FACULTY OF SCIENCE

SYLLABI

FOR

B.Sc. (Honours School) Zoology

1ST TO 6TH SEMESTER

EXAMINATIONS 2015 - 2016
### OUTLINE OF TESTS, SYLLABUS AND COURSES OF READING FOR B.SC. (HONOURS SCHOOL) IN ZOOLOGY (SEMESTER SYSTEM) FOR THE EXAMINATION, 2015-2016

**B.Sc. (H.S.) First Semester**  
Zoology (Major)

<table>
<thead>
<tr>
<th>Paper</th>
<th>Course/Paper</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Theory</td>
<td>Practical</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Course No.</td>
<td>Marks</td>
</tr>
<tr>
<td>I</td>
<td>English</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>II</td>
<td>Chemistry/Biochemistry (Subsidiary-I)</td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>III</td>
<td>Botany (Subsidiary-II)</td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>IV</td>
<td>Zoology-I (Biodiversity: Invertebrates-I)</td>
<td>BZO 1001</td>
<td>75</td>
</tr>
<tr>
<td>V</td>
<td>Zoology-II (Biodiversity: Chordates-I)</td>
<td>BZO 1002</td>
<td>75</td>
</tr>
</tbody>
</table>

Total Credits: 20  
Total Marks: 500

**B.Sc. (H.S.) First Semester**  
Zoology (Subsidiary)

<table>
<thead>
<tr>
<th>Paper</th>
<th>Course/Paper</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Theory</td>
<td>Practical</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Course No.</td>
<td>Marks</td>
</tr>
<tr>
<td>I</td>
<td>Zoology-IIS (Invertebrates-I)</td>
<td>BZO 1031</td>
<td>75</td>
</tr>
</tbody>
</table>

**B.Sc. (H.S.) Second Semester**  
Zoology (Major)

<table>
<thead>
<tr>
<th>Paper</th>
<th>Course/Paper</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Theory</td>
<td>Practical</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Course No.</td>
<td>Marks</td>
</tr>
<tr>
<td>I</td>
<td>English</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>II</td>
<td>Chemistry/Biochemistry (Subsidiary-I)</td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>III</td>
<td>Botany (Subsidiary-II)</td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>IV</td>
<td>Zoology-III (Biodiversity: Invertebrates-II)</td>
<td>BZO 1003</td>
<td>75</td>
</tr>
<tr>
<td>V</td>
<td>Zoology-IV (Biodiversity: Chordates-II and evolution)</td>
<td>BZO 1004</td>
<td>75</td>
</tr>
</tbody>
</table>

Total Credits: 20  
Total Marks: 500

**B.Sc. (H.S.) Second Semester**  
Zoology (Subsidiary)

<table>
<thead>
<tr>
<th>Paper</th>
<th>Course/Paper</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Theory</td>
<td>Practical</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Course No.</td>
<td>Marks</td>
</tr>
<tr>
<td>II</td>
<td>Zoology-IIS (Invertebrates-II)</td>
<td>BZO 1032</td>
<td>75</td>
</tr>
</tbody>
</table>

[2]
### B.Sc. (H.S.) Second Semester

**Zoology (Subsidiary) (For Basic Medical Sciences Only)**

<table>
<thead>
<tr>
<th>Paper</th>
<th>Course/Paper</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Course No.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Marks</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>Zoology Subsidiary (For Basic Medical Sciences Only)</td>
<td>BZO 1033</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BZO 1073</td>
<td>25</td>
</tr>
</tbody>
</table>

### B.Sc. (H.S.) Third Semester

**Zoology (Major)**

<table>
<thead>
<tr>
<th>Paper</th>
<th>Course/Paper</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Course No.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Marks</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>Biochemistry (Subsidiary-I)</td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>II</td>
<td>Botany (Subsidiary-II)</td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>III</td>
<td>Zoology-V: Functional Anatomy of Non-Chordates-I (Protozoa, Porifera and Coelenterata)</td>
<td>BZO 2001</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BZO 2051</td>
<td>25</td>
</tr>
<tr>
<td>IV</td>
<td>Zoology-VI: Functional Anatomy of Non-Chordates-II (Helminths)</td>
<td>BZO 2002</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BZO 2052</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BZO 2053</td>
<td>25</td>
</tr>
</tbody>
</table>

Total Credits: 20
Total Marks: 500

### B.Sc. (H.S.) Third Semester

**Zoology (Subsidiary)**

<table>
<thead>
<tr>
<th>Paper</th>
<th>Course/Paper</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Course No.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Marks</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>Zoology-III (Biodiversity: Chordates-I)</td>
<td>BZO 2031</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BZO 2071</td>
<td>25</td>
</tr>
</tbody>
</table>

### B.Sc. (H.S.) Fourth Semester

**Zoology (Major)**

<table>
<thead>
<tr>
<th>Paper</th>
<th>Course/Paper</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Course No.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Marks</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>Biochemistry (Subsidiary-I)</td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>II</td>
<td>Botany (Subsidiary-II)</td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>III</td>
<td>Zoology-VIII: Functional Anatomy of Non-Chordates-IV (Arthropoda-II)</td>
<td>BZO 2004</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BZO 2054</td>
<td>25</td>
</tr>
<tr>
<td>IV</td>
<td>Zoology-IX: Functional Anatomy of Non-Chordates-V (Annelida and Minor Phyla)</td>
<td>BZO 2005</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BZO 2055</td>
<td>25</td>
</tr>
<tr>
<td>V</td>
<td>Zoology-X: Functional Anatomy of Non-Chordates-VI (Mollusca and Echinodermata)</td>
<td>BZO 2006</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BZO 2056</td>
<td>25</td>
</tr>
</tbody>
</table>

Total Credits: 20
Total Marks: 500

### B.Sc. (H.S.) Fourth Semester

**Zoology (Subsidiary)**

<table>
<thead>
<tr>
<th>Paper</th>
<th>Course/Paper</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Course No.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Marks</td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>Zoology-IVS (Biodiversity: Chordates-II)</td>
<td>BZO 2032</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BZO 2072</td>
<td>25</td>
</tr>
</tbody>
</table>
B.Sc. (H.S.) Fifth Semester
Zoology (Major)

<table>
<thead>
<tr>
<th>Paper</th>
<th>Course/Paper</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Zoology-XI: General Account of Vertebrates (Fishes, Amphibians and Reptiles)-I</td>
<td>BZO 3001 75 BZO 3051 25</td>
<td>4</td>
</tr>
<tr>
<td>II</td>
<td>Zoology-XII: Comparative Anatomy of Vertebrates-I and Wildlife</td>
<td>BZO 3002 75 BZO 3052 25</td>
<td>4</td>
</tr>
<tr>
<td>III</td>
<td>Zoology-XIII: Cell Biology</td>
<td>BZO 3003 75 BZO 3053 25</td>
<td>4</td>
</tr>
<tr>
<td>IV</td>
<td>Zoology-XIV: Animal Physiology</td>
<td>BZO 3004 75 BZO 3054 25</td>
<td>4</td>
</tr>
<tr>
<td>V</td>
<td>Zoology-XIV: Taxonomy, Ecology and Palaeontology-I</td>
<td>BZO 3005 75 BZO 3055 25</td>
<td>4</td>
</tr>
</tbody>
</table>

Total Credits: 20
Total Marks: 500

B.Sc. (H.S.) Sixth Semester
Zoology (Major)

<table>
<thead>
<tr>
<th>Paper</th>
<th>Course/Paper</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Zoology-XVI: General account of Vertebrates (Aves and Mammals)-II and Zoogeography</td>
<td>BZO 3006 75 BZO 3056 25</td>
<td>4</td>
</tr>
<tr>
<td>II</td>
<td>Zoology-XVII: Comparative anatomy of Vertebrates-II</td>
<td>BZO 3007 75 BZO 3057 25</td>
<td>4</td>
</tr>
<tr>
<td>III</td>
<td>Zoology-XVIII: Cytogenetics</td>
<td>BZO 3008 75 BZO 3058 25</td>
<td>4</td>
</tr>
<tr>
<td>IV</td>
<td>Zoology-XIX: Embryology and Endocrinology</td>
<td>BZO 3009 75 BZO 3059 25</td>
<td>4</td>
</tr>
<tr>
<td>V</td>
<td>Zoology-XX: Taxonomy, Ecology and Palaeontology-II</td>
<td>BZO 3010 75 BZO 3060 25</td>
<td>4</td>
</tr>
</tbody>
</table>

Total Credits: 20
Total Marks: 500

Consolidation of Marks for B.Sc. (H.S.) Zoology (Major)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Class</th>
<th>Total Marks</th>
<th>Total No. of Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>B.Sc. (H.S.) 1st Year</td>
<td>1000</td>
<td>40</td>
</tr>
<tr>
<td>2</td>
<td>B.Sc. (H.S.) 2nd Year</td>
<td>1000</td>
<td>40</td>
</tr>
<tr>
<td>3</td>
<td>B.Sc. (H.S.) 3rd Year</td>
<td>1000</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td><strong>Grand Total</strong></td>
<td><strong>3000</strong></td>
<td><strong>120</strong></td>
</tr>
</tbody>
</table>

IMPORTANT NOTE:
The Environment & Road Safety Education is a compulsory qualifying paper, which the students have to study in the B.Sc. 1st year (2nd Semester). If the student/s failed to qualify the paper during 2nd semester, he/she /they will be allowed to appear /qualify the same in the 4th or 6th Semester/s.
ENVIRONMENT AND ROAD SAFETY EDUCATION (SEMESTER – II)

Note: The syllabus has 15 topics to be covered in 25 hour lectures in total, with 2 lectures in each topic from 2 to 11 and one each for the topics 1 and 12 to 15.

1. Environment Concept:
Introduction, concept of biosphere – lithosphere, hydrosphere, atmosphere; Natural resources – their need and types; Principles and scope of Ecology; concepts of ecosystem, population, community, biotic interactions, biomes, ecological succession.

2. Atmosphere:
Parts of atmosphere, components of air; pollution, pollutants, their sources, permissible limits, risks and possible control measures.

3. Hydrosphere:
Types of aquatic systems; Major sources (including ground water) and uses of water, problems of the hydrosphere, fresh water shortage; pollution and pollutants of water, permissible limits, risks and possible control measures.

4. Lithosphere:
Earth crust, soil – a life support system, its texture, types, components, pollution and pollutants, reasons of soil erosion and possible control measures.

5. Forests:
Concept of forests and plantations, types of vegetation and forests, factors governing vegetation, role of trees and forests in environment, various forestry programmes of the Govt. of India, Urban Forests, Chipko Andolan.

6. Conservation of Environment:
The concepts of conservation and sustainable development, why to conserve, aims and objectives of conservation, policies of conservation; conservation of life support systems – soil, water, air, wildlife, forests.

7. Management of Solid Waste:
Merits and demerits of different ways of solid waste management– open dumping, landfill, incineration, resource reduction, recycling and reuse, vermicomposting and vermiculture, organic farming.

8. Indoor Environment:
Pollutants and contaminants of the in-house environment; problems of the environment linked to urban and rural lifestyles; possible adulterants of the food; uses and harms of plastics and polythene; hazardous chemicals, solvents and cosmetics.

9. Global Environmental Issues:
Global concern, creation of UNEP; Conventions on climate change, Convention on biodiversity; Stratospheric ozone depletion, dangers associated and possible solutions.

10. Indian Laws on Environment:
Indian laws pertaining to Environmental protection: Environment (Protection) Act, 1986; General information about laws relating to control of air, water and noise pollution. What to do to seek redressal.

11. Biodiversity:
What is biodiversity, levels and types of biodiversity, importance of biodiversity, causes of its loss, how to check its loss; Hotspot zones of the world and India, Biodiversity Act, 2002.

12. Noise and Microbial Pollution:
Polution due to noise and microbes and their effects.

13. Human Population and Environment:

14. Social Issues:
Environmental Ethics: Issues and possible solutions, problems related to lifestyle, sustainable development; Consumerisms and waste generation.

15. Local Environmental Issues:
Environmental problems in rural and urban areas. Problem of Congress Grass & other weeds, problems arising from the use of pesticides and weedicides, smoking etc.

Practical
Depending on the available facility in the college, a visit to vermicomposting units or any other such non-polluting eco-friendly site or planting/caring of vegetation/trees could be taken.

Examination Pattern:
A qualifying paper of 50 marks comprising of fifty multiple choice questions (with one correct and three incorrect alternatives and no deduction for wrong answer or un-attempted question), and of 1 hour duration.

The students have to obtain 33% marks to qualify the paper. The marks are not added / included in the final mark sheet.

UNIT II (ROAD SAFETY)

1. Concept and Significance of Road Safety.
2. Role of Traffic Police in Road Safety.
3. Traffic Engineering – Concept & Significance.
5. How to obtain Driving License.
7. Common Driving mistakes.
8. Significance of First-aid in Road Safety.
9. Role of Civil Society in Road Safety.

Note: Examination Pattern:
- The Environment and Road Safety paper is 70 marks.
- Seventy multiple choice questions (with one correct and three incorrect alternatives and no deduction for wrong or un-attempted questions).
- The paper shall have two units: Unit I (Environment) and Unit II (Road Safety).
- Unit II shall comprise of 20 questions with minimum of 1 question from each topics 1 to 10.
- The entire syllabus of Unit II is to be covered in 10 hours.
- All the questions are to be attempted.
- Qualifying Marks 33 per cent i.e. 23 marks out of 70.
- Duration of examination: 90 minutes.
- The paper setter is requested to set the questions strictly according to the syllabus.

Suggested Readings
2. Road Safety Signage and Signs (2011), Ministry of Road Transport and Highways, Government of India.

Websites:
(a) www.chandigarhpolice.nic.in
(b) www.punjabpolice.gov.in
(c) www.haryanapolice.gov.in
(d) www.hppolice.nic.in
Objectives
To enable the students to develop an appreciation for the biodiversity of invertebrate species and to impart knowledge about co-existence of different forms of living organisms ranging from unicellular to multicellular animals. Studies on this group of animals bring to light knowledge of basic functions of life viz., nutrition, respiration, excretion, reproduction etc. and how the organisms of various phyla structurally and functionally adapt themselves for surviving in different ecological conditions.

Classification and general characters of the following phyla up to orders with a detailed study of the animals mentioned against each phylum in Units given below:

UNIT-I
Protozoa : Amoeba, Euglena, Paramecium, Plasmodium

UNIT-II
Porifera : Sycon
Coelenterata : Obelia, Aurelia, Sea anemone

UNIT-III
Platyhelminthes : Planaria, Fasciola, Taenia

UNIT-IV
Nematoda : Ascaris, Enterobius, Hookworm

Note: Examiner will set a total of nine questions comprising two questions from each Unit, and one compulsory question of short answer type covering the whole syllabus. It will consist of eight short answer questions of 1½ marks each. Students will attempt one question from each Unit and the compulsory questions. All questions may carry equal marks.

Books Recommended
Practicals based on Theory Paper BZO 1001 (BZO 1051):

| Classification up to orders and study of the specimens mentioned against each phylum with ecological note. |

1. **Protozoa** (a) Culture of Amoeba, Euglena, Paramecium and Vorticella.
   (b) Permanent slides of Balantidium, Nyctotherus, Opalina, Radiolarian and Foraminiferan.

2. **Porifera** (a) Specimens: Sycon, Grantia, Spongilla, Euplectella, Hyalonema, Chalina, Euspongia.
   (b) Permanent slides: Spicules, Gemmules, Sycon (T.S. and L.S.).

   (b) Permanent slides: Hydra (W.M.) with bud, T.S. through the regions of testis and ovary, Obelia (colony, medusa and polyp), Sertularia, Tubipora, Plumularia, Pennaria, Bougainvillea.

4. **Platyhelminthes** (a) Specimens: Planaria, Fasciola, Taenia, Ascaris (male and female).
   (b) Permanent slides: Planaria (W.M.), Fasciola (W.M. & T.S.), miracidium larva, sporocyst, redia, cercaria, Taenia (scolex. Proglottid-mature and gravid, T.S.), Ascaris (T.S. male and female-gravid)

**Note:** Candidate will be required to submit duly signed note-books of practical record.

---

**Paper-V**

**Zoology-II (Biodiversity: Chordates-I) (BZO 1002)**

<table>
<thead>
<tr>
<th>Theory hours per week: 4</th>
<th>Practical hours per week: 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Marks</strong>: 100</td>
<td><strong>Theory</strong>: 75</td>
</tr>
<tr>
<td><strong>Theory</strong>: 75</td>
<td>Internal Ass. : 15</td>
</tr>
<tr>
<td><strong>Internal Ass.</strong>: 05</td>
<td>Annual Exam. : 60</td>
</tr>
<tr>
<td><strong>Annual Exam</strong>: 25</td>
<td><strong>Practical</strong>: 25</td>
</tr>
<tr>
<td></td>
<td>Internal Ass. : 05</td>
</tr>
<tr>
<td></td>
<td>Annual Exam: 20</td>
</tr>
</tbody>
</table>

**Objectives**

To acquaint the students about the structure and function of protochordates and chordates and to make the student understand the basic characters, advancements and adaptations of different types of vertebrates.

Detailed study (morphology & anatomy), systematic position, distinctive characters, distribution, ecology, economic importance, if any, of the following animals:
UNIT-I
Urochordata : Herdmania including development and affinities, alternation of generation in Urochordata.

UNIT-II
Cephalochordata : Branchiostoma including its development and affinities.
Cyclostomata : Petromyzon including its migration.

UNIT-III
Pisces : Labeo
Amphibia : Rana

UNIT-IV
Reptilia : Uromastix

Note: Examiner will set a total of nine questions comprising two questions from each Unit, and one compulsory question of short answer type covering the whole syllabus. It will consist of eight short answer questions of 1½ marks each. Students will attempt one question from each Unit and the compulsory questions. All questions may carry equal marks.

Book Recommended

Practicals based on Theory Paper BZO 1002 (BZO 1052):

Marks : 25
Internal Ass. : 05
Annual Exam.: 20

1. Demonstration of dissection of Herdmania and Labeo to show internal anatomy through charts/models/video clipping.
2. Skeleton : To study the skeleton of Labeo, Rana, Varanus.
3. Prepared Slides: T.S. *Branchiostoma* through different regions, Placoid, cycloid and ctenoid scales of fishes, pharynx and spicules of *Herdmania*.

4. Specimens: General survey and classification up to orders, (except Pisces and Aves where it is required only upto sub-classes), habitat, habits, external characters and economic importance (if any) of the following animals.

Protochordata – *Herdmania, Molgula, Ciona, Ascidia, Botryllus, Pyrosoma, Salpa, Doliolum, Oikopleura* and *Branchiostoma*.

Cyclostomata – *Myxine, Petromyzon* and *Ammocoetes* larva.

Chondrichthyes - *Zygaena, Pristis, Narcine, Trygon* and *Rhinobatos*.

Actinopterygii – *Polypterus, Acipenser, Lepidosiren, Mystus, Catla, Labeo rohita, Cirrhinus mrigala, Cyprinus carpio, Hippocampus, Syngnathus, Exocoetus, Anabas, Diodon, Ostracion, Tetradon, Echeneis, Lophius, Solea* and *Anguilla*.

Dipneusti (Dipnoi) – Any of the lungfishes.

Amphibia – *Necturus, Proteus, Ambiuma, Salamandra, Ambystoma, Triton, Hyla, Rhacophorus, Uraeotyphlus, Ichthyophis* and *Axolotl* larva.

Reptilia- Tortoise, Turtle, *Hemidactylus, Calotes, Draco, Varanus, Phrynosoma, Chameleon, Typhlops, Python, Erys, Ptyas, Bungarus, Naja, Hydrus, Vipera, Crocodilus, Gavialis* and *Alligator*.

Note: The candidates are required to submit duly signed note books of practical record and the prepared slides.

**ZOOLOGY SUBSIDIARY**

**Paper-I**

**Zoology-IS (Invertebrates-I) (BZO 1031)**

<table>
<thead>
<tr>
<th>Total Marks</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory</td>
<td>75</td>
</tr>
<tr>
<td>Internal Ass.</td>
<td>15</td>
</tr>
<tr>
<td>Annual Exam</td>
<td>60</td>
</tr>
<tr>
<td>Practical</td>
<td>25</td>
</tr>
<tr>
<td>Internal Ass.</td>
<td>05</td>
</tr>
<tr>
<td>Annual Exam</td>
<td>20</td>
</tr>
</tbody>
</table>
Objectives

To enable the students to understand the basic biology of Invertebrates. To understand that the biological science is fundamental to creative thought and the diversity of invertebrate species provides the excellent examples for some of these central principles.

Classification and general characters of following Phyla up to orders with a detailed study of the animals mentioned against each phylum in the Units given below:

UNIT – I
Protozoa : Amoeba, Euglena, Paramecium and Plasmodium.

UNIT-II
Porifera : Sycon
Coelenterata : Obelia

UNIT –III
Platyhelminthes : Planaria, Fasciola hepatica, Taenia solium, Parasitic adaptations of Platyhelminthes.

UNIT-IV
Nematoda : Ascaris, Hook worm, Enterobious

Note: Examiner will set a total of nine questions comprising two questions from each Unit, and one compulsory question of short answer type covering the whole syllabus. It will consist of eight short answer questions of 1½ marks each. Students will attempt one question from each Unit and the compulsory questions. All questions may carry equal marks.

Books Recommended

Practicals based on Theory Paper BZO 1031 (BZO 1071):

Classification up to orders and important characters alongwith ecological note of the specimens mentioned against each phylum.

1. Protozoa  (a) Culture of Amoeba, Euglena, Paramecium and Vorticella.
   (b) Prepared slides : Balantidium, Nectotherus, Opalina, Radiolarian and Foraminiferan oozes.

2. Porifera  (a) Specimens : Sycon, Grantia, Spongilla.
   (b) Prepared slides : Spicules, Gemmules, Sycon (T.S. and L.S.)
3. **Coelenterata**
   (a) Specimens: *Porpita, Velella, Physalia, Aurelia, Metridium, Alycyonium, Tubipora, Zooanthus, Madrepora, Favia, Fungia.*
   (b) Prepared slides: *Hydra* (W.M. with bud, T.S. through the regions of testis and ovary), *Obelia* (colony and medusa), *Sertularia, Tubularia, Plumularia.*

4. **Platyhelminthes and Nematoda**
   (a) Specimens: *Planaria, Fasciola, Taenia, Ascaris* (male & female)
   (b) Prepared slides: *Planaria* (W.M.), Liver fluke (W.M., T.S.)
       Larvae: miracidium, sporocyst, redia, cercaria), *Taenia*
       (mature and gravid proglottids, scolex), *Ascaris* (T.S. of male and female- gravid).

**Note:** Candidates will be required to submit duly signed note-books of practical record and prepared slides.
B.Sc. (HONS.SCHOOL) SECOND SEMESTER

ZOOGOY MAJOR

Paper-IV
Zoology-III (Biodiversity: Invertebrates-II) (BZO 1003)

Total Marks : 100

Theory hours per week: 4
Practical hours per week: 4

Theory : 75
Internal Ass. : 15
Annual Exam. : 60
Practical : 25
Internal Ass. : 05
Annual Exam : 20

Objectives
To enable the student to develop an appreciation for the biodiversity of invertebrate species and to impart knowledge about co-existence of different forms of living organisms ranging from unicellular to multicellulars. Studies on this group of animals bring to light variety of modes of performing basic functions of life viz., nutrition, respiration, excretion, reproduction etc. and how the organisms of various phyla structurally and functionally adapt themselves for surviving in different ecological conditions.

Classification and general characters of the following phyla up to orders with a detailed study of the animals mentioned against each phylum in Units given below. :

UNIT-I
Annelida : Nereis, Earthworm

UNIT-II
Arthropoda : Palaemon, Cockroach

UNIT-III
Mollusca : Pila, Anodonta

UNIT-IV
Echinodermata : Asterias, Sea urchin, Sea cucumber
Hemichordata : Balanoglossus (external characters only) and its systematic position.

Note: Examiner will set a total of nine questions comprising two questions from each Unit, and one compulsory question of short answer type covering the whole syllabus. It will consist of eight short answer questions of 1½ marks each. Students will attempt one question from each Unit and the compulsory questions. All questions may carry equal marks.

Books Recommended


Practicals based on Theory Paper BZO 1003 (BZO 1053):

Marks :25
Internal Ass.: 05
Annual Exam.: 20

Classification up to orders and study of the specimens mentioned against each phylum with ecological note.

1. Annelida
   (a) Demonstration of dissection of Earthworm and Nereis to show Nervous, digestive, excretory and reproductive systems through charts/models/video clipping.
   

   (c) Prepared slides: Earthworm (T.S. typhlosolar region, setae, pharyngeal nephridia, septal nephridium and integumentary nephridium).

   Nereis (parapodium of Nereis and Heteronereis).

2. Arthropoda
   (a) Demonstration of dissection of Cockroach (Digestive, Nervous, and Reproductive systems) and Prawn (Appendages, Digestive and Nervous systems) through charts/models/video clipping

   (b) Specimens: Peripatus, Lepisma, cockroach, grasshopper, praying mantis, earwig, dragonfly, termite (queen and other castes), ant, butterfly, moth, beetle, wasp, honeybee, crab, prawn, Lepas, Balanus, Apus, Limulus, scorpion, spider, millipede and centipede.

   Prepared slides: Body louse, bed-bug, rat flea, Cypris, Cyclops, Daphnia, trachea of insects, genitalia of cockroach, gill and statocyst of prawn.

3. Mollusca
   (a) Demonstration of dissection of Anodonta (Digestive and Nervous systems) and Pila (Pallial complex, Digestive and Nervous systems) through charts/models/video clipping

   (b) Specimens: Anodonta, Mytilus, Pholas, Pecten, Haliotis, Aply sia, Doris, Limax, Pila, Sepia, Octopus, Nautilus, Chiton and Anodonta.

   (c) Prepared slides: Glochidium larva, radula of Pila and gill lamina of Anodonta.

4. Echinodermata
   (a) Specimens: Asterias, Echinus, Cucumaria, Antedon, Ophiothrix.

   (b) Prepared slide: T.S. of Star-fish.
5. Hemichordata  
(a) Specimens: *Balanoglossus*.  
(b) Prepared slide: T.S. *Balanoglossus*, Tornaria larva.

*Note:* Candidate will be required to submit duly signed note-books of practical record.

---

**Paper-V**

**Zoology-IV (Biodiversity: Chordates-II and Evolution) (BZO 1004)**

<table>
<thead>
<tr>
<th>Theory hours per week: 4</th>
<th>Practical hours per week: 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Marks</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Theory</strong></td>
<td>75</td>
</tr>
<tr>
<td>Internal Ass. :</td>
<td>15</td>
</tr>
<tr>
<td>Annual Exam.</td>
<td>60</td>
</tr>
<tr>
<td><strong>Practical</strong></td>
<td>25</td>
</tr>
<tr>
<td>Internal Ass. :</td>
<td>05</td>
</tr>
<tr>
<td>Annual Exam:</td>
<td>20</td>
</tr>
</tbody>
</table>

**Objectives**

To acquaint the students about the structure and function of chordates and to make the student understand the basic characters, advancements and adaptations of different types of vertebrates.

Detailed study (morphology & anatomy), systematic position, distinctive characters, distribution, ecology, economic importance, if any, of the following animals:

**UNIT-I**

- **Aves**: *Columba*

**UNIT-II**

- **Mammalia**: *Oryctolagus*

**UNIT-III**

Origin of life: Origin of bio molecules (DNA, RNA) and its scientific evidence, Origin of prokaryote and eukaryote cells, Origin of unicellularity and multicellularity. 
Evidences from Zoogeography, taxonomy, comparative morphology and anatomy, Palaeontology, Comparative physiology, embryology, genetics, molecular biology and biochemistry.

**UNIT-IV**

Theories: Lamarckism and Neo-Lamarckism; Darwinism and Neo- Darwinism (Synthetic theory) : Weismann’s theory; Mutation theory; mutation, variations and selection; modern concept of interpretation of evolution and future of evolutionary process.

Note: Examiner will set a total of **nine** questions comprising **two** questions from each Unit, and **one compulsory question** of short answer type covering the whole syllabus. It will consist of **eight short answer questions** of 1½ marks each. Students will attempt **one** question from each Unit and the **compulsory questions**. All questions may carry equal marks.

**Book Recommended**


Practicals based on Theory Paper BZO 1004 (BZO 1054):

Marks : 25
Internal Ass. : 05
Annual Exam.: 20

1. Demonstration of dissection of the following animals through charts/models/video clipping:
   (a) Fowl : Digestive, arterial, venous and urinogenital systems.
   (b) Rat : Digestive, arterial, venous and reproductive systems.

2. Skeleton : Gallus and Oryctolagus.


Note : The candidates are required to submit duly signed note books of practical record.

ZOOLGY SUBSIDIARY
Paper-II
Zoology-IIS (Invertebrates-II) (BZO 1032)

<table>
<thead>
<tr>
<th>Theory hours per week: 4</th>
<th>Theory : 75</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical hours per week: 4</td>
<td>Internal Ass. : 15</td>
</tr>
<tr>
<td>Total Marks : 100</td>
<td>Annual Exam. 60</td>
</tr>
<tr>
<td>Practical : 25</td>
<td>Internal Ass. : 05</td>
</tr>
<tr>
<td>Annual Exam: 20</td>
<td></td>
</tr>
</tbody>
</table>
Objectives

To enable the students to understand the basic biology of Invertebrates. To understand that the biological science is fundamental to creative thought and the diversity of invertebrate species provides the excellent examples for some of these central principles.

Classification and general characters of following Phyla up to orders with a detailed study of the animals mentioned against each phylum in the Units given below:

UNIT-I
Annelida : Earthworm

UNIT-II
Arthropoda : Palaemon, Cockroach

UNIT – III
Mollusca : Anodonta, Pila

UNIT-IV
Echinodermata : Asterias
Hemichordata : Balanoglossus (external characters and its systematic position)

Note: Examiner will set a total of nine questions comprising two questions from each Unit, and one compulsory question of short answer type covering the whole syllabus. It will consist of eight short answer questions of 1½ marks each. Students will attempt one question from each Unit and the compulsory questions. All questions may carry equal marks.

Books Recommended

Practicals based on Theory Paper BZO 1032 (BZO 1072):

<table>
<thead>
<tr>
<th>Description</th>
<th>Total Marks</th>
<th>Internal Ass.</th>
<th>Annual Exam.:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>25</td>
<td>05</td>
<td>20</td>
</tr>
</tbody>
</table>

Classification up to orders and important characters alongwith ecological note of the specimens mentioned against each phylum.
1. Annelida (a) Demonstration of dissection of Earthworm to show entire anatomy through charts/models/video clipping.
Specimens: *Pheretima, Nereis, Heteronereis, Polynoe, Aphrodite, Amphitrite, Chaetopterus, Arenicola* and *Pontobdella*.

2. **Arthropoda**
   (a) Demonstration of dissection of Cockroach (digestive, nervous and reproductive systems), Prawn (appendages, digestive, nervous and reproductive systems) through charts/models/video clipping.
   (c) Prepared slides: Body louse, bed-bug, ratflea, *Cypris, Cyclops, Daphnia*, trachea of insects, genitalia of cockroach, gill and statocyst of prawn.

3. **Mollusca**
   (a) Demonstration of dissection of *Anodonta* (digestive and nervous systems), *Pila* (pallial complex, digestive and nervous systems) through charts/models/video clipping.
   (b) Specimens: *Anodonta, Mytilus, Pholas, Pecten, Haliotis, Aplysia, Doris, Limax, Pila, Octopus, Nautilus* shell, *Chiton* and *Dentalium*.
   (c) Prepared slides: Glochidium larva, radula of Pila, gill lamina of *Anodonta*.

4. **Echinodermata**
   (a) Demonstration of dissection of *Asterias* (digestive and water vascular systems) through charts/models/video clipping.
   (b) Specimens: *Asterias, Echinus, Cucumaria, Antedon, Ophiothrix*.
   (c) Prepared slide: T.S. of Star-fish.

5. **Hemichordata**
   (a) Specimens: *Balanoglossus*.
   (b) Prepared slide: T.S. *Balanoglossus*.

**Note:** Candidates will be required to submit duly signed note-books of practical record.

---

**Zoology Subsidiary**
**Paper-I**
*(For Basic Medical Sciences only) (BZO 1033)*

**Theory**

<table>
<thead>
<tr>
<th></th>
<th>Total Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory</td>
<td>75</td>
</tr>
<tr>
<td>Internal Ass.</td>
<td>15</td>
</tr>
<tr>
<td>Annual Exam.</td>
<td>60</td>
</tr>
<tr>
<td>Practical</td>
<td>25</td>
</tr>
<tr>
<td>Internal Ass.</td>
<td>05</td>
</tr>
<tr>
<td>Annual Exam.</td>
<td>20</td>
</tr>
</tbody>
</table>

**Objectives**
To enable the students to identify, classify and study the general characters of invertebrates and vertebrates. To make the students understand the concept of speciation and origin of life. To
enable the students to understand the structure of cell, its organelles and types of cell division.

UNIT-I
1. Classification and general characters of invertebrates and vertebrates up to class with important examples.

UNIT-II
2. Detailed study of *Plasmodium, Fasciola, Ascaris*, cockroach and rabbit.

UNIT-III
3. Study of cell and its organelles, mitosis and meiosis, and their importance.
4. Study of simple and compound tissues.

UNIT-IV
5. Mendel’s laws, chromosomal theory of inheritance.

Note: Examiner will set a total of nine questions comprising two questions from each Unit, and one compulsory question of short answer type covering the whole syllabus. It will consist of eight short answer questions of 1½ marks each. Students will attempt one question from each Unit and the compulsory questions. All questions may carry equal marks.

Books Recommended

Practical based on theory Paper BZO 1033 (For Basic Medical Sciences only) (BZO 1073):

<table>
<thead>
<tr>
<th>Marks</th>
<th>Internal Ass.</th>
<th>Annual Exam.</th>
</tr>
</thead>
<tbody>
<tr>
<td>:25</td>
<td>:05</td>
<td>:20</td>
</tr>
</tbody>
</table>

Classification up to orders of the following specimens with important characters:

**Protozoa**: Amoeba, Paramecium, Euglena, Volvox

**Porifera**: Sycon

**Platyhelminthes**: Fasciola, Tapeworm, Ascaris

**Annelida**: Nereis, Pharetima, Hirudinaria

**Arthropoda**: Cockroach, Prawn, Scorpion

**Mollusca**: Unio, Pila, Sepia

**Echinodermata**: Asterias, Echinus, Cucumaria

**Hemichordata**: Balanoglossus

**Urochordata**: Herdmania

**Cephalochordata**: Branchiostoma

**Cyclostomata**: Petromyzon
Chondrichthyes: *Scoliodon*
Osteichthyes: *Labeo*
Amphibia: Frog and Toad
Reptilia: *Uromastix, Wall lizard, Python, Cobra, Krait and Viper*
Aves: *Columba*
Mammalia: *Oryctolagus*
Dissections: Demonstration of dissection of Rabbit/Rat (digestive, (Demonstrations) circulatory, reproductive systems) through charts/models/video clipping.
Skeleton: Rabbit
Permanent slides: Simple tissues, mouth parts of cockroach.

Note: Candidate will be required to submit the original duly signed note books containing a record of their laboratory work.

**B.Sc. (Honours School) - Zoology**
**SECOND YEAR (THIRD SEMESTER) EXAMINATION**

**Paper-III**
**Zoology-V: Functional Anatomy of Non-Chordates-I**
*(Protozoa, Porifera, and Coelenterata) (BZO 2001)*

**Total Marks**: 100
Theory hours per week: 3
Practical hours per week: 3

**Theory**: 75
Internal Ass.: 15
Annual Exam.: 60

**Practical**: 25
Internal Ass.: 05
Annual Exam.: 20

**Objectives:**
- To acquaint the students with the variety of non-chordates from Protozoa, Porifera and Coelenterata to study their functional anatomy.
- To enable the students to understand the difference in their morphology and general anatomy and to classify and study their general characters.

**Protozoa**

**Unit –I**
- Protozoa: General organisation, comparative account of morphology (size, shape, skeleton, nucleus, locomotor organelles etc.), nutrition, locomotion, reproduction, excretion, behaviour, osmoregulation etc.

**Unit-II**
- Detailed classification of Protozoa (N.D. Levine, 1980).
- General account including morphology, life cycle, pathogenicity, diagnosis and prophylaxis of important parasitic protozoan’s of man representing each taxon for example: *Leishmania, Trypanosoma, Balantidium, Giardia, Entamoeba, Toxoplasma, Trichomonas*.

**Unit-III**

**Porifera**
- General organisation, classification up to orders of Porifera mentioning their characteristic features with examples.
• Comparative account of canal system, skeletal system, reproduction and development of sponges.

Unit-IV

Coelenterata
• General organisation, classification up to orders of Coelenterates giving their characteristic features with examples.
• Corals and coral formation, polymorphism and affinities of the group.
• Life history and alternation of generation in coelenterata.

Note: - Examiner will set a total of nine questions comprising two questions from each unit and one compulsory question of short answer type covering the whole syllabus. It will consist of eight short answer type questions of $1\frac{1}{2}$ marks each. Students will attempt one question from each unit and the compulsory question. All questions carry equal marks.

Practicals based on theory paper BZO 2001 (BZO 2051):

Protozoa
• Prepare permanent stained preparations of Protozoans from fresh water culture.
• Study of permanent slides of *Amoeba*, *Diffugia*, *Opalina*, *Arcella*, *Balantidium*, *Radiolarian*, *Foraminifera shells*, *Elphidium*, *Euglena*, *Nycotherus*, *Noctiluca*, *Vorticella*, *Ceratium Volox*, *Paramaecium*.

Porifera
• General survey of sponges by the study of specimens and slides of important representatives from various poriferan classes.
• Study of canal system, spicules, gemmules and various developmental stages using permanent slides present in the museum of the department.

Coelenterata
• General survey of coelenterates by the study of specimens and permanent slides available in the museum of the department.

Books recommended

Paper-IV
Zoology-VI: Functional Anatomy of Non-Chordates-II
(Helminths) (BZO 2002)

<table>
<thead>
<tr>
<th></th>
<th>Total Marks</th>
<th>Theory</th>
<th>Practical</th>
<th>Internal Ass.</th>
<th>Annual Exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory hours per week:</td>
<td>100</td>
<td>75</td>
<td>25</td>
<td>15</td>
<td>60</td>
</tr>
<tr>
<td>Practical hours per week:</td>
<td>75</td>
<td>15</td>
<td>25</td>
<td>05</td>
<td>20</td>
</tr>
</tbody>
</table>

Objectives
- To acquaint the students with the latest classification, general organization, comparative account of morphology and physiology of Platyhelminthes & Nematodes.
- To introduce the student to the important parasites causing diseases in animals and men.
- To make the students study a comparative account of variation in their morphology, lifecycles, pathogenicity etc.

Unit-I
Platyhelminthes
1. Turbellaria: General organisation, classification and ecology.
2. Trematoda: General organisation, classification and ecology.
3. Monogenea: General account, structure and function, development and ecology of important forms.
4. Digenea:
   i. General account, structure and functions, development and ecology of important forms representing the following families:
      Dicrocoeliidae, Opisthorchiidae, Troglotrematidae, and Schistosomatidae.
   ii. Varied types of cercariae and other larval forms, variation in life cycles in Digenea.

Unit-II
   i. Cestodaria: General account with special reference to the morphology and functions, and life cycles of typical cestodians.
   ii. Eucestoda: General account and classification with special reference to the structure and functions, development and effect of the important forms representing Pseudophyllidea and Cyclophyllidea and also with special reference to the distribution, patterns of life cycles and larval forms met within the group.

Unit-III
Aschelminthes
- General characters and classification with special reference to morphology and functions and life cycle of a typical nematode and other important forms representing the following families: Trichuridae, Ancylostomatidae, Oxyuridae, Filaridae, Dracunculidae, Strongylidae, Trichinellidae.

Unit-IV
- Comparative account of the pharynx, excretory and reproductive systems in Nematoda.
- A brief account of plant parasitic nematodes.
Note: - Examiner will set a total of nine questions comprising two questions from each unit and one compulsory question of short answer type covering the whole syllabus. It will consist of eight short answer type questions of $1\frac{1}{2}$ marks each. Students will attempt one question from each unit and the compulsory question. All questions carry equal marks.

Practicals based on theory paper BZO 2002 (BZO 2052):

Turbellaria
- Study of specimens from the museum of the Department.

Trematoda
- Collection, fixation, preservation and permanent staining of trematodes obtained from intestine of goat/sheep procured from slaughter house.
- Study of specimens from the museum of the Department.

Cestoda
- Collection, fixation, preservation and permanent staining of cestodes from intestine of sheep or goat procured from slaughter house.
- Study of specimens from the museum of the Department.

Nematoda
- Collection, fixation, preservation and permanent staining of nematodes from intestine of sheep or goat procured from slaughter house.
- Study of anatomy of *Ascaris*.
• Study of specimens from the museum of the Department.
• Collection and study of plant parasitic and free-living nematodes.

Books Recommended

Paper-V
Zoology-VII: Functional Anatomy of Non-Chordates-III
(Arthropoda-I) (BZO 2003)

<table>
<thead>
<tr>
<th>Theory hours per week: 3</th>
<th>Total Marks : 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical hours per week: 3</td>
<td>Theory : 75</td>
</tr>
<tr>
<td></td>
<td>Internal Ass. : 15</td>
</tr>
<tr>
<td></td>
<td>Annual Exam. : 60</td>
</tr>
<tr>
<td></td>
<td>Practical : 25</td>
</tr>
<tr>
<td></td>
<td>Internal Ass. : 05</td>
</tr>
<tr>
<td></td>
<td>Annual Exam: 20</td>
</tr>
</tbody>
</table>

Objectives
• To enable the students to understand the dominance of Arthropods and their association with human welfare in a number of ways.
• To impart in depth knowledge about their different modes of living and structural modification acquired to suit varied living conditions.

Unit-I
• General characters and classifications up to orders with examples of class Crustacea.
• General characters and classifications up to orders with examples of class Arachnida.
• General account of classes Trilobita, Onychophora, Symphyla, Chilopoda and Diplopoda.

Unit-II
• Larvae of Crustacea.
• Comparative functional anatomy of digestive, respiratory, circulatory, nervous and reproductive systems of Crustacea.
• Endocrine glands and their function in moulting, pigmentation and reproduction in Crustacea.
Unit-III
- Structural organisation of class Insecta, criteria and history of classification.
- Salient features of various apterygote orders and important pterygote orders (Ephemeroptera, Odonata, Orthoptera, Hemiptera, Lepidoptera, Diptera, Hymenoptera, Coleoptera) with examples.

Unit-IV
- Development of head and the study of head capsule in Insecta; general structure and the functional modifications in tentorium, antennae and mouthparts in insects.

Note: - Examiner will set a total of nine questions comprising two questions from each unit and one compulsory question of short answer type covering the whole syllabus. It will consist of eight short answer type questions of \( \frac{3}{2} \) marks each. Students will attempt one question from each unit and the compulsory question. All questions carry equal marks.

Practicals based on theory paper BZO 2003 (BZO 2053):

General survey of Arthropoda other than insects by the study of specimens and slides of important representatives from various classes.
1. Study of different types of larvae of crustaceans with the help of slides and preserved specimens
2. Study of insects from different orders.

3. Comparative study of the external functional morphology of insects by preparing charts of the following:
   (a) Head capsule
   (b) Head appendages
   (c) Tentorium
4. Study of crustacean appendages through charts.

Books recommended
OBJECTIVES
To acquaint the students about the structure and function of protochordates and chordates and to make the student understand the basic characters, advancements and adaptations of different types of vertebrates.
Detailed study (morphology & anatomy), systematic position, distinctive characters, distribution, ecology, economic importance, if any, of the following animals:

UNIT-I
Urochordata : Herdmania including retrogressive metamorphosis (excluding embryology) and its affinities.
Cephalochordata : Branchiostoma (excluding embryology) and its affinities.

UNIT-II
Cyclostomata : Petromyzon (external characters) and its migration.
Pisces : Labeo

UNIT-III
Amphibia : Rana

UNIT-IV
Reptilia : Uromastix

Note: - Examiner will set a total of nine questions comprising two questions from each unit and one compulsory question of short answer type covering the whole syllabus. It will consist of eight short answer type questions of 1 1/2 marks each. Students will attempt one question from each unit and the compulsory question. All questions carry equal marks.

Book Recommended

Practicals based on theory paper BZO 2031 (BZO 2071):

Total Marks : 100
Theory : 75
Internal Ass. : 15
Annual Exam. : 60
Practical : 25
Internal Ass. : 05
Annual Exam: 20

Objectives
To acquaint the students about the structure and function of protochordates and chordates and to make the student understand the basic characters, advancements and adaptations of different types of vertebrates.
Detailed study (morphology & anatomy), systematic position, distinctive characters, distribution, ecology, economic importance, if any, of the following animals:

UNIT-I
Urochordata : Herdmania including retrogressive metamorphosis (excluding embryology) and its affinities.
Cephalochordata : Branchiostoma (excluding embryology) and its affinities.

UNIT-II
Cyclostomata : Petromyzon (external characters) and its migration.
Pisces : Labeo

UNIT-III
Amphibia : Rana

UNIT-IV
Reptilia : Uromastix

Note: - Examiner will set a total of nine questions comprising two questions from each unit and one compulsory question of short answer type covering the whole syllabus. It will consist of eight short answer type questions of 1 1/2 marks each. Students will attempt one question from each unit and the compulsory question. All questions carry equal marks.

Book Recommended

Practicals based on theory paper BZO 2031 (BZO 2071):

Total Marks : 100
Theory : 75
Internal Ass. : 15
Annual Exam. : 60
Practical : 25
Internal Ass. : 05
Annual Exam: 20
1. Demonstration of dissection of *Herdmania* (General Anatomy) and *Laboe* (Digestive, arterial and reproductive systems) through charts/models/video clipping.

2. Skeleton : To study the skeleton of *Laboe, Rana* and *Varanus*.

3. Prepared Slides : Tornaria larva, T.S. *Branchiostoma* through different regions, Placoid, cycloid and ctenoid scales of fishes. Pharynx and Spicules of *Herdmania*.

4. Specimens : General survey and classification up to orders, (except Pisces where it is required only upto sub-classes), habitat, habits, external characters and economic importance (if any) of the following animals.

   Protochordata - *Herdmania, Molgula, Ciona, Ascidia, Botryllus, Pyrosoma, Salpa, Doliolum, Oikopleura* and *Branchiostoma*.

   Cyclostomata – *Myxine, Petromyzon* and *Amnocoetes* larva.

   Chondrichthyes - *Zygaena, Pristi, Narcine, Trygon* and *Rhinobatus*.

   Actinopterygii – *Polypterus, Acipenser, Lepidosiren, Mystus, Catla, Laboe rohita, Cirrhinus mrigala, Cyprinus carpio, Hippocampus, Syngnathus, Exocoetus, Anabas, Diodon, Ostracion, Tetradon, Echeneis, Lophius, Solea* and *Anguilla*.

   Dipneusti (Dipnoi) – Any of the lungfishes.

   Amphibia – *Necturus, Proteus, Amphiuma, Salamandra, Ambystoma, Triton, Hyla, Rhacophorus, Uraeotyphlus, Ichthyophis* and Axolotl larva.

   Reptilia- *Tortoise, Turtle, Hemidactylus, Calotes, Draco, Varanus, Phrynosoma, Chameleon, Typhlops, Python, Erys, Ptyas, Bungarus, Naja, Hydrus, Vipera, Crocodylus, Gavialis* and *Alligator*.

Note: The candidates are required to submit duly signed note books of practical record and the prepared slides.
B.Sc. (Honours School) - Zoology  
SECOND YEAR (FOURTH SEMESTER) EXAMINATION

Paper-III  

Total Marks: 100  
Theory: 75  
Practical: 25  
Internal Ass.: 15  
Internal Ass.: 05  
Annual Exam.: 60  
Annual Exam.: 20

Objectives
- To enable the students to understand the dominance of Arthropods and their association with human welfare in a number of ways.
- To impart in depth knowledge to students about the different modes of living and structural modification acquired to suit varied living conditions.

Unit-I
- Preliminary knowledge of thoracic and abdominal segments of insects.
- General structure and functional modifications in the wings and legs in different insect groups.
- External male genitalia and external female genitalia in different insect groups.

Unit-II
- Comparative account of the structure and functions of digestive system in insects with special reference to the functional modifications like filter chamber and peritrophic membrane and digestive glands.
- Comparative account of the nervous system in insects.

Unit-III
- Comparative account of the male and female reproductive systems in insects.
- General structure and functions of excretory, respiratory and circulatory systems in insects.

Unit-IV
- Postembryonic development and types of metamorphosis in insects.
- Structural modifications in larvae and pupae and relationship of nymphs and naiads.

Note: - Examiner will set a total of nine questions comprising two questions from each unit and one compulsory question of short answer type covering the whole syllabus. It will consist of eight short answer type questions of 1\(\frac{1}{2}\) marks each. Students will attempt one question from each unit and the compulsory question. All questions carry equal marks.

Practicals based on theory paper BZO 2004 (BZO 2054):
1. Comparative study of the external functional morphology of insects by preparing charts of:  
   Wings  
   Legs  
   Genitalia
2. Demonstration of dissection of suitable insects to show their Digestive, Nervous and Reproductive systems through charts/models/video clipping.
3. Study of different types of preserved larvae and pupae from slides and specimens available in the museum.

Books recommended


Paper-IV

Zoology-IX: Functional Anatomy of Non-Chordates-V
(Annelida and Minor phyla) (BZO 2005)

Total Marks : 100
Theory :  75
Practical : 25
Internal Ass. : 05
Annual Exam: 20
Annual Exam: 20

Objectives
- To acquaint the students with the variety of Annelida and various minor phyla so as to make them aware of the diversity and evolutionary affinities.
- To enable the students to understand the difference in the morphology and general anatomy and to classify and study the general characters of these groups.

Unit-I

Annelida
- General organization and classification of Annelida.
- Comparative account of excretory, respiratory and reproductive systems.
- Regeneration and sexual reproduction.

Unit-II

Nemertine or Rhyncocoela
- General organisation and classification.
- Life history of a typical nemertine.
- Affinities of the group.
Nematomorpha
- General organisation and classification.
- Life history of a typical nematomorph.
- Affinities of the group.

Unit-III

Acanthocephala
- General organisation and classification.
- Life history of a typical Acanthocephala.
- Affinities of the group.

Rotifera
- General organisation and classification.
- Life history of a typical Acanthocephala.
- Affinities of the group.

Unit-IV

Other Minor Phyla
- General organisation, classification, development and ecology of the animals belonging to the following minor phyla:
  - Gastrotricha
  - Kinorhyncha,
  - Bryozoa
  - Brachiopoda
- Comparative account of body wall, digestive, circulatory and nervous system.

Note: - Examiner will set a total of nine questions comprising two questions from each unit and one compulsory question of short answer type covering the whole syllabus. It will consist of eight short answer type questions of 1\(\frac{1}{2}\) marks each. Students will attempt one question from each unit and the compulsory question. All questions carry equal marks.

Practicals based on theory paper BZO 2005 (BZO 2055):

Annelida
- Demonstration of dissection of Nereis, earthworm and leech to show various system through charts/models/video clipping
- Study of T.S. of various annelids.
- To study permanent slides of the various structures such as parapodia and nephridia.
- General survey of Annelida.

Nemertine or Rhynchocoela
- Study of the specimens from museum and mounted slides representing families as prescribed from the theory.

Nematomorpha
- Study of Gordius from specimen and prepared slides.

Acanthocephala
- Study of the specimens from museum and mounted slides representing families as prescribed from the theory: Echinorhynchus, Macracanthorhynchus, Centrorhynchus.
- Histology of Acanthocephala from the slides.

Other Minor Phyla
• Identification of museum specimens and permanent mounts from various minor phyla as per the theory course.

Books Recommended


Paper-V

Zoology-X: Functional Anatomy of Non-Chordates-VI
(Mollusca and Echinodermata) (BZO 2006)

Total Marks : 100
Theory : 75
Practical : 25
Internal Ass. : 15
Annual Exam. : 60
Internal Ass. : 05
Annual Exam : 20

Objectives
• To acquaint the students with the variety of non-chordates from Mollusca and Echinodermata and to study their functional anatomy.
• To enable the students to understand the differences in the morphology and general anatomy molluscus and echinodermes to classify and study their general characters.

Unit-I
Mollusca
• General organisation and classification of Mollusca up to orders.
• Comparative account of:
  (i) Digestive system
  (ii) Nervous systems and sense organs
  (iii) Reproductive system
  (iv) Respiratory system
  (v) Circulatory system
  (vi) Excretory system

Unit-II

• Shell and its development
• Torsion and detorsion in gastropods
• Organs of locomotion
• Different types of larvae

Unit-III
Echinodermata
• General organization, classification, development and ecology of important animals belonging to the five different classes of the phyla i.e. Asteroidea, Echinoidea, Holothuroidea, Crinoidea and Ophiuroidea.
• Comparative account of the larvae.
Unit-IV

- Development of internal organs and metamorphosis.
- Affinities of the group.
- Important fossil forms.

**Note:** Examiner will set a total of nine questions comprising two questions from each unit and one compulsory question of short answer type covering the whole syllabus. It will consist of eight short answer type questions of $1\frac{1}{2}$ marks each. Students will attempt one question from each unit and the compulsory question. All questions carry equal marks.

**Books recommended**


**Practicals based on theory paper BZO 2006 (BZO 2056):**

**Mollusca**
- General survey of molluscs by the study of specimens and slides.
- Study of permanent slides of various forms from various classes.

**Echinodermata**
- General survey of echinoderms by the study of specimens and slides.
- Study of permanent slides of various forms from various classes.

**ZOOLOGY SUBSIDIARY**

**Paper-IV**

**Zoology-IVS: (Biodiversity: Chordates-II) (BZO 2032)**

<table>
<thead>
<tr>
<th>Total Marks</th>
<th>Theory:</th>
<th>Practical:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Annual Exam:</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>Internal Ass.:</td>
<td>05</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Annual Exam: 20</td>
</tr>
</tbody>
</table>

Theory hours per week: 4
Practical hours per week: 4
Objectives
To acquaint the students about the structure and function of protochordates and chordates and to make the student understand the basic characters, advancements and adaptations of different types of vertebrates.

Detailed study (morphology & anatomy), systematic position, distinctive characters, distribution, ecology, economic importance, if any, of the following animals:

UNIT-I
Aves : Columba

UNIT-II
Mammalia : Oryctolagus

UNIT-III
Ecology : Definition, subdivisions and scope of ecology, Ecosystem- Definition, components and functioning of pond ecosystem; Food chain and food web; concepts of ecological niche; Ecological adaptations- Aquatic, Volant and desert adaptations.

UNIT-IV
Behaviour
Parental care, migration with particular reference to Fishes and birds.

Physiology
Introduction to the physiology, physiology of digestion, circulation, respiration, conduction of nerve impulse and muscle contraction. Introduction to endocrinology with detailed account of hormones.

Note: Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer type covering the whole syllabus. It will consist of eight short answer questions of 1½ marks each. Students will attempt one question from each Unit and the compulsory questions. All questions may carry equal marks.

Book Recommended
Practicals based on theory paper BZO 2032 (BZO 2072):

Marks : 25  
Internal Ass. : 05  
Annual Exam.: 20

1. Demonstration of dissection of Chick and Rat to show digestive, arterial, venous and reproductive systems through charts/models/video clipping.

2. To study prepared slides of developmental stages in the life history of chick upto 24hrs stage.

3. To study skeletons of Gallus and Oryctolagus.

4. General survey and classification upto orders, habitat, habits, external characters and economic importance (if any) of the following animals:
   Aves- Anas, Ardea, Milvus, Pavo, Tyto, Alcedo, Eudynamis, Casuarius and Struthio.

5. Physiology:
   a. Diffusion and dialysis through Cellophane/dialysis Membrane.
   b. Demonstration of effect of isotonic, hypotonic and hypertonic solutions on erythrocytes through charts/models/video clipping.
   c. Demonstration of different types of human blood groups through charts/models/video clipping.
   d. Demonstration of haemoglobin percentage in human blood through charts/models/video clipping.
   e. Demonstration of the presence of amylase enzyme in saliva.
   f. Study of the sections of thyroid, pancreas, adrenal and ovary (corpus luteum) of mammal from the prepared slides.


Note: The candidates are required to submit duly signed note books of practical record and the prepared slides.
Objectives
To acquaint the students with the classification and general characters including morphology and physiology of different vertebrates from fishes to reptiles including their behaviour and physiological adaptations. To educate the students about the importance of wildlife conservation.

UNIT-I

Fishes
Form and locomotion: Body form in various groups of fishes (cartilaginous and bony fishes).
Locomotion: Passive and active locomotion (body muscles, fins and other miscellaneous methods).

Body coverings: Scales, types (placoid, Cosmoid, ganoid, cycloid, ctenoid), functions and modifications.

Fins: Structure of typical fin of a bony fish, paired fins, unpaired fins and the modifications of the fins.

Buoyancy: Structure of swim bladder, variations of swim bladder in different groups of fishes, functions of swim bladder. Weberian ossicles and swim bladder.

UNIT-II

Fishes
Respiration: Structure of typical gill, types and variations of gills in various groups of fishes, air breathing organs in fishes.
Age determination and growth in fishes, age determination in Indian freshwater fishes using hard parts (scales, vertebrae, opercular bones etc.) Growth measurements using Fraser-Lee equation.

Reproduction: Breeding behaviour, breeding and migration in Salmon and Anguilla.

UNIT-III

Amphibia
Classification upto orders (only living forms), general characters and peculiar features of the class Amphibia; adaptive radiations in Amphibia; morphological and physiological adaptations; parental care and neoteny in Amphibia; migration in Amphibia.

UNIT-IV

Reptilia
Classification upto orders (only living forms) of class Reptilia, general, distinctive peculiar features of the class Reptilia; adaptative radiations in Reptilia; shell in Chelonia; epidermal and dermal Plates and modifications in various families; identification of poisonous and non-

**Note:** - Examiner will set a total of nine questions comprising two questions from each unit and one compulsory question of short answer type covering the whole syllabus. It will consist of eight short answer type questions of 1\(\frac{1}{2}\) marks each. Students will attempt one question from each unit and the compulsory question. All questions carry equal marks.

**Practicals based on theory paper BZO 3001 (BZO 3051):**

1. Demonstration of dissection of a bony fish to show alimentary canal, cranial nerves, afferent and efferent vessels, reproductive organs through charts/models/video clippings.
2. Demonstration of dissection of Weberian Ossicles of bony fishes through charts/models/video clippings.
3. Demonstration of dissection of air breathing organs of bony fishes through charts/models/video clippings.
4. Study of variations in the body form and fins in fishes through specimens.
5. Study of different types of scales in fishes, permanent preparations of scales.
6. Study of museum specimens belonging to different groups with classification, morphological characters and ecological notes.

**BOOKS RECOMMENDED**


**Paper II**

**Zoology-XII: Comparative Anatomy of Vertebrates-I and Wildlife (BZO 3002)**

<table>
<thead>
<tr>
<th></th>
<th>Total Marks</th>
<th>Theory</th>
<th>Internal Ass.</th>
<th>Annual Exam.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory hours per week:</td>
<td>100</td>
<td>75</td>
<td>15</td>
<td>60</td>
</tr>
<tr>
<td>Practical hours per week:</td>
<td>25</td>
<td></td>
<td>05</td>
<td>20</td>
</tr>
</tbody>
</table>

**Objectives**

To enable the students to draw a comparative account of the morphology and general anatomy of the vertebrates and to understand evolution of different system in vertebrates. To educate the students about the importance of wildlife conservation.
UNIT –I

Integument: Basic microscopic structure in different groups, types of integumentary glands and their functions.

Exoskeleton: A general account of scales in the vertebrates, morphology of horn, antlers, feathers and hair.

UNIT –II

Endoskeleton: Chondrocranium, Splanchnocranium, modification of visceral arches, Jaw suspension, Dermatocranium.

UNIT – III

Wild Life

Wildlife habitat with particular reference to food, shelter and water requirements, Biotic succession and wildlife, successional classification of wildlife.

UNIT-IV

Methods of studying wildlife, Government and non-government organisations of wildlife. Law and legislation regarding wildlife.

Special projects for endangered species (a) Project tiger, (b) Gir Lion Sanctuary Project, (c) Crocodile Breeding Project and (d) Project Hangul.

Note: - Examiner will set a total of nine questions comprising two questions from each unit and one compulsory question of short answer type covering the whole syllabus. It will consist of eight short answer type questions of 1½ marks each. Students will attempt one question from each unit and the compulsory question. All questions carry equal marks.

Practical based on theory paper BZO 3002 (3052):

1. Permanent Slides: Study of histology of integument of different vertebrates from museum slides.
3. Study of the birds of Panjab University Campus along with their roosting and nesting sites.
4. Study of the winter migratory birds of Sukhna Lake, Chandigarh.
5. Study of the wild animals both in nature and Captivity of Chhatbir Zoo near Chandigarh.
6. Visit to Pinjore Garden to study wild animals in nature and Captivity.
7. Visit to Kansal Sanctuary to study the wildlife.

Books Recommended

5. Chordate Morphology by M. Jolly, Van Nostrad, USA.
6. Wildlife in India by Saharai, Bishan Singh Mohinder Singh, Dehradun, India.

**Paper-III**

Zoology-XIII: Cell Biology (BZO 3003)

<table>
<thead>
<tr>
<th></th>
<th>Total Marks</th>
<th>Theory</th>
<th>Internal Ass.</th>
<th>Annual Exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory hours per week</td>
<td></td>
<td>75</td>
<td>15</td>
<td>60</td>
</tr>
<tr>
<td>Practical hours per week</td>
<td></td>
<td></td>
<td>05</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Annual Exam:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Objectives
To enable the students to learn various aspects of cell biology.

**UNIT I**

**Plasma membrane:** Chemical nature of plasma membrane, Different models of plasma membrane (in brief), fluid mosaic model in detail, differentiation at cell surface (microvilli, tight junctions, desmosomes etc.)

**Endoplasmic reticulum:** Morphology, Chemical composition, morphological differentiation, functions and its role during mitosis.

**Microbodies:** Structure, chemical composition, functions and origin of peroxisomes and glyoxysomes.

**UNIT-II**

**Golgi complex:** Morphology, chemical composition, relationship with other cell components, its function with special reference to cell secretion.

**Lysosomes:** Morphology, chemistry, their polymorphism in relation to cytosis, cell ageing and cell autophagy.

**UNIT-III**

**Nucleus:** Nuclear envelope, nuclear permeability, structure of interphase nucleus, structure and cytochemistry of nucleus, structure and biogenesis of ribosomes.

Centrioles, basal bodies, cilia, flagella, microtubules, amoeboid movement.

**UNIT-IV**
Mitochondria: Morphology including vital examination, light and ultramicroscopic structures, structural variations with regard to functions, chemical composition, role in cell physiology, mitochondria as semi-autonomous organoids.

Ultrastructure of typical sperm of insect.
Vitellogenesis in insects.

Note: - Examiner will set a total of nine questions comprising two questions from each unit and one compulsory question of short answer type covering the whole syllabus. It will consist of eight short answer type questions of 1 1/2 marks each. Students will attempt one question from each unit and the compulsory question. All questions carry equal marks.

Practicals based on theory paper BZO 3003 (BZO 3053):

1. Carbohydrates: Basics of PAS and staining with PAS.
2. Proteins: Basis of Mercuric-bromophenol blue and staining of proteins with Hg-SPB.
3. Lipids: Basis of Sudan black B and Nile blue sulphate methods and staining of acids and neutral lipids with the help of SPB & HBS techniques.
4. Nucleic acids: Basis of Feulgen’s and Methyl green/pyronin G and staining of nucleic acids with Feulgen and MG/PG techniques.
5. Study of slides of insects and mammalian testes showing different stages of spermatogenesis.
6. Study of permanent slides of ovaries of insects, birds and mammals showing various stages of oogenesis.

Books recommended


Paper IV
Zoology-XIV: Animal Physiology (BZO 3004)

<table>
<thead>
<tr>
<th>Total Marks</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory</td>
<td>75</td>
</tr>
<tr>
<td>Internal Ass.</td>
<td>15</td>
</tr>
<tr>
<td>Annual Exam.</td>
<td>60</td>
</tr>
<tr>
<td>Practical</td>
<td>25</td>
</tr>
<tr>
<td>Internal Ass.</td>
<td>05</td>
</tr>
<tr>
<td>Annual Exam:</td>
<td>20</td>
</tr>
</tbody>
</table>

Objectives

To make the students understand the physiological processes going on inside the vertebrates.
UNIT-I

Digestion: Intracellular and extracellular digestion, digestive enzymes, digestion by means of symbionts, coordination of digestive enzymes, intestinal absorption.

UNIT-II

Muscle: Muscle contraction – physiology and chemistry.

Nitrogen excretion: Chemical nature of nitrogenous products, distribution of excretory products of protein metabolism, mechanism and control of excretion.

UNIT-III

Circulatory System: Blood components, functions of components, cardiac output and heart rate, physiology of heart, control of cardiovascular function.

Respiration: Nature of respiratory organs, transport of respiratory gases, respiratory quotient and caloric equivalent of oxygen, control of respiration.

UNIT-IV

Nervous system: Structural elements, nerve impulse, resting and action potentials, conduction of action potential, synaptic transmission.

Reproduction: Structure of gonads and physiology of reproduction.

Note: - Examiner will set a total of nine questions comprising two questions from each unit and one compulsory question of short answer type covering the whole syllabus. It will consist of eight short answer type questions of 1½ marks each. Students will attempt one question from each unit and the compulsory question. All questions carry equal marks.

Practical based on theory paper BZO 3004 (BZO 3054):

1. Identification of food stuffs-starch, sucrose, glucose, proteins and fats.
2. Demonstration of osmosis and diffusion.
3. Demonstration of the presence of amylase enzyme in saliva. Effect of pH and temperature on enzyme action.
4. Demonstration of coagulation and bleeding time of blood through charts/models/video clipping.
5. Demonstration of different types of human blood groups through charts/models/video clipping.
7. Recording of blood pressure of man.
8. Demonstration of counting of red blood corpuscles and white blood corpuscles of man through charts/models/video clipping.
Books Recommended


Paper-V
Zoology-XV: Taxonomy, Ecology & Palaeontology-I (BZO 3005)

<table>
<thead>
<tr>
<th>Theoretical hours per week:</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical hours per week:</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total Marks</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory</td>
<td>75</td>
</tr>
<tr>
<td>Internal Ass.</td>
<td>15</td>
</tr>
<tr>
<td>Annual Exam</td>
<td>60</td>
</tr>
<tr>
<td>Practical</td>
<td>25</td>
</tr>
<tr>
<td>Internal Ass.</td>
<td>05</td>
</tr>
<tr>
<td>Annual Exam</td>
<td>20</td>
</tr>
</tbody>
</table>

Objectives

To enable the students to identify, classify and name the organism according to international code of zoological nomenclature. To acquaint the student with different procedures of taxonomy and different methods of analysis of variations and theories of classification. To educate the students about the basic environmental phenomena like ecosystem, energy flow through the ecosystem and biogeochemical cycles. To enable the students understand the adaptations of the animals to their environment. To make the students understand the importance of Palaeontology with special reference to the fossils, dating of fossils and geological time scale.

UNIT-I
Definitions and perspectives of systematics, classification and taxonomy; history, goals and importance of taxonomy; procedures of taxonomy-identification, classification, nomenclature, phena, taxa, category; key and its significance; higher taxa and linnean hierarchy; qualitative and quantitative methods of analysis of variations; history and theories of classification; international code of Zoological nomenclature-principles and objectives and rules for nomenclature, type system and priority for different taxa.

UNIT-II
Introduction to Ecology-Definition, subdivision of ecology and scope of ecology.
Ecological Factors-Temperature and light as ecological factors.
Ecosystem - Definition, components of ecosystem, Grazing and detritus type of food chain, Food Web and Trophic levels.
Ecological pyramids-Pyramids of number, biomass and energy.

UNIT-III
Energy flow-Flow of energy through a food chain in relation to laws of thermodynamics.
Biogeochemical cycles – Gaseous and Sedimentary type of biogeochemical cycles.
Principles of limiting factor- Leibig’s law of minimum, Shelfords law of tolerance and concept of limiting factors.
Ecological niche – Concept of ecological niche, and competitive exclusion principle.
UNIT –IV
Introduction to Palaeontology: History, Stratigraphy; Principles, Importance, Successive stratigraphic steps, fossils, importance and dating of fossils, Geologic time Scale, General account of Palaeo-Meso-and Cenozoic Eras with a mention of important fossil groups in different Eras, periods and epochs.

Note: - Examiner will set a total of nine questions comprising two questions from each unit and one compulsory question of short answer type covering the whole syllabus. It will consist of eight short answer type questions of 1½ mark each. Students will attempt one question from each unit and the compulsory question. All questions carry equal marks.

Practicals based of theory paper BZO 3005 (BZO 3055):
1. Study of components of ecosystem and ecological pyramids.
2. Use of keys to various taxas from different orders of animals. Methods of describing animals with particular reference to the recording of taxonomic characters.
3. Study of Fossils and their models.
4. Study of some charts relevant to Palaeontology.
5. Study of models of dinosaurs.
7. Visit to fossil park, Saketi, Kala Amb (H.P.).

Books Recommended
B.Sc. (Honours School) - Zoology
THIRD YEAR (SIXTH SEMESTER) EXAMINATION

Paper-I
Zoology-XVI: General Account of Vertebrates (Aves and Mammals)-II and Zoogeography
(BZO 3006)

Total Marks: 100
Theory: 75
Internal Ass.: 15
Annual Exam.: 60
Practical: 25
Internal Ass.: 05
Annual Exam.: 20

Objectives
To acquaint the students with the classification and general characters including morphology and physiology of different vertebrates from Aves to mammals including their behaviour and physiological adaptations. To enable the students understand the scope and importance of zoogeography.

UNIT-I
Aves
Classification upto orders, general characters and peculiar features of the class Aves. Detailed account of Ratitae; migration in birds; beaks & feet in birds; aerodynamics of flight in Aves. Adaptive radiations and affinities of class Aves.

UNIT-II
Mammals

UNIT-III
Zoogeography: Scope and importance of zoogeography
Divisions and the distribution of the vertebrates in the Palaearctic, Oriental, Ethiopian, Nearctic, Neotropical and Australian regions.

UNIT-IV
Island faunas: Recent continental island, Fringing Archipelagos and other islands and archipelagos. Dispersal and migration of vertebrates. Continental drift theory, Gondwana Mass and its dismemberment.

Note: - Examiner will set a total of nine questions comprising two questions from each unit and one compulsory question of short answer type covering the whole syllabus. It will consist of eight short answer type questions of 1½ mark each. Students will attempt one question from each unit and the compulsory question. All questions carry equal marks.
Practicals based on theory paper BZO 3006 (BZO 3056):

General Account of Vertebrates:
1. Study of museum specimens belonging to different groups with classification, morphological characters and ecological notes.

Zoogeography:
2. Study of the world maps to draw political, physical, climatic, vegetational and animal distribution in them.
3. Study of continental shelves of various parts of the world to determine land connections with various islands of the world.
4. Map study of continents in relations to distribution of animals peculiarities.
5. To draw line maps and fill in names of important animals, vegetation and climate.

Books Recommended

Paper-II

Zoology-XVII: Comparative Anatomy of Vertebrates-II (BZO 3007)

Theory hours per week: 4
Practical hours per week: 3

Total Marks : 100
Theory : 75
Internal Ass. : 15
Annual Exam. 60
Practical : 25
Internal Ass. : 05
Annual Exam: 20

Objectives
To enable the students to draw a comparative account of the morphology and general anatomy of the vertebrates and to understand evolution of different system in vertebrates.

UNIT-I


Digestive system-II: Comparative accounts: Pharynx, stomach and intestine in vertebrates. Variation of stomach in mammals.

UNIT-II

Respiratory system: A general account of the respiratory system in vertebrates.
Circulatory system: Formation and evolution of heart, aortic arches and their significance.

UNIT – III


Receptor organs: Organs of hearing, sight in vertebrates.

UNIT-IV

Urinogenital system: Types of kidney-Archinephros, Mesonephros, Metanephros, urinary bladder.

Reproductive organs: Gonads, ducts and their modifications in males and females in the vertebrates group. Uteri in mammals.

Note: - Examiner will set a total of nine questions comprising two questions from each unit and one compulsory question of short answer type covering the whole syllabus. It will consist of eight short answer type questions of 1\(\frac{1}{2}\) mark each. Students will attempt one question from each unit and the compulsory question. All questions carry equal marks.

Practicals based on theory paper BZO 3007 (BZO 3057):

1. Histotological slides available in museums with respect to different systems.
2. Dentition of vertebrates.
3. Demonstration of dissection of blood vascular system of Gallus; air sacs, muscles of flight and pectin of Columba through charts/models/video clippings.
4. Demonstration of dissection of Rattus (Rat): neck nerves, blood vascular and reproductive systems through charts/models/video clippings.

Books Recommended


Paper-III

Zoology-XVIII: Cytogenetics (BZO 3008)

<table>
<thead>
<tr>
<th>Total Marks</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory</td>
<td>75</td>
</tr>
<tr>
<td>Internal Ass.</td>
<td>15</td>
</tr>
<tr>
<td>Annual Exam.</td>
<td>60</td>
</tr>
<tr>
<td>Practical</td>
<td>25</td>
</tr>
<tr>
<td>Internal Ass.</td>
<td>05</td>
</tr>
<tr>
<td>Annual Exam</td>
<td>20</td>
</tr>
</tbody>
</table>

Objectives
To enable the students to learn various aspects of cytogenetics. To give an insight into evolution of genetic material, its functional aspects and changes in the environment that bring about mutations and evolution.

UNIT-I

Physical basis of heredity – Mendelism, interaction of genes, multiple alleles, chromosome structure and function in Eukaryotes (except in chemistry, models and concepts). Polytene chromosomes, lampbrush chromosomes.

UNIT-II

Cell division- Mitosis & Meiosis.
Sex determination-Sex chromosomes & sex chromatin, different types of sex mechanisms.

UNIT-III

Chromosome changes- Structural aberrations and its significance. Numerical changes, polyploidy and its types.
Nature of genes-Double helix structure of DNA, mechanisms of DNA replication.
Changes in genes-Spontaneous mutations and induced Mutations, physical and chemical mutagens.

UNIT-IV

Linkage of genes, crossing over, sex linkage in Drosophila and man, criss-cross inheritance, colour blindness and haemophilia.
Cytoplasmic inheritance.
Human Genetics-Normal and abnormal karyotypes.

Note: - Examiner will set a total of nine questions comprising two questions from each unit and one compulsory question of short answer type covering the whole syllabus. It will consist of eight short answer type questions of 1\( \frac{1}{2} \) mark each. Students will attempt one question from each unit and the compulsory question. All questions carry equal marks.

Practicals based on theory paper BZO 3008 (BZO 3058):

1. Study of mitosis from onion root tips by making temporary squash preparations and staining with aceto carmine/aceto orcein.
2. Study of various staining techniques for chromosome preparation through charts/models/video clippings
3. The study of drum sticks as sex chromatin.
4. Study of sex chromatin from human buccal mucosa.
5. Study of metaphase karyotypes from permanent slides of invertebrate and vertebrate species such as mosquitoes, grasshoppers, mice, man and numerical or structural aberrations, if any.
6. Study of Mendelian ratios from the study of seed coat colour pattern of bean seeds (Monohybrid and Dihybrid ratios).
7. Survey of human subjects for the demonstration of the frequency of dominant and recessive traits such as free and attached pinna, rolling of tongue, eye colour, hair colour etc.
8. Screening of films of Heredity, gene expression, DNA structure, cell division etc. available in the Department.

Books recommended

5. Gupta P.K., Genetics, Rastogi Publishers, Meerut, 2011

Paper-IV
Zoology-XIX: Embryology and Endocrinology (BZO 3009)

Total Marks: 100
Theory: 75
Internal Ass.: 15
Annual Exam.: 60
Practical: 25
Internal Ass.: 05
Annual Exam.: 20

Objectives
To enable the students to know about the development of all the vertebrates from an egg to the embryo. To acquaint the students with the functions of various endocrine glands and their secretions i.e. hormones.

UNIT I
History, Problems and Scope: Types of eggs, fertilization, early development (cleavage, blastulation, gastrulation and tubulation), presumptive areas, organisers and inductors.

UNIT II
Development of membranes and formation of placenta. Types of placenta in mammals, pregnancy tests. Bio-chemical basis of embryology, regeneration, metamorphosis.

UNIT-III
Introduction to hormones and their mode of action.
Gonadal hormones in Mammals.
Hormonal control of metabolism, development, somatic pigmentation and reproduction in insects.

UNIT-IV
Structure of endocrine glands-pituitary, thyroid, adrenal and pancreas of vertebrates.
Biological actions of hormones of pituitary, thyroid, adrenal and pancreas.

Note: - Examiner will set a total of nine questions comprising two questions from each unit and one compulsory question of short answer type covering the whole syllabus. It will consist of eight short answer type questions of 1½ mark each. Students will attempt one question from each unit and the compulsory question. All questions carry equal marks.
Practicals based on theory paper BZO 3009 (BZO 3059):

**Embryology**
1. Study of the slides showing the development of frog from zygote upto 7mm embryo.
2. Making stained permanent preparations of the blastodiscs from 18 to 90 hours incubated chick eggs.
3. Study of the whole mounts of the blastodiscs of 18 to 90 hours age.
4. Study of the slides of *Amphioxus* and *Herdmania* larvae.

**Endocrinology**
1. Demonstration of localization of endocrine glands in rat through charts/models/video clippings.
2. Demonstration of estrous cycle in mice/rat through charts/models/video clippings.

**Books Recommended**

---

**Paper-V**

Zoology-XX: Taxonomy, Ecology & Palaeontology-II (BZO 3010)

<table>
<thead>
<tr>
<th></th>
<th>Total Marks : 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory hours per week:</td>
<td>75</td>
</tr>
<tr>
<td>Practical hours per week:</td>
<td>25</td>
</tr>
<tr>
<td>Internal Ass. :</td>
<td>15</td>
</tr>
<tr>
<td>Annual Exam.</td>
<td>60</td>
</tr>
<tr>
<td>Practical               :</td>
<td>20</td>
</tr>
<tr>
<td>Internal Ass. :</td>
<td>05</td>
</tr>
<tr>
<td>Annual Exam:</td>
<td>20</td>
</tr>
</tbody>
</table>

**Objectives**

To enable the students to identify, classify and name the organism according to international code of zoological nomenclature. To acquaint the student with different procedures of taxonomy and different methods of analysis of variations and theories of classification. To educate the students about the basic environmental phenomena like ecosystem, energy flow through the ecosystem and biogeochemical cycles. To enable the students understand the adaptations of the animals to their environment. To make the students understand the importance of Palaeontology. To acquaint the students with origin of different vertebrates and ancestries of some vertebrates.

**UNIT-I**
Population structure of species; polytypic species, race, variety, cline, subspecies, semispecies, super species; speciation, species concepts-Typological species concept, nominalistic species concept, biological species concept, evolutionary species concept; difficulties in applying biological species concept.

UNIT-II
Population –Characteristics of a population, interspecific relationships (positive, negative and neutral relationships).

UNIT-III
Ecological adaptations – Natatorial, Desert, Volant and Fossorial adaptations.
Mimicry and Protective colouration – Definition, kinds of mimicry. Protective mimicry, Aggressive Mimicry and Conscious mimicry.

UNIT-IV

Practicals based on theory paper BZO 3010 (3060):
1. Phototactic behaviour of an insect.
2. Geotactic behaviour of an insect/annelid.
3. Food preferences in insects/larvae.
4. Habituation response in mosquito larvae.
5. Study of population, association and inter specific relationships.
6. Ecological adaptations through specimens, models and charts.
8. Study of models of ancestry of Elephant.
9. Study of some charts relevant to Palaeontology.

Books Recommended