PROPOSED CURRICULUM IN ZOOLOGY FOR
B.Sc. (UG)
(I to VI SEMESTERS)
CBCS 2018-19 and Onwards
## Theory

<table>
<thead>
<tr>
<th>Sem</th>
<th>Paper Code</th>
<th>Title of the paper</th>
<th>Total number Of hours</th>
<th>Hours /week</th>
<th>Marks</th>
<th>Internal Assessment*</th>
<th>Total Marks</th>
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<tbody>
<tr>
<td>I</td>
<td>Paper-I</td>
<td>Non Chordata-I</td>
<td>52</td>
<td>04</td>
<td>70</td>
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<tr>
<td>IV</td>
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<td>Comparative anatomy, Human anatomy, Cell Biology and Histology</td>
<td>52</td>
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<td>V</td>
<td>Paper-V</td>
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<td>03</td>
<td>70</td>
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<td>Paper-VI</td>
<td>Genetics and Biotechnology</td>
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<td>VI</td>
<td>Paper-VII</td>
<td>Developmental biology and Organic Evolution</td>
<td>40</td>
<td>03</td>
<td>70</td>
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<td></td>
<td>Paper-VIII</td>
<td>Animal Physiology and Techniques in Biology</td>
<td>40</td>
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Internal Assessment marks* - 30

## Practical

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Internal Assessment marks* - 15
Zoology UG Credit System

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

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Paper</th>
<th>Hours/week</th>
<th>Duration of Exam (hrs)</th>
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<tr>
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<td>1 Theory 1 Practical</td>
<td>1 x 4 1 x 3</td>
<td>3 3</td>
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### b) V/VI Semester B.Sc.

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<td>2 x 3 2 x 3</td>
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<td>2 x 70 2 x 35</td>
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<table>
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<th>Theory</th>
<th>Practical</th>
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<td>V/VI Semester</td>
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PROPOSED CURRICULUM IN ZOOLOGY FOR B.Sc.,(UG)
CBCS 2018 – 19 ONWARDS

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

Unit: I - Animal Architecture and Protozoa:

a) Animal Architecture

(To be taught citing suitable examples and keeping in view the evolutionary trends
and significance)

1.1. **Body symmetry:** Definition and types – spherical, radial, biradial and bilateral symmetry
- 01 hr

1.2. **Body organisation:** Hierarchical organisation of animal complexity – protoplasmic level, cellular level, tissue level and organ level of organisation.
- 01 hr

1.3. **Germ layers:** Definition, types - diploblastic condition (apparent and absolute) and
triploblastic condition.
- 01 hr

1.4. **Body coelom:** Definition, origin and types – acoelom, pseudocoelom, eucoelom (enterocoelom and schizocoelom).

1.5. **Metamerism:** Definition and types – pseudometamerism, true metamerism - - 02 hrs
homonomous and heteronomous.

b) Protozoa: The Animal-like Protista

1.6. General characters of the phylum up to classes with examples.
- 01 hr

1.7. **Nutrition:** Holozoic, holophytic, saprozoic, mixotrophic and parasitic with an example for each.
- 02 hrs

1.8. **Locomotion:** 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. **Reproduction:** Conjugation in *Paramoecium caudatum*, significance of conjugation.
- 01 hr

Unit: II – Porifera, Coelenterata and Ctenophora

a) Porifera: The Sponges – Nature’s dead end

2.1. General characters of the phylum up to classes with examples.
- 01 hr

2.2. **Sycon:** Morphology, microscopic structure of body wall and sexual reproduction.
- 03 hrs

2.3. **Canal System and its evolution:** Asconoid, syconoid, leuconoid and rhagonoid types.
- 02 hrs

b) Coelenterata and Ctenophora: The Radiate Animals

2.4. General characters of the phylum Coelenterata up to classes with examples.
- 01 hr

2.5. **Aurelia:** Morphology, reproduction and life cycle
- 03 hrs

2.6. **Polymorphism:** Definition and significance. Example: *Halistemma*.
- 01 hr

2.7. **Coral reefs:** Definition, types and theories of coral reef formation
- 01 hr

2.8. **Ctenophores:** General organisation and affinities.
- 02 hrs
Unit: III – Helminthes and Annelida

a) Helminthes - 10 hrs
   3.1. General characters of the phylum Platyhelminthes up to classes with examples. - 01 hr
   3.2. Planaria: Externals, digestive system, excretory system and nervous system. - 03 hrs
   3.3. General characters of the phylum Nematoda with examples. - 01 hr

b) Annelida - 05 hrs
   3.4. General characters of the phylum up to classes with examples - 01 hr
   3.5. Earth worm (Pheretima) - Morphology, digestive system, excretory system, reproductive system and development. - 04 hrs

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

a) Parasitology: - 13 hrs
   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:
       Entamoeba histolytica, Leishmania donovani, Fasciola hepatica, Taenia solium, Ascaris lumbricoides and Wuchereria bancrofti.
   iii) Parasitic adaptations - Flat worms and leech - 02 hrs

b) Economic Importance of Annelida - 02 hrs
   4.2. Leech - Economic Importance
       Earthworm - Vermiculture and Vermicompost

REFERENCES:

1. Use of microscopes – Simple, Compound, Oil immersion and 01 Unit Stereozoom

02. Preparation and observation of plankton culture (also Protozoans). 01 Unit

03. Protozoa: Study of permanent slides of Amoeba, Euglena, Noctiluca, Paramoecium, Vorticella and Radiolarian - Foraminiferon ooze (Elphidiun) 01 Unit

04. Porifera: Sycon, Euplectella, Hyalonema, Spongilla and Euspongia. 01 Unit

05. Coelenterata: Hydra, T.S. of Hydra, Obelia colony, Obelia medusa, Physalia, Aurelia and Ephyra larva. 01 Unit

06. Coelenterata and Ctenophora: Corals–Fungia, Corallium, Meandrina, Gorgonia and Pennatula, Ctenophora – Pleurobrachia W.M. 01 Unit

07. Helminthes: Planaria, Liver fluke and Tape worm. Ascaris – Male, female and T.S of male and female Ascaris. 01 Unit

08. Annelida: Types of Earthworm species, T.S of earthworm, Nereis and Heteronereis, T.S of parapodium. 01 Unit

09. Observation of systems/ organs in earthworm– Nervous system, ovary and setae (Use of permanent slides, models or photographs). 02 Units

10. Observation of systems/ organs in leech– Digestive system, jaw and testicular nephridium (Use of permanent slides, models or photographs). 02 Units

11. Parasitology: Permanent slides of Entamoeba, Leishmanina, 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

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<tbody>
<tr>
<td><strong>01</strong></td>
<td><strong>Systematics:</strong> Identify, classify and comment on A to E with labelled diagrams</td>
<td>20 marks</td>
</tr>
<tr>
<td><strong>02</strong></td>
<td><strong>Project Report:</strong> Economic Zoology/ Parasitology*</td>
<td>05 marks</td>
</tr>
<tr>
<td><strong>03</strong></td>
<td><strong>Observation of systems/organisms:</strong> Identify and describe the given system or organ ‘F’ with a neat labelled diagram. <strong>Or</strong> Mount and stain the plankton (or protozoan) culture given, identify and comment on any one specimen.</td>
<td>05 marks</td>
</tr>
<tr>
<td><strong>04</strong></td>
<td><strong>Class Records</strong></td>
<td>05 marks</td>
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<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>35</strong> <strong>marks</strong></td>
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**Note:** **Project topics - Economic Zoology:** Corals and Coral reefs, Parasitic adaptations and economic importance of Leech, Vermiculture and vermicomposting.  
**Parasitology:**  
*Entomoeba histolitica, Leishmania donovani, Taenia solium, Fasciola hepatica, Ascaris lumbricoides, Wuchereria bancrofti*
II SEMESTER B.SC ZOOLOGY
PAPER – II: NON-CHORDATA: PART – II

UNIT: I – ARTHROPODA

1.1. General characters of the phylum and classification upto classes with suitable examples

1.2. Peripatus - Systematic position, unique features, affinities with Annelida and Arthropoda.

1.3. Prawn (Palaeomon) - Morphology, structure of a typical appendage, structure and function of appendages, concept of serial homology, circulatory system, reproductive system and life cycle.


1.5. Sense organs – Simple eye and compound eye.

1.6. Metamorphosis – Definition and types with suitable examples.

UNIT: II - MOLLUSCA

2.1. General characters of the phylum and classification upto classes with suitable examples

2.2. Unio: Morphology, structure of shell (sectional view), digestive system, circulatory system, respiratory system, reproduction and life cycle.

UNIT: III – ECHINODERMATA AND HEMICHORDATA

A Echinodermata

3.1. General characters of the phylum and classification upto classes with suitable examples

3.2. Sea Star (Asterias) – Morphology, digestive system, water vascular system, reproduction and life history.


B Hemicordata

3.5. Balanoglossus – Morphology, coelom, and Tornaria larva.

3.6. Affinities and systematic position of Hemicordata.

UNIT: IV - ECONOMIC ZOOLOGY - II


4.2. Apiculture: Species of honeybee, bee keeping and management practices, bee products, pests of honey bees.

4.3. Prawn Fisheries: Types of prawn fishery, prawn culture and farming, preservation and processing of prawn.

4.4 Pearl culture.

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

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

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

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

01. Arthropoda: *Penaeus, Palaeomon*, lobster and crayfish. Crustacean larvae - Nauplius, Zoea, Mysis 01 Unit
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   Bipinnaria and Echinopluteus larva.
11. Hemichordata: *Balanoglossus* – Specimen, T.S through proboscis, 01 Unit
   Tornaria larva
## SCHEME OF PRACTICAL EXAMINATION

**II SEMESTER B.Sc. ZOOLOGY**

**NON-CHORDATA : PRACTICAL – II**

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<tr>
<th>Duration: 3 hrs.</th>
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<tr>
<td><strong>01</strong> Systematics: Identify, classify and comment on A to E with labelled diagrams</td>
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<tr>
<td><strong>02</strong> Project Report: Economic Zoology*</td>
<td>05 marks</td>
</tr>
<tr>
<td><strong>03</strong> Mounting: Honey bee – Mounting of pollen basket and sting apparatus or Observation of systems/organisms: Identify and describe the given system or organ ‘F’ with a neat labelled diagram.</td>
<td>05 marks</td>
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<td><strong>04</strong> Class Records</td>
<td>05 marks</td>
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<td><strong>Total</strong></td>
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**Note: Project Topics**

**Economic Zoology-II:** Sericulture, Apiculture, Prawn fisheries, Pearl culture, Mytilus culture, Oyster culture
### III SEMESTER B.Sc ZOOLOGY
**PAPER - III: CHORDATA**

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<th>UNIT: I</th>
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<td><strong>PROTOCHORDATA</strong></td>
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<tr>
<td>1.1. Basic Chordate characters and outline classification upto classes.</td>
<td>1 hr</td>
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<tr>
<td>1.2. <strong>Urochordata</strong>: Herdmania – Morphology, tadpole of Herdmania and retrogressive metamorphosis.</td>
<td>4 hrs</td>
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<tr>
<td>1.3. <strong>Cephalochordata</strong>: Amphioxus – Morphology, feeding and circulatory system.</td>
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<th>UNIT: II</th>
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<tr>
<td><strong>AGNATHA – THE JAWLESS VERTEBRATES</strong></td>
<td>2 hrs</td>
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<tr>
<td>1.4. General characters of Agnatha</td>
<td>1 hr</td>
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<tr>
<td>1.5. Ammocoete larva and its significance.</td>
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<tr>
<td><strong>PISCES</strong></td>
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<tr>
<td>1.6. General characters and classification upto subclasses - Chondrichthyes and Osteichthyes</td>
<td>1 hr</td>
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<tr>
<td>1.7. <strong>Dipnoi</strong>: Interesting features and their evolutionary significance.</td>
<td>1 hr</td>
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<td>1.8. <strong>Migration in fishes</strong>: Catadromous and anadromus</td>
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<th>UNIT: III</th>
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<td><strong>REPTILIA</strong></td>
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<tr>
<td>2.1. General characters and classification of living Amphibians upto orders, with suitable examples</td>
<td>2 hrs</td>
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<tr>
<td>2.2. <strong>Origin of Amphibia</strong>: Transition from water to land.</td>
<td>1 hr</td>
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<tr>
<td>2.3. <strong>Frog Osteology</strong>: Skull, lower Jaw, vertebral column, pectoral and pelvic girdles, limb bones(except bones of hand and foot)</td>
<td>2 hrs</td>
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<th><strong>AVES</strong></th>
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<tr>
<td>2.4. General characters and outline classification of modern reptiles with suitable examples</td>
<td>2 hrs</td>
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<tr>
<td>2.5. Adaptive radiation in extinct reptiles with suitable examples</td>
<td>2 hrs</td>
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<tr>
<td>2.6. Temporal fossae in reptiles</td>
<td>2 hrs</td>
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<tr>
<td>2.7. Interesting features of Sphenodon.</td>
<td>1 hr</td>
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<tr>
<th><strong>MAMMALIA</strong></th>
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<tbody>
<tr>
<td>2.7. General characters, differences between Ratitae and Carinatae.</td>
<td>2 hrs</td>
</tr>
<tr>
<td>2.8. Interesting features of Archaeopteryx.</td>
<td>1 hr</td>
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<tr>
<td>2.9. Flight adaptations in birds</td>
<td>2 hrs</td>
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<td>3.0. Migration in birds</td>
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<tbody>
<tr>
<td><strong>MAMMALIA</strong></td>
<td>11 hrs</td>
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<tr>
<td>3.1. General characters and classification upto subclasses (Prototheria, Metatheria and Eutheria) with suitable examples.</td>
<td>2 hrs</td>
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<tr>
<td>3.2. <strong>Type study: Rat</strong>: Morphology, digestive system, circulatory system (arterial and venous), brain and cranial nerves, urinogenital system (male and female).</td>
<td>9 hrs</td>
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UNIT: IV
ECONOMIC ZOOLOGY-III  10hrs

4.1. Pisciculture:  3 hrs
   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:
5. Economic Zoology by Shukla and Upadayana(2016)
7. Protochordata by Bhatia(1972)
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.
     b. Cyclostoma: Petromyzon, Ammocoete larva and Myxine.

02. Pisces:  03 Units
   a. Cartilaginous Fishes: Narcine, Trygon, Pristis, Myolobatis (any two)
c. Accessory respiratory organs: *Saccobranchus, Clarias and Anabas*

03. **Amphibia:**
   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*.

05. **Aves:**
   b. Types of feathers.

06. **Mammalia:** *Mongoose, Squirrel, Pangolin, Hedge Hog, and Loris*.

07. **Mounting:** Preparation of whole mount of fish scale/ coelenterate colony/ mouth parts of insects

08. **Observation of systems in shark and rat** (Use of dissected animal/ photograph/ chart/model)
   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**

|   | **Systematics:** Identify, classify and comment on the specimens A, B, C, D and E (E is from endoskeleton of frog/bird) with neat labelled diagram. | 20 marks  
|   | **(5x4)** |   |
| 01 | **Whole mount:** Prepare a whole mount of the given material. | 05 marks |
| 02 | **Observation of system/organ/chart/model:** Identify and describe F with a neat labelled diagram. | 05 marks |
| 03 | **Class Records** | 05 marks |
| 04 | **Total** | 35 marks |
IV SEMESTER B.Sc ZOOLOGY
PAPER IV: COMPARATIVE ANATOMY, HUMAN ANATOMY, CELL BIOLOGY AND HISTOLOGY

UNIT: I 09 hrs
COMPARATIVE ANATOMY
1.1. Respiratory organs in Fishes (gills and swim bladders), 03 hrs
    Respiratory organs in Amphibians, Reptiles, Birds and Mammals (lungs).
1.2. Circulatory system:
    a. Evolutionary trends of heart in vertebrates. 06 hrs
    b. Evolutionary trends of aortic arches in vertebrates.

UNIT: II 07 hrs
COMPARATIVE ANATOMY
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

UNIT: III 11 hrs
HUMAN ANATOMY
3.1. Digestive system, Lung, Heart, Kidney, Brain, Eye and Ear. 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.

UNIT: IV 15 hrs
CELL BIOLOGY
4.1. Ultra structure of an animal cell: 07 hrs
    Functions – transport across cell membrane: passive transport (simple and facilitated diffusion; osmosis) and active transport (Na\(^+\), H\(^+\) and Ca\(^{2+}\) 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, 02 hrs
    carcinogens, prevention and regulation; chemotherapy, radiotherapy and gene therapy
4.4. Cell senescence and Apoptosis 01 hr
    Immunology: 04 hrs
a. Active and Passive immunity.
b. Hypersensitivity and allergy.
c. Autoimmune diseases: Myasthenia gravis and rheumatoid arthritis.

UNIT: V

HISTOLOGY

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

REFERENCES:

1. Comparative Anatomy by Romer(1977)
2. Comparative Anatomy by Eten and Kent(1954)
9. Histology by Bailey(1975)
10. Histology by Bevelander(1979)
11. Histology by Ham(1987)
IV SEMESTER B.Sc., ZOOLOGY PRACTICAL
PAPER – IV: COMPARATIVE ANATOMY, HUMAN ANATOMY,
CELL BIOLOGY 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).

Human Osteology: 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, CELL BIOLOGY AND HISTOLOGY: PRACTICAL – IV

Duration: 3 hrs. Max. Marks: 35

| 01. Comparative Anatomy: Identify A and B and comment on the evolutionary trends with labelled diagrams. | 08 marks |
| 02. Human osteology: Identify C and D and comment with labelled diagrams. | 05 marks |
| 03. Cell Biology: Prepare a temporary squash of the given material. Identify and comment on the observed stage. | 05 marks (3+2) |
| 04. Histology: Identify and comment on the histological features of E, F and G with neat labelled diagrams | 2 marks (3x4) |
| 05. Class Records | 05 marks |
| **Total** | **35 marks** |
V SEMESTER B.Sc ZOOLOGY
PAPER – V:ENVIRONMENTAL BIOLOGY & ETHOLOGY

UNIT: I
ENVIRONMENTAL BIOLOGY

1.1 Fundamentals of Ecology:
   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.

1.3 Primary and Secondary productivity in an ecosystem.


1.5 Community Ecology: Interspecific interactions – Negative (Antibiosis, Competition, Parasitism and Predatism) and Positive (Commensalism, Proto Co-operation and Mutualism).

1.6 Ecological succession:
   a. Definition, Causes, Types, Examples – Hydrosere and Xerosere.
   b. Concept of climax – Monoclimax theory, Polyclimax theory and Climax pattern hypothesis.

1.7 Current Environmental Issues:
   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

2.1 Toxicology:
   a. Definition.
   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 **Integrated pest management (IPM):** Definition and types. 01 hr

2.3 **Energy Resources:** 03 hrs
   a. Types: renewable and non-renewable.
   c. Nuclear energy and Nuclear reactions: Definition, risk of nuclear accidents, advantages and disadvantages of nuclear power plants.

2.4 **Solid waste management:** Disposal and recovery (Collection centres, Land filling, Incinerations, Recycling of Wastes and construction of Sanitary Latrines). 01 hr

2.5 **Wild life conservation and its management:** 03 hrs
   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 a. **Remote sensing:** Definition, types (Satellite remote sensing and Microwave remote sensing) and applications. 02 hrs
   b. **Geographic information system (GIS):** Definition, components and applications.

**UNIT III - ETHOLOGY (ANIMAL BEHAVIOUR) 3hrs**

3.1 Introduction to animal behaviour, historical perception, aims and objectives. 01 hr

3.2 **Stereotyped and Acquired behaviour:** 02 hrs
   a. Stereotyped behaviour: Kinesis, Taxes, Reflexes, Instincts and Motivation with suitable examples.

3.3 **Pheromones (Chemical communication):** Definition and types, Pheromones in insects and vertebrates. 01 hr

3.4 **Social behaviour:** 02 hrs
   a. Social behaviour in Insects – Honey Bees and Termites.
   b. Social system in Primates: Monkeys and Apes.

3.5 **Biological rhythms:** Definition, Circadian rhythm and Biological clock. 01 hr

3.6 **Communication in Animals:** Dances of Honey Bees, Alarm calls, Eco-location or Sonar in Bat, Aggression and Bioluminescence. 02 hrs

3.7 **Parental care:** Fishes and Amphibians (two examples each) 01 hr

3.8 **Special/unique behaviour:** 03 hrs
   - Courtship behaviour
   - Altruism
   - Kin selection
   - Mimicry

**References:**
1. Animal behaviour by Alock(2013)
5. Learning and instinct in animals by Thorpe (1956)

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.
5. Estimation of total hardness.

II. Ecological Adaptations:
03 units
1. Tubiculous worms: Arenicola and Chaetopterus.
2. Fossorial (Burrowing) forms: Dentalium.
   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.

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**

<table>
<thead>
<tr>
<th>Duration: 3 hrs.</th>
<th>Max.Marks: 35</th>
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<tbody>
<tr>
<td><strong>01</strong> Limnology:</td>
<td>08 marks</td>
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<tr>
<td>Identify and comment on the observed Plankton/s in the given water sample.</td>
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<td><strong>OR</strong></td>
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<tr>
<td>Estimate ------ in the given water sample and discuss the result.</td>
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<tr>
<td>(experiment from serial number 2 to serial number 6 of Unit I)</td>
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<tr>
<td><strong>02</strong> Ecological adaptations: Identify, draw a neat labelled diagram and comment on the ecological adaptations of A, B, &amp; C.</td>
<td>12 marks</td>
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<td>(4x3)</td>
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<tr>
<td><strong>03</strong> Ethology: Identify and discuss on the behaviour of D &amp; E</td>
<td>5 marks</td>
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<tr>
<td>(2½+2½)</td>
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<tr>
<td><strong>04</strong> Project Report submission</td>
<td>05 marks</td>
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<tr>
<td><strong>05</strong> Class Records</td>
<td>05 marks</td>
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**Total 35 marks**

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

GENETICS

1.1 Heredity and Environment: Concept of genotype, phenotype, phenocopy, Norm of reactions (Experiments on Potentilla glandulosa, Fur colour in Himalayan Rabbit, studies of Human twins). 02 hrs

1.2 Introduction to Mendelism: Mendelian principles- Law of segregation and Law of independent assortment. 02 hrs

1.3 Deviation from Mendelism:
   a. Multiple allelism (Ex: Inheritance of ABO blood groups), Rh factor and its inheritance, significance of Rh factor: Erythroblastosis foetalis.
   c. Multiple factor inheritance: Inheritance of skin colour in man.
   d. Sex linkage:
      • X – linked inheritance, Eye colour in Drosophila, Colour blindness and Haemophilia.
      • Construction of pedigree charts for colour blindness and haemophilia.
      • Y – linked inheritance: Hypertrichosis in man.

1.4 Cytoplasmic inheritance: Kappa particles in Paramecium, Coiling of shells in snail. 01 hr

UNIT II

13 hrs

2.1 Giant chromosomes: Polytene and Lampbrush chromosomes. 02 hrs

2.2 a. Chromosomal basis of sex determination: Types with examples. 02 hrs
   b. Genic balance theory.
   c. Gynandromorphs and Free Martins.

2.3 a. Numerical aneuploidy—Down’s syndrome, Cri du Chat syndrome, Turner’s syndrome and Klinefelter’s syndrome. 03 hrs
   b. Genetic diseases: Alcaptonuria, Albinism, Thalassemia, Galactosemia and Cystic fibrosis.

2.4 Concept of gene: Fine structure of gene: Cistron, Recon and Mution, Operon concept: Inducible Operon (E.g. Lac Operon) 01 hr

2.5 Gene mutations: Spontaneous and induced mutations, CIB method of detection of mutations, Physical, Chemical and Biological mutagens. 03 hrs

2.6 a. Eugenics: Definition, aspects of positive eugenics and negative eugenics. 02 hrs
   b. Euthenics and Euphenics.

UNIT III

BIOTECHNOLOGY

14 hrs

3.1 Genetic Engineering / Recombinant DNA (rDNA) Technology 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.

3.2 Applications of Biotechnology:

a. Transgenesis: 01 hr
   i. Introduction – Meaning and significance.
   ii. Transgenesis in mice, Knock out and Knock in technology.

b. Animal improvement: 02 hrs
   i. Super ovulation and embryo transfer: Steps, benefits and limitations of embryo transfer.
   ii. Artificial insemination

c. Gene therapy: 01 hr
   i. Somatic cell gene therapy, Embryo cell gene therapy and Germ cell gene therapy.
   ii. In vivo and ex-vivo gene therapy.

d. Stem cells: Introduction, features, types, sources and applications 01 hr

e. Hybridoma technology: Monoclonal antibodies and their applications.

f. DNA fingerprinting: Definition, steps involved and applications.

3.3 PCR technique: Definition, steps involved and applications. 02 hrs

RFLP, RAPD and AFLP: Definition and applications.

References:
2. Gene cloning by Brown(2016)
5. Transgenic animals by M.M.Ranga(2006)
V SEMESTER B.Sc., ZOOLOGY PRACTICAL - VI
PAPER – VI - GENETICS AND BIOTECHNOLOGY

15 Units

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

01. Drosophila Genetics: 05 marks
    a) Identify and comment on A and B with neat labelled diagram:
       (Drosophila male/female/mutants- any two) (2\(1/2\)+2\(1/2\))
       b) Mounting: Polytene Chromosome (Salivary Gland Chromosome) or Sex comb or Genital Plate.
       or
       Genetic problems (any two) (4+3 marks)

02. Human Genetics: from d to f (any one) 06 marks

03. Biotechnology:
    c) From g, h and i (any one) 06 marks
    d) From 5, 6, 7 and 8 (any one)

04. Class Records 05 marks

Total 35 marks
UNIT I

DEVELOPMENTAL BIOLOGY

1.1 Introduction: Definition and scope, Historical review – Preformation theory, Epigenetic theory, Baer’s Law and Biogenetic law. 01 hr

1.2 Types of eggs: 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

1.3 Reproductive cycles: Oestrous and Menstrual cycles and their regulation 02 hrs

1.4 Patterns of development: Oviparity, ovoviviparity and viviparity with examples. 01 hr

1.5 Fertilization:
   a. Definition, Types, Mechanism of fertilization and significance. 03 hrs
   b. Polypermy: pathological and physiological polyspermy with examples.
   c. Mechanism to block polyspermy in monospermic forms (fast block and slow block).

1.6 Cleavage:
   a. Definition, planes of cleavage – meridional, vertical, equatorial and latitudinal. 02 hrs
   b. Patterns of cleavage – radial, biradial, spiral and bilateral cleavage with examples.
   c. Influence of yolk in cleavage.

1.7 Blastulation: Comparative account with reference to Amphioxus, Frog and Chick. 02 hrs

UNIT II

2.1 Fate maps and cell lineage:
   a. Presumptive organ forming areas and fate maps in Frog and Chick. 02 hrs
   b. Cell lineage in Nereis.

2.2 Gastrulation in Amphioxus, Frog and Chick. 03 hrs

2.3 Frog: Neurulation, post-neurular development and metamorphosis. 02 hrs

2.4 Role of organizers in development: Transplantation experiments of Spemann and Mangold, Chemistry of Organiser. 02 hrs

2.5 Foetal membranes in Chick - formation, structure and function. 01 hr

2.6 Placenta: Types - Yolk sac and Chorio-allantoic placenta; Deciduate and non-deciduate placenta; morphological and histological placental types with suitable examples. 02 hrs

2.7 Parthenogenesis:
   a. Definition.
   b. Natural parthenogenesis (arhenotoky and thelytoky)
   c. Artificial parthenogenesis
   d. Significance of parthenogenesis. 02 hr

2.8 Regeneration:
   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

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
   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).
   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 Cromagnost man

References:
1. Introduction to Embryology by Balinsky B.L.(1970)
5. Embryology by Barath
6. Chick Embryology by Patten(1971)
VI SEMESTER B.Sc., ZOOLOGY PRACTICAL
PAPER – VII - DEVELOPMENTAL BIOLOGY AND ORGANIC EVOLUTION

I. Developmental Biology:

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:

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

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

Duration: 3 hrs.
Max.Marks:35

01 Developmental Biology: 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)

02 Organic Evolution: Identify and comment on the evolutionary trends of E and F with neat labelled diagrams. (Note: From 1 and 2) 06 marks (3x2)

03 Organic Evolution: Identify and comment on ‘G’. (Note: Any one from 3 and 4) 03 marks

04 Viva voce: Based on the questions of the practical examination (Minimum of 3 to 4 questions) 05 marks

05 Class Records 05 marks

Total 35 marks
VI SEMESTER B.Sc ZOOLOGY
PAPER VIII – ANIMAL PHYSIOLOGY AND TECHNIQUES IN BIOLOGY

40 hrs

UNIT I
ANIMAL PHYSIOLOGY

16 hrs

1.1 Digestion:
   i. Neural-Hormonal control of digestive glandular secretion.
   ii. Symbiotic digestion in Ruminants.

1.2 Circulation:
   i. Respiratory pigments: Major types and their features.
   ii. Fuld and Spiro’s theory of blood clotting.

1.3 Respiration:
   i. Regulation of respiration.
   ii. Transport of O₂ and CO₂.
   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).

1.4 Excretion:
   i. Ammonotelism, Uricotelism and Ureotelism with examples.
   ii. Formation of Ammonia (Deamination of amino acids), Urea (Ornithine cycle) and Uric acid (Purine degradation)

1.5 Muscle Physiology:
   i. Ultrastructure of skeletal muscle.
   ii. Chemical composition of muscle.
   iii. Physico-chemical aspects of muscle contraction.
   iv. Sliding filament theory of muscle contraction.

1.6 Neuro-Physiology:
   i. Propagation and conduction of nerve impulse – Axonal and Synaptic.

1.7 Physiology of Sense organs:
   i. Vision
   ii. Hearing

UNIT II

15 hrs

2.1 Homeostatic functions:
   a. Endocrinology:
      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.
   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.
   d. Osmoregulation:
      i. Types of osmoregulatory mechanisms with examples.
      ii. Osmoregulation in migratory fishes.
   e. Thermoregulation in Homeotherms: Methods of heat loss and heat gain,
Role of Hypothalamus in thermoregulation.

2.2 Common disorders in man: Renal failure and dialysis, Anaemia, Diabetes mellitus and Obesity.

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
   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)
4. Elements of Biostatistics by Prasad(2016)
6. Animal Physiology by Hoar(1966)
9. Human Physiology Vol I & II by Chatterjee(2016)
I. Physiology Experiments: 08 Units
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.

II. Techniques in Biology: 05 Units
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

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

Total 35 marks
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)
   \[10 \times 1 = 10\]

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)
   \[5 \times 3 = 15\]

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)
   \[5 \times 5 = 25\]

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)
   \[2 \times 10 = 20\]

\[\text{TOTAL: 70 Marks}\]
### BLUE PRINT FOR PREPARATION OF QUESTION PAPER I

**NONCHORDATA PART-I**

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**ENVIRONMENTAL BIOLOGY & ETHOLOGY**

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**GENETICS AND BIOTECHNOLOGY**

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DEVELOPMENTAL BIOLOGY AND ORGANIC EVOLUTION

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ANIMAL PHYSIOLOGY AND TECHNIQUES IN BIOLOGY

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