects 02 Units
08. **Observation of systems in shark and rat** (Use of dissected animal/ photograph/ chart/model) 02 Units  
 a. Shark: Afferent and Efferent branchial systems; Glossopharyngeal and Vagus nerves, and Brain.  
 b. Rat: Urinogenital system of both male and female rat.

**SCHEME OF PRACTICAL EXAMINATION  
 III SEMESTER B.Sc ZOOLOGY  
 CHORDATA : PRACTICAL – III**

**Duration: 3 hrs.**

**Max. Marks: 35**

01	<b>Systematics:</b> Identify, classify and comment on the specimens <b>A, B, C, D</b> and <b>E</b> ( <b>E</b> is from endoskeleton of frog/bird) with neat labelled diagram.	20 marks (5x4)
02	<b>Whole mount:</b> Prepare a whole mount of the given material.	05 marks
03	<b>Observation of system/organ/chart/model:</b> Identify and describe <b>F</b> with a neat labelled diagram.	05 marks
04	<b>Class Records</b>	05 marks
	<b>Total</b>	<b>35 marks</b>

**IV SEMESTER B.Sc ZOOLOGY**  
**PAPER IV: COMPARATIVE ANATOMY, HUMAN ANATOMY, CELL**  
**BIOLOGY AND HISTOLOGY**

<b>UNIT: I 09 hrs</b>	<b>52 hrs</b>
<b>COMPARATIVE ANATOMY</b>	
1.1. Respiratory organs in Fishes (gills and swim bladders), Respiratory organs in Amphibians, Reptiles, Birds and Mammals (lungs).	03 hrs
1.2. Circulatory system:	
a. Evolutionary trends of heart in vertebrates.	06 hrs
b. Evolutionary trends of aortic arches in vertebrates.	
<b>UNIT: II</b>	
<b>COMPARATIVE ANATOMY</b>	
2.1. Evolution of kidney in vertebrates: Pronephros, Mesonephros and Metanephros types in different classes of vertebrates.	02 hrs
2.2. Evolution of brain in vertebrates: Shark, Frog, Lizard, Bird and Rabbit.	05 hrs
<b>UNIT : III</b>	
<b>HUMAN ANATOMY</b>	
3.1. Digestive system, Lung, Heart, Kidney, Brain, Eye and Ear.	<b>11hrs</b> 08 hrs
3.2. Limb bones (except bones of hand and foot).	03 hrs
3.3. Human osteology: Skull, lower jaw, vertebral column, sternum, rib, pectoral and pelvic girdles,	
<b>UNIT: IV</b>	
<b>CELL BIOLOGY</b>	
4.1. Ultra structure of an animal cell:	07 hrs
a. Plasma membrane: Chemical composition, structure -Fluid mosaic model, role of lipids in maintaining fluidity of cell membrane. Functions – transport across cell membrane: passive transport (simple and facilitated diffusion; osmosis) and active transport (Na <sup>+</sup> , H <sup>+</sup> and Ca <sup>2+</sup> pumps, exocytosis, endocytosis -phagocytosis and pinocytosis);	
b. Nucleus.	
c. Cytoplasm: Ultra structure and functions of mitochondrion, golgi complex, endoplasmic reticulum, ribosomes, lysosomes and centrosomes.	
4.2. Cell cycle and regulation	01 hr
4.3. Biology of cancer: Introduction, general properties of cancer cells, carcinogens, prevention and regulation; chemotherapy, radiotherapy and gene therapy	02 hrs
4.4. Cell senescence and Apoptosis	01 hr
<b>Immunology:</b>	04 hrs

- a. Active and Passive immunity.
- b. Hypersensitivity and allergy.
- c. Autoimmune diseases: Myasthenia gravis and rheumatoid arthritis.

**UNIT: V**  
**HISTOLOGY**

**10 hrs**

- 5.1.** Histological features of mammalian organs: Tongue, Stomach, Pancreas, Liver, Kidney, Ovary, Testis, Pituitary, Thyroid and Adrenal. 10 hrs

**REFERENCES:**

1. Comparative Anatomy by Romer(1977)
2. Comparative Anatomy by Eten and Kent(1954)
3. Principles of Anatomy and Physiology by Gerard J Tortora and Nicholas P. Anagnostakos. 6<sup>th</sup> Ed(1990)
4. Cell biology by C.B. Power Vol I and II(2010)
5. Cell biology by Tomer(2005)
6. Cellular and Molecular Biology Rastogi publication(2017)
7. Bloom and D. Faweett. 1972. Text book of histology. 10<sup>th</sup> Ed.
8. Janis Kuby. 1997. Text book of Immunology. 3<sup>rd</sup> Ed.
9. Histology by Bailey(1975)
10. Histology by Bevelander(1979)
11. Histology by Ham(1987)
12. Histology by Berry(2015)
13. Atlas of Histology Papero
14. Atlas of Histology Freeman(1966)

**IV SEMESTER B.Sc., ZOOLOGY PRACTICAL  
PAPER – IV: COMPARATIVE ANATOMY, HUMAN ANATOMY,  
CELLBIOLOGY AND HISTOLOGY**

**COMPARATIVE ANATOMY**

**15 Units**

- |     |   |          |
|-----|---|----------|
| 01. | Comparative study of derivatives of integument in Vertebrates: Carapace and Plastron of Tortoise/Turtle, horn of Sheep/Goat/Cow, hoof of Sheep/ Goat/Cow. | 01 Unit  |
| 02. | Comparative study of skin of Vertebrates – Fish, Frog and Rat.  | 01 Unit  |
| 03. | Comparative study of heart of Vertebrates: Fish (Shark), Amphibian (Frog), Bird (Pigeon) and Mammal (Rat).  | 01 Unit  |
| 04. | Comparative study of brain of Vertebrates: Fish (Shark), Amphibian (Frog), Bird (Pigeon) and Mammal (Rat).  | 01 Unit  |
|     | <b>Human Osteology:</b> Skull. Lower jaw, vertebral column, sternum, rib, pectoral and pelvic girdles, limb bones (except bones of hand and foot).        | 04 Units |

**CELL BIOLOGY**

- |     |   |          |
|-----|---|----------|
| 01. | Preparation of Squash: Onion root tip for mitosis/ Grass hopper testis for meiosis. | 02 Units |
|-----|---|----------|

**HISTOLOGY**

- |     |  |          |
|-----|--|----------|
| 01. | Permanent slides of sections of mammalian organs- Tongue, Stomach, Pancreas, Liver, Kidney, Ovary, Testis, Pituitary, Adrenal and Thyroid. | 05 Units |
|-----|--|----------|

**SCHEME OF PRACTICAL EXAMINATION  
IV SEMESTER B.Sc ZOOLOGY,  
COMPARATIVE ANATOMY, HUMAN ANATOMY, CELLBIOLOGY  
AND HISTOLOGY: PRACTICAL – IV**

**Duration: 3 hrs.**

**Max.Marks: 35**

<b>01.</b>	Comparative Anatomy: Identify A and B and comment on the evolutionary trends with labelled diagrams.	08 marks
<b>02.</b>	Human osteology: Identify C and D and comment with labelled diagrams.	05 marks
<b>03.</b>	Cell Biology: Prepare a temporary squash of the given material. Identify and comment on the observed stage.	05 marks (3+2)
<b>04.</b>	Histology: Identify and comment on the histological features of E, F and G with neat labelled diagrams	2 marks (3x4)
<b>05.</b>	Class Records	05 marks
	<b>Total</b>	<b>35 marks</b>



**V SEMESTER B.Sc ZOOLOGY**  
**PAPER – V:ENVIRONMENTAL BIOLOGY & ETHOLOGY**

**40 hrs**

**UNIT: I**  
**ENVIRONMENTAL BIOLOGY**

**15 hrs**

- 1.1** Fundamentals of Ecology: 04hrs
- a. Sub-divisions and Scope of Ecology.
  - b. Concept of habitat: Micro-habitat and Macro-habitat.
  - c. Concept of Ecological Niche: Spatial, Trophic and Multidimensional.
  - d. Abiotic factors: Light, Temperature and Soil.
- 1.2** Energy Flow in the Ecosystem: First and Second law of thermodynamics. 01hr
- 1.3** Primary and Secondary productivity in an ecosystem. 01hr
- 1.4** **Population Ecology:** Density, Natality, Mortality, Age distribution, Growth, Dispersion and Biotic Potential. 02hrs
- 1.5** **Community Ecology:** Interspecific interactions – Negative (Antibiosis, Competition, Parasitism and Predatism) and Positive (Commensalism, Proto 02hrs Co-operation and Mutualism).
- 1.6** **Ecological succession:**
- a. Definition, Causes, Types, Examples – Hydrosere and Xerosere. 02hrs
  - b. Concept of climax – Monoclimax theory, Polyclimax theory and Climax pattern hypothesis.
- 1.7** **Current Environmental Issues:** 03hrs
- a. Greenhouse effect and Global warming:
    - Introduction.
    - Greenhouse gases and their main anthropogenic sources.
    - Global warming and its impact on climate change (sea level change, crop yield, water balance) and human health.
    - Mitigation/control measures.
  - b. Acid rain:
    - Introduction.
    - Nature of acid rain.
    - Impact of acid rain on human health, aquatic environment, terrestrial environment, and the built environment.
    - Mitigation/control measures.
  - c. Ozone layer depletion:
    - Introduction.
    - Ozone layer depletion process.
    - Consequence of Ozone layer depletion– human health, animals, terrestrial plants, aquatic ecosystems and climate.
    - Mitigation/control measures.

**UNIT II**

**12hrs**

- 2.1** **Toxicology:**
- a. Definition. 02hrs
  - b. Toxins–Types: Insecticides (Chlorinated hydrocarbons, Organophosphates and Carbamate), Rodenticides, Herbicides, Fungicides and Heavy metals (Lead, Mercury, Cadmium & Arsenic)

	c. Concept of Biomagnification and Biotransformation	
2.2	<b>Integrated pest management (IPM):</b> Definition and types.	01 hr
2.3	<b>Energy Resources:</b>	03 hrs
	a. Types: renewable and non-renewable.	
	b. Non-Conventional renewable sources of energy: Solar, Tidal, Wind, Geothermal, Biogas, Biodiesel, Hydrogen –the fuel of future.	
	c. Nuclear energy and Nuclear reactions: Definition, risk of nuclear accidents, advantages and disadvantages of nuclear power plants.	
2.4	<b>Solid waste management:</b> Disposal and recovery (Collection centres, Land filling, Incinerations, Recycling of Wastes and construction of Sanitary Latrines).	01hr
2.5	<b>Wild life conservation and its management:</b>	03 hrs
	a. Red data book.	
	b. In situ conservation: Wild life sanctuaries, National parks and Biosphere reserves.	
	c. Ex situ conservation: Zoological gardens, Botanical gardens, Seed banks, Pollen storage and Tissue culture.	
2.6	<b>a. Remote sensing:</b> Definition, types (Satellite remote sensing and Microwave remote sensing) and applications.	02 hrs
	<b>b. Geographic information system (GIS):</b> Definition, components and applications.	
	<b>UNIT III - ETHOLOGY (ANIMAL BEHAVIOUR)</b>	<b>3hrs</b>
3.1	Introduction to animal behaviour, historical perception, aims and objectives.	01hr
3.2	<b>Stereotyped and Acquired behaviour:</b>	02 hrs
	a. Stereotyped behaviour: Kinesis, Taxes, Reflexes, Instincts and Motivation with suitable examples.	
	b. Acquired behaviour (Learnt behaviour): Imprinting, Habituation, Trial and Error learning.	
3.3	<b>Pheromones (Chemical communication):</b> Definition and types, Pheromones in insects and vertebrates.	01hr
3.4	<b>Social behaviour:</b>	02 hrs
	a. Social behaviour in Insects – Honey Bees and Termites.	
	b. Social system in Primates: Monkeys and Apes.	
3.5	<b>Biological rhythms:</b> Definition, Circadian rhythm and Biological clock.	01hr
3.6	<b>Communication in Animals:</b> Dances of Honey Bees, Alarm calls, Eco-location or Sonar in Bat, Aggression and Bioluminescence.	02 hrs
3.7	<b>Parental care:</b> Fishes and Amphibians (two examples each)	01hr
3.8	<b>Special/ unique behaviour:</b>	03 hrs
	• Courtship behaviour	
	• Altruism	
	• Kin selection	
	• Mimicry	

**References:-**

1. Animal behaviour by Alock(2013)
2. Survival strategies by R. Gadakar(1997)
3. Introduction to Animal behaviour by Manning A. & M.S.Dawkins(2012)
4. Animal Behaviour by Robert A(1966)

5. Learning and instinct in animals by Thorpe(1956)
6. Ethology bu Reena Matur(1998)
7. Ecology by Charles J. Krebs(2009)
8. Fundamentals of Ecology by Eugene P. Odum(1953)
9. Elements of Ecology by Clarke(2015).

**V SEMESTER B.Sc., ZOOLOGY PRACTICAL  
PAPER- V ENVIRONMENTAL BIOLOGY AND ETHOLOGY**

**15 Units**

**I. Limnological studies:**

**06 units**

1. Examination of water samples from near by ponds and tanks for the identification of phytoplankton and zooplankton.
2. Estimation of dissolved oxygen by Winkler's method.
3. Estimation of dissolved salt by Mohr's method.
4. Estimation of dissolved organic matter.
5. Estimation of total hardness.
6. Estimation of pH using pH meter/ pH paper/ Titrimetry.

**II. Ecological Adaptations:**

**03 units**

1. Tubicolous worms: Arenicola and Chaetopterus.
2. Fossorial (Burrowing) forms: Dentalium.
3. Sedentary forms: Sea anemone and Lepas.
4. a. Passive fliers: Exocoetus and Draco.  
b. Active fliers: Insects and Bat
5. Animal associations:
  - a. Polymorphic forms: Physalia
  - b. Facultative mutualism: Hermit crab and Sea anemone
6. Desert forms: Phrynosoma
7. Arboreal for: Hyla

**III. Ethology:**

**03 units**

1. Demonstration of Drosophila behaviour: Response of Drosophila flies to different culture media. (ripe banana, rava, curds)
2. Social behaviour in termites: Study of different castes.
3. Mimicry/Camouflage: Stick insect and Chameleon.

**IV. Project report submission:**

**03 units**

- a. Toxicology- Analysis of water (polluted), Solid waste management, Air pollution (Tie up with Pollution control Board, BWSSB, PG dept of Environmental Science, DST and NGOs is recommended)
- b. Rain water harvesting
- c. Visit to Wild Life Sanctuary, National Park, Bio-reserve and Sacred Grove.
- d. Social organisation in Termites and Primates (monkeys and apes).  
*(Field/ industrial visits for the topics related to project report, is recommended)*

**SCHEME OF PRACTICAL EXAMINATION,  
V SEMESTER : B.Sc ZOOLOGY  
ENVIRONMENTAL BIOLOGY AND ETHOLOGY: PRACTICAL - V**

<b>Duration: 3 hrs.</b>		<b>Max.Marks: 35</b>
<b>01</b>	<b>Limnology:</b> Identify and comment on the observed Plankton/s in the given water sample.	08 marks
<b>OR</b>		
	Estimate ----- in the given water sample and discuss the result. (experiment from serial number 2 to serial number 6 of Unit I)	
<b>02</b>	<b>Ecological adaptations:</b> Identify, draw a neat labelled diagram and comment on the ecological adaptations of A, B, & C.	12 marks (4x3)
<b>03</b>	<b>Ethology:</b> Identify and discuss on the behaviour of D & E	5 marks
<b>04</b>	<b>Project Report submission</b>	(2 <sup>1/2</sup> +2 <sup>1/2</sup> ) 05 marks
<b>05</b>	<b>Class Records</b>	05 marks
		<b>Total 35 marks</b>

Note: Question 3- Ethology- **D** from 2 of unit-III;  
**E** from 3 of unit-III

**V SEMESTER B.Sc ZOOLOGY**  
**PAPER VI: – GENETICS AND BIOTECHNOLOGY**

		<b>40hours</b>
<b>UNIT I</b>		<b>13 hrs</b>
<b>GENETICS</b>		
<b>1.1</b>	<b>Heredity and Environment:</b> Concept of genotype, phenotype, phenocopy, Norm of reactions (Experiments on <i>Potentilla glandulosa</i> , Fur colour in Himalayan Rabbit, studies of Human twins).	02 hrs
<b>1.2</b>	<b>Introduction to Mendelism:</b> Mendelian principles- Law of segregation and Law of independent assortment.	02 hrs
<b>1.3</b>	<b>Deviation from Mendelism:</b>	08 hrs
	a. Multiple allelism (Ex: Inheritance of ABO blood groups), Rh factor and its inheritance, significance of Rh factor: Erythroblastosis foetalis.	
	b. Interaction of genes: Inheritance of comb shape in poultry.	
	c. Multiple factor inheritance: Inheritance of skin colour in man.	
	d. Sex linkage:	
	• X – linked inheritance, Eye colour in <i>Drosophila</i> , Colour blindness and Haemophilia.	
	• Construction of pedigree charts for colour blindness and haemophilia.	
	• Y – linked inheritance: Hypertrichosis in man.	
<b>1.4</b>	<b>Cytoplasmic inheritance:</b> Kappa particles in <i>Paramecium</i> , Coiling of shells in snail.	01 hr
<b>UNIT II</b>		<b>13 hrs</b>
<b>2.1</b>	<b>Giant chromosomes:</b> Polytene and Lampbrush chromosomes.	02 hrs
<b>2.2</b>	a. Chromosomal basis of sex determination: Types with examples.	02 hrs
	b. Genic balance theory.	
	c. Gynandromorphs and Free Martins.	
<b>2.3</b>	a. Numerical aneuploidy– Down’s syndrome, Cri du Chat syndrome, Turner’s syndrome and Klinefelter’s syndrome.	03 hrs
	b. Genetic diseases: Alcaptonuria, Albinism, Thalassaemia, Galactosemia and Cystic fibrosis.	
<b>2.4</b>	<b>Concept of gene:</b> Fine structure of gene: Cistron, Recon and Muton, Operon concept: Inducible Operon (E.g. Lac Operon)	01 hr
<b>2.5</b>	<b>Gene mutations:</b> Spontaneous and induced mutations, CIB method of detection of mutations, Physical, Chemical and Biological mutagens.	03 hrs
<b>2.6</b>	a. <b>Eugenics:</b> Definition, aspects of positive eugenics and negative eugenics.	02 hrs
	b. Euthenics and Euphenics.	
<b>UNIT III</b>		<b>14 hrs</b>
<b>BIOTECHNOLOGY</b>		
<b>3.1</b>	<b>Genetic Engineering / Recombinant DNA (rDNA) Technology</b>	04 hrs
	a. Molecular tools: Restriction enzymes, DNA ligases, Alkaline phosphatase.	
	b. Vectors: Plasmids, Bacteriophages and Cosmids.	
	c. Host cells: Prokaryotic hosts and Eukaryotic hosts.	
	d. Bioreactors: Definition, types (mention) and applications.	
	e. Methods of gene transfer: Microinjection, electroporation, of DNA,	

	lipofection and direct transfer of DNA.	
<b>3.2</b>	<b>Applications of Biotechnology:</b>	
	<b>a. Transgenesis:</b>	01 hr
	i. Introduction – Meaning and significance.	
	ii. Transgenesis in mice, Knock out and Knock in technology.	
	<b>b. Animal improvement:</b>	02 hrs
	i. Super ovulation and embryo transfer: Steps, benefits and limitations of embryo transfer.	
	ii. Artificial insemination	02 hrs
	<b>c. Gene therapy:</b>	
	i. Somatic cell gene therapy, Embryo cell gene therapy and Germ cell gene therapy.	01 hr
	ii. In vivo and ex-vivo gene therapy.	01 hr
	<b>d. Stem cells:</b> Introduction, features, types, sources and applications	01 hr
	<b>e. Hybridoma technology:</b> Monoclonal antibodies and their applications.	
	<b>f. DNA fingerprinting:</b> Definition, steps involved and applications.	
<b>3.3</b>	<b>PCR technique:</b> Definition, steps involved and applications.	02 hrs
	<b>RFLP, RAPD and AFLP:</b> Definition and applications.	

**References:-**

1. Genetic Engineering by Sandhya Mitra(2015)
2. Gene cloning by Brown(2016)
3. Molecular biotechnology by Sathyanarayana U(2008)
4. Biotechnology by S.S. Purohith(2012)|
5. Transgenic animals by M.M.Ranga(2006)
6. Animal Biotechnology by M.M. Ranga(2007)
7. Molecular Biotechnology by Chennarayappa(2007)
8. Human Genetics by Mange and Mange(1993)
9. Principles of Genetics by Robert H Tamarin Ta Ta McGraw- Hill pub(2004).
10. Genetics by Monroe W. Strickberger , Mac Millan Pub(2008)

**V SEMESTER B.Sc., ZOOLOGY PRACTICAL - VI  
PAPER – VI - GENETICS AND BIOTECHNOLOGY**

	<b>15 Units</b>
1. Drosophila Genetics:	04 Units
a. Sexual dimorphism and Mutant forms – Vestigial wing, White eye, Bar eye, Sepia eye, Yellow body and Ebony body.	
b. Mounting of Polytene chromosome (Salivary gland chromosome)	
c. Mounting of Sex comb and Genital plate.	
d. Genetic problems: Monohybrid cross, Dihybrid cross, multiple alleles, gene interaction	
e. Sex linkage (Construction of pedigree charts for colour blindness and haemophilia)	
2. Human Genetics:	04 Units
d. Blood typing	
e. Preparation of Buccal smear for sex chromatin	
f. Preparations of Blood smear for identification of cell types and comment on the types of leucocytes.	
3. Biotechnology:	03 Units
g. Staining and identification of Bacteria (Gram staining)	
h. Biochemical analysis to determine the interaction of bacteria with different substrates.	
i. Isolation of plasmid DNA	
4. Isolation of DNA from animal tissue.	01 Unit
5. Qualitative detection of acetic acid in Yeast culture (Student is required to prepare the culture)	01 Unit
6. Study of polyploidy in Onion root tip using Colchicine	01 Unit
7. Translocation in Rheo.	01 Unit

**SCHEME OF PRACTICAL EXAMINATION  
V SEMESTER B.Sc ZOOLOGY  
GENETICS AND BIOTECHNOLOGY: PRACTICAL - VI**

**Duration: 3 hrs.**

**Max.Marks: 35**

<b>01.</b>	Drosophila Genetics:	05 marks
	a) Identify and comment on A and B with neat labelled diagram: (Drosophila male/female/mutants- any two)	(2 <sup>1/2</sup> +2 <sup>1/2</sup> )
	b) Mounting: Polytene Chromosome (Salivary Gland Chromosome) or Sex comb or Genital Plate.	07 marks
	or	
	Genetic problems (any two) (4+3 marks)	
<b>02.</b>	Human Genetics : from d to f (any one)	06 marks
<b>03.</b>	Biotechnology:	06 marks
	c) From g, h and i (any one)	06 marks
	d) From 5, 6, 7 and 8 (any one)	
<b>04.</b>	Class Records	05 marks
	<b>Total</b>	<b>35 marks</b>

**VI SEMESTER B.SC ZOOLOGY**  
**PAPER VII – DEVELOPMENTAL BIOLOGY AND ORGANIC EVOLUTION**

		<b>40hours</b>
<b>UNIT I</b>		<b>13 hrs</b>
<b>DEVELOPMENTAL BIOLOGY</b>		
<b>1.1</b>	<b>Introduction:</b> Definition and scope, Historical review – Preformation theory, Epigenetic theory, Baer’s Law and Biogenetic law.	01 hr
<b>1.2</b>	<b>Types of eggs:</b> Based on amount of yolk and distribution of yolk with examples. Mosaic and regulative eggs, Cleidoic egg (e.g., Hen’s egg) and its significance.	02 hrs
<b>1.3</b>	<b>Reproductive cycles:</b> Oestrous and Menstrual cycles and their regulation	02 hrs
<b>1.4</b>	<b>Patterns of development:</b> Oviparity, ovoviviparity and viviparity with examples.	01 hr
<b>1.5</b>	<b>Fertilization:</b>	03 hrs
	a. Definition, Types, Mechanism of fertilization and significance.	
	b. Polyspermy: pathological and physiological polyspermy with examples.	
	c. Mechanism to block polyspermy in monospermic forms (fast block and slow block).	
<b>1.6</b>	<b>Cleavage:</b>	02 hrs
	a. Definition, planes of cleavage – meridional, vertical, equatorial and latitudinal.	
	b. Patterns of cleavage – radial, biradial, spiral and bilateral cleavage with examples.	
	c. Influence of yolk in cleavage.	
<b>1.7</b>	<b>Blastulation:</b> Comparative account with reference to Amphioxus, Frog and Chick.	02 hrs
<b>UNIT II</b>		<b>15hrs</b>
<b>2.1</b>	<b>Fate maps and cell lineage:</b>	02 hrs
	a. Presumptive organ forming areas and fate maps in Frog and Chick.	
	b. Cell lineage in Nereis.	
<b>2.2</b>	Gastrulation in Amphioxus, Frog and Chick.	03 hrs
<b>2.3</b>	Frog: Neurulation, post-neurular development and metamorphosis.	02 hrs
<b>2.4</b>	<b>Role of organizers in development:</b> Transplantation experiments of Spemann and Mangold, Chemistry of Organiser.	02 hrs
<b>2.5</b>	Foetal membranes in Chick - formation, structure and function.	01 hr
<b>2.6</b>	<b>Placenta:</b> Types - Yolk sac and Chorion-allantoic placenta; Deciduate and non-deciduate placenta; morphological and histological placental types with suitable examples	02 hrs
<b>2.7</b>	<b>Parthenogenesis:</b>	02 hr
	a. Definition.	
	b. Natural parthenogenesis (arhenotoky and thelytoky)	
	c. Artificial parthenogenesis	
	d. Significance of parthenogenesis.	
<b>2.8</b>	<b>Regeneration:</b>	
	a. Definition and types – morphollaxis and epimorphosis with examples.	01 hr
	b. Regeneration in Planarians (Polarity, dominance of head, Axial gradient theory of Child).	



**UNIT III**  
**EVOLUTIONARY BIOLOGY**

**12 hrs**

- 3.1 Neo-Darwinism:** Concept of gene pool and gene frequency, Hardy- Weinberg law – Definition and significance. 01 hr
- 3.2 Role of Evolutionary forces in speciation:** 04 hrs
- a. Sexual reproduction
  - b. Mutation
  - c. Genetic drift
  - d. Natural Selection- Introduction, Stabilizing selection, Directional selection and Disruptive selection.
  - e. Isolation and Isolating mechanisms –
    - i. Geographical isolation.
    - ii. Reproductive isolation:
      - Prezygotic/Premating isolation – Ecological, Seasonal, Ethological, Mechanical, Physiological and Gametic mortality.
      - Post zygotic/Postmating isolation – Cytological, Zygotic mortality, Hybrid inviability, Hybrid sterility.
  - f. Speciation: Introduction; Phyletic, Allopatric and Sympatric speciation.
- 3.3 Evidences of Organic Evolution:** 05 hrs
- a. Paleontological evidences: Fossils
    - i. Fossil formation and types (Petrification, preservation, impressions, moulds and casts).
    - ii. Dating of fossils–Lead method, Carbon method, Potassium–Argon method, Fission Track method.
  - b. Morphology and Comparative anatomy: Homologous structures (Fore limb of vertebrates, mouth parts of insects), analogous structures (cephalopod eye and vertebrate eye, wing of insect and bird), atavism and adaptive radiations.
  - c. Embryological evidences.
- 3.4 Human evolution:** Salient features of important fossil stages of man: 02 hrs  
Ramapithecus, Australopithecus, Homo erectus, Rhodesian man, Neanderthal man and Cromagnon man

**References:**

1. Introduction to Embryology by Balinsky B.L.(1970)
2. Development by Beril N J and Karpotata(1978)
3. Developmental biology by Gilbert(2016)
4. Embryology by Gilbert and Raunio(1997)
5. Embryology by Barath
6. Chick Embryology by Patten(1971)

**VI SEMESTER B.Sc., ZOOLOGY PRACTICAL  
PAPER – VII - DEVELOPMENTAL BIOLOGY AND ORGANIC EVOLUTION**

**15 Units**

**I. Developmental Biology:**

09 units

1. Early development of Frog: Cleavage, Blastula, Gastrula and Neurula.
2. Late development of Frog: Metamorphosis (Tadpole to young Frog)
3. Development of Chick: 18 hrs, 24 hrs, 36 hrs, 48 hrs and 72 hrs incubation stages
4. Mammals: T.S. of uterus and fallopian tube
5. Placenta: Morphological and histological types.

**II. Organic evolution:**

06 units

1. Study of Homologous organs:
  - a. Fore limb bones of terrestrial Vertebrates (Frog, Lizard, Bird, Rat or Rabbit or Human).
  - b. Mouth parts of Cockroach, House fly, Butterfly and Mosquito.
2. Study of Analogous organs:
  - a. Cephalopod Eye and Vertebrate eye.
  - b. Wing of Insect and Bird
3. Study of Vestigial organs: Appendix, Coccyx and Molar tooth.
4. Study of Connecting links: Peripatus and Tornaria larva.

**SCHEME OF PRACTICAL EXAMINATION  
VI SEMESTER B.Sc. ZOOLOGY  
DEVELOPMENTAL BIOLOGY AND ORGANIC  
EVOLUTION: PRACTICAL - VII**

**Duration: 3 hrs.**

**Max.Marks:35**

<b>01</b>	<b>Developmental Biology:</b> Identify and comment on A, B, C and D with neat labelled diagrams. (Any one larval stage of Frog to be compulsorily included in the question)	16 marks (4x4)
<b>02</b>	<b>Organic Evolution:</b> Identify and comment on the evolutionary trends of E and F with neat labelled diagrams. (Note: From 1 and 2)	06 marks (3x2)
<b>03</b>	<b>Organic Evolution:</b> Identify and comment on 'G'. (Note: Any one from 3 and 4)	03 marks
<b>04</b>	<b>Viva voce:</b> Based on the questions of the practical examination (Minimum of 3 to 4 questions)	05 marks
<b>05</b>	<b>Class Records</b>	05 marks

**Total 35 marks**

**VI SEMESTER B.Sc ZOOLOGY**  
**PAPER VIII – ANIMAL PHYSIOLOGY AND TECHNIQUES IN BIOLOGY**

<b>UNIT I</b>	<b>40 hrs</b>
<b>ANIMAL PHYSIOLOGY</b>	<b>16 hrs</b>
<b>1.1</b> Digestion:	02 hrs
i. Neural-Hormonal control of digestive glandular secretion.	
ii. Symbiotic digestion in Ruminants.	
<b>1.2</b> Circulation:	02 hrs
i. Respiratory pigments: Major types and their features.	
ii. Fuld and Spiro's theory of blood clotting.	
<b>1.3</b> Respiration:	03 hrs
i. Regulation of respiration.	
ii. Transport of O <sub>2</sub> and CO <sub>2</sub> .	
iii. Oxygen dissociation curve: Definition and factors affecting the Oxygen dissociation curve (Oxygen, Carbon Dioxide, Temperature, pH, Body size and Organic phosphate compounds – Bohr effect and Haldane effect to be highlighted).	
<b>1.4</b> Excretion:	02 hrs
i. Ammonotelism, Uricotelism and Ureotelism with examples.	
ii. Formation of Ammonia (Deamination of amino acids), Urea (Ornithine cycle) and Uric acid (Purine degradation)	
<b>1.5</b> Muscle Physiology:	03 hrs
i. Ultrastructure of skeletal muscle.	
ii. Chemical composition of muscle.	
iii. Physico-chemical aspects of muscle contraction.	
iv. Sliding filament theory of muscle contraction.	
<b>1.6</b> Neuro-Physiology:	02 hrs
i. Propagation and conduction of nerve impulse – Axonal and Synaptic.	
ii. Neuro-transmitters.	
<b>1.7</b> Physiology of Sense organs:	02 hrs
i. Vision	
ii. Hearing	
<b>UNIT II</b>	<b>15 hrs</b>
<b>2.1</b> Homeostatic functions:	
a. Endocrinology:	05 hrs
i. Chemical nature of hormones.	
ii. Endocrine glands: Pituitary, Thyroid, Parathyroid and Adrenal glands; secretions and their actions, effect of hyposecretion and hypersecretion.	
iii. Concept of neuro-secretion with examples.	03 hrs
b. Concept of Homeostasis and role of feedback mechanism:	
i. Positive – Oxytocin secretion.	
ii. Negative – Thyroid secretion (details of regulation required)	
c. Hormonal control of metamorphosis in Insects and Amphibians.	01 hrs
d. Osmoregulation:	02 hrs
i. Types of osmoregulatory mechanisms with examples.	
ii. Osmoregulation in migratory fishes.	
e. Thermoregulation in Homeotherms: Methods of heat loss and heat gain,	02 hrs

- Role of Hypothalamus in thermoregulation.
- 2.2 Common disorders in man: Renal failure and dialysis, Anaemia, Diabetes mellitus and Obesity. 02 hrs

### UNIT III

#### TECHNIQUES IN BIOLOGY

- 09 hrs
- 3.1 Microtechnique: Introduction and procedure – fixation, embedding, microtomy, staining – simple and differential and mounting 01 hr
- 3.2 Immuno assay: Principle and applications. 01 hr
- 3.3 Separation techniques: Principle and applications of Centrifugation, Chromatography, Fractionation and Electrophoresis (Details of types and techniques to be avoided). 02 hrs
- 3.4 Autoradiography: Principle and applications 01 hr
- 3.5 Microscopy: 02 hrs
- a. Principle – magnification and resolution.
- b. Types: Light, Phase contrast, Fluorescent and Electron microscopy (TEM and SEM).
- 3.6 Micrometry: Principle and applications. 01 hr
- 3.7 Endoscopy: Principle and applications. 01 hr

#### References:-

1. Animal Microtechniques by Humason(1962)
2. Animal Cell culture a practical approach by R.W. Masters(2000)
3. Biostatistics by Khan and Khannum(1994).
4. Elements of Biostatistics by Prasad(2016)
5. Medical Physiology by Grabowski and Tortora(2003)
6. Animal Physiology by Hoar(1966)
7. Review of Medical Physiology by Ganong(2012)
8. Human Physiology by A.C. Guyton(2006)
9. Human Physiology Vol I & II by Chatterjee(2016)
10. Animal Physiology by Randol(2001).

**VI SEMESTER B.Sc., ZOOLOGY PRACTICAL  
PAPER – VIII - ANIMAL PHYSIOLOGY AND  
TECHNIQUES IN BIOLOGY**

- 15 Units**  
08 Units
- I. Physiology Experiments:**
1. Qualitative analysis of Carbohydrates, Proteins and Lipids.
  2. Qualitative analysis of Nitrogenous wastes – Ammonia, Urea and Uric acid.
  3. Quantitative estimation of Oxygen consumption by fresh water Crab.
  4. Quantitative estimation of salt gain and salt loss by fresh water Crab.
  5. Detection of glucose, albumin and ketone bodies in urine.
  6. Qualitative analysis of digestive enzymes in human saliva.
  7. Estimation of muscle glycogen (Anthrocin method).
- 05 Units**
- II. Techniques in Biology:**
1. Paper Chromatography for separation of amino acids and proteins.
  2. Demonstration of Rocket electrophoresis technique for detection of specific antigens.
  3. Scientific drawing of microscopic specimens using a prism type Camera Lucida.
  4. Differential counting of blood cells using haemocytometer
  5. Micrometry of cell types
- III. Project report on:** Dialysis, Diabetes mellitus, Obesity, Cardio vascular diseases and Anaemia.  
02Units

**SCHEME OF PRACTICAL EXAMINATION  
VI SEMESTER B.Sc ZOOLOGY  
PAPER –VIII - ANIMAL PHYSIOLOGY AND TECHNIQUES IN  
BIOLOGY PRACTICAL-VIII**

<b>Duration: 3 hrs.</b>	<b>Max.Marks : 35</b>
01. Physiology Experiment	12 marks
02. Techniques in Biology	08 marks
03. Project Report submission	05 marks
04. Viva-voce ( On Project submitted) ( Minimum of 3 – 4 questions )	05 marks
05. Class Records	05 marks
<b>Total</b>	<b>35 marks</b>

# BANGALORE UNIVERSITY

## Scheme of examination for I, II, III, IV, V and VI Semesters (B.Sc Zoology) – Theory

**Duration of examination: 3hrs**

**1. PART A**

Comprising of **TEN** compulsory questions, requiring **one word or one sentence** answers of **ONE** mark each. (Questions should be from all units)

**10x1=10**

**2. Part B**

Comprising of **SEVEN** questions, with internal choice of any **FIVE**, requiring short answers of fifty words of **THREE** marks each. (Questions should be from all units)

**5x3=15**

**3. PART C**

Comprising of **SEVEN** questions, with internal choice of any **FIVE**, requiring descriptive answers of one hundred and fifty words, of **FIVE** marks each. (Questions should be from all units)

**5x5=25**

**IV PART D**

Comprising of **FOUR** questions, with internal choice of any **TWO**, requiring essay type answers of two hundred and fifty words, of **TEN** marks each. (Questions should be from all units)

**2x10=20**

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**TOTAL: 70 Marks**

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**BANGALORE UNIVERSITY**  
**ZOOLOGY B.Sc (UG) 2018-19 Onwards**  
**BLUE PRINT FOR PREPARATION OF QUESTION PAPER I**  
**NONCHORDATA PART-I**

UNIT		Teaching (hrs)	Number of Questions				Total Marks
			10 (1 Mark)	07 (3Marks)	07 (5Marks)	05 (10Marks)	
IA	Animal Architecture:	06	01	01	1	-	09
IB	Protozoa	07	01	01	01	1	19
IIA	Porifera	06	01	01	01	½	14
IIB	Coelenterata and Ctenophora	08	02	01	01	1	20
IIIA	Helminthes	05	01	01	½	½	11½
IIIB	Annelida	05	01	-	½	½	8 ½
IVA	Economic Zoology	02	-	01	01	-	08
IVB	Parasitology	13	03	01	01	½	16
<b>Total</b>		<b>52</b>	<b>1x10=10</b>	<b>03x07=21</b>	<b>05x07=35</b>	<b>4x10=40</b>	<b>106</b>

**BLUE PRINT FOR PREPARATION OF QUESTION PAPER II**  
**NONCHORDATA PART-II**

UNIT		Teaching (hrs)	Number of Questions				Total Marks
			10 (1Mark)	07 (3Marks)	07 (5Marks)	05 (10Marks)	
I	Arthropoda	17	03	03	02	01	32
II	Mollusca	10	02	01	02	01	25
IIIA	Echinodermata	10	02	01	½	1	17½
IIIB	Hemichordata	04	01	01	½	-	06 ½
IV	Economic Zoology	11	02	01	02	1	25
<b>Total</b>		<b>52</b>	<b>1x10=10</b>	<b>03x07=21</b>	<b>05x07=35</b>	<b>4x10=40</b>	<b>106</b>

**BLUE PRINT FOR PREPARATION OF QUESTION PAPER III -CHORDATA**

UNIT		Teaching (hrs)	Number of Questions				Total Marks
			10 (1Mark)	07 (3Marks)	07 (5Marks)	05 (10Marks)	
IA	Protochordata	7	01	01	01	½	14
IB	Agnatha	2	01	-	½	-	3 ½
IC	Pisces	3	-	01	½	-	5 ½
IIA	Amphibia	5	01	01	01	½	14
IIB	Reptilia	7	02	01	01	½	15
IIC	Aves	7	02	01	01	½	15
III	Mammalia	11	02	01	01	1	20
IV	Economic Zoology	10	01	01	01	1	19
<b>Total</b>		<b>52</b>	<b>1x10=10</b>	<b>03x07=21</b>	<b>05x07=35</b>	<b>4x10=40</b>	<b>106</b>

**BLUE PRINT FOR PREPARATION OF QUESTION PAPER - IV – COMPARATIVE ANATOMY, HUMAN ANATOMY, CELL BIOLOGY, AND HISTOLOGY**

UNIT		Teaching (hrs)	Number of Questions				Total Marks
			10 (1Mark)	07 (3Marks)	07 (5Marks)	05 (10Marks)	
I	Comparative Anatomy	09	02	01	01	01	20
II	Comparative Anatomy	07	02	01	01	½	15
III	Human Anatomy	11	02	01	01	1	20
IV	Cell Biology	15	02	02	02	1	27
V	Histology	10	02	02	02	½	23
<b>Total</b>		<b>52</b>	<b>1x10=10</b>	<b>03x07=21</b>	<b>05x07=35</b>	<b>4x10=40</b>	<b>106</b>



**BLUE PRINT FOR PREPARATION OF QUESTION PAPER – V  
ENVIRONMENTAL BIOLOGY & ETHOLOGY**

UNIT		Teaching (hrs)	Number of Questions				Total Marks
			10 (1Mark)	07 (3Marks)	07 (5Marks)	05 (10Marks)	
I	Environmental Biology	15	03	03	03	1 ½	42
II	Toxicology	12	04	02	02	1 ½	35
III	Ethology	13	03	02	02	01	29
<b>Total</b>		<b>40</b>	<b>1x10=10</b>	<b>03x07=21</b>	<b>05x07=35</b>	<b>4x10=40</b>	<b>106</b>

**BLUE PRINT FOR PREPARATION OF QUESTION PAPER – VI  
GENETICS AND BIOTECHNOLOGY**

UNIT		Teaching (hrs)	Number of Questions				Total Marks
			10 (1Mark)	07 (3Marks)	07 (5Marks)	05 (10Marks)	
I	Genetics	13	03	02	02	2	39
II	Genetics	13	02	02	03	1	33
III	Biotechnology	14	05	03	02	1	34
<b>Total</b>		<b>40</b>	<b>1x10=10</b>	<b>03x07=21</b>	<b>05x07=35</b>	<b>4x10=40</b>	<b>106</b>

**BLUE PRINT FOR PREPARATION OF QUESTION PAPER VII  
DEVELOPMENTAL BIOLOGY AND ORGANIC EVOLUTION**

UNIT		Teaching (hrs)	Number of Questions				Total Marks
			10 (1Mark)	07 (3Marks)	07 (5Marks)	05 (10Marks)	
I	Developmental Biology	13	03	02	03	1	34
II	Developmental Biology	15	04	03	02	02	43
III	Organic Evolution	12	03	02	02	1	29
<b>Total</b>		<b>40</b>	<b>1x10=10</b>	<b>03x07=21</b>	<b>05x07=35</b>	<b>4x10=40</b>	<b>106</b>

**BLUE PRINT FOR PREPARATION OF QUESTION PAPER VIII  
ANIMAL PHYSIOLOGY AND TECHNIQUES IN BIOLOGY**

UNIT		Teaching (hrs)	Number of Questions				Total Marks
			10 (1Mark)	07 (3Marks)	07 (5Marks)	05 (10Marks)	
I	Animal Physiology	16	04	03	03	1½	43
II	Animal Physiology	15	03	02	02	2	39
III	Techniques in Biology	09	03	02	02	½	24
<b>Total</b>		<b>40</b>	<b>1x10=10</b>	<b>03x07=21</b>	<b>05x07=35</b>	<b>4x10=40</b>	<b>106</b>