REVISED CBCS
SYLLABUS FOR
THREE YEARS UNDER-GRADUATE COURSE
IN
Zoology (HONOURS)
(w.e.f. 2018-19)

BANKURA UNIVERSITY
BANKURA
WEST BENGAL
PIN 722155
## MODEL STRUCTURE IN Zoology (HONOURS)

### SEMESTER – I

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| UG/ZOO H 301/C-5 | CT-5: Diversity of Chordata  
CP-5: Diversity of Chordata Lab                                      | 4 2    | 10  25 15 | 50           |
| UG/ZOO H/302/ C-6 | CT-6: Animal Physiology: Controlling and Co-ordinating systems  
CP-6: Animal Physiology: Controlling and Co-ordinating systems Lab | 4 2    | 10  25 15 | 50           |
| UG/ZOO H/303/C-7 | CT-7: Fundamental of Biochemistry  
CP-7: Fundamental of Biochemistry Lab                                | 4 2    | 10  25 15 | 50           |
| UG/ZOO/304/GE-3 | GET : Environment and Public Health  
GEP : Environment and Public Health Lab                               | 4 2    | 10  25 15 | 50           |
| UG/ZOOH/305/SEC-1 | SECT: Apiculture                                                      | 2      | 10  40  | 50           |
| **Total in Semester - III**                       |                                                               | 26     | 50    200  | 250           |

## SEMESTER –IV

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| UG/ZOOH/401/C-8 | CT-8: Comparative Anatomy of Vertebrates  
CP-8: Comparative Anatomy of Vertebrates Lab | 4 2    | 10  25 15 | 50           |
| UG/ZOOH/402/C-9 | CT-9: Animal Physiology: Life Sustaining System  
CP-9: Animal Physiology: Life Sustaining System Lab | 4 2    | 10  25 15 | 50           |
| UG/ZOOH/403/C-10 | CT-10: Immunology  
CP-10: Immunology Lab                                                      | 4 2    | 10  25 15 | 50           |
| UG/ZOO/404/GE-4 | GET : Insect Vectors and Diseases  
GEP : Insect Vectors and Diseases Lab                                   | 4 2    | 10  25 15 | 50           |
| UG/ZOOH/405/SEC-2 | SECT: Sericulture  
Or  
Aquarium Fish keeping                                               | 2      | 10  40  | 50           |
| **Total in Semester – IV**                       |                                                               | 26     | 50    200  | 250           |
# SEMESTER – V

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# SEMESTER – VI

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<td>Or DSET: Parasitology</td>
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**SC = Subject Code, C= Core Course, AECC= Ability Enhancement Compulsory Course, SEC= Skill Enhancement Course, GE= Generic Elective, DSE= Discipline Specific Elective IA= Internal Assessment, ESE= End-Semester Examination, Lec.=Lecture, Tu.= Tutorial, and Prc.=Practical**
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<thead>
<tr>
<th>Content</th>
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<td>2.1 Credit Distribution across Courses</td>
<td>9</td>
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<tr>
<td>2.2 Scheme for CBCS Curriculum</td>
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<td>2.3 Choices for Discipline Specific Electives</td>
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<td>2.4 Choices for Skill Enhancement Courses</td>
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<td>3. Core Subjects Syllabus</td>
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4. Discipline Specific Electives Subjects Syllabus 44-53

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5.3 SEC T3 – Aquarium Fish Keeping

6. General Elective

6.1 GE T1 - Animal Diversity
6.2 GE P1 - Animal Diversity Lab
6.3 GE T2 - Aquatic Biology
6.4GE P2 - Aquatic Biology Lab
6.5 GE T3 - Environment and Public Health
6.6 GE P3 - Environment and Public Health Lab
6.7 GE T4 - Insect Vectors and Diseases
6.8 GE P4 - Insect Vectors and Diseases Lab

Appendix I - Scheme for CBCS Curriculum for Pass Course

7.1 Credit Distribution across Courses
7.2 Scheme for CBCS Curriculum
1. Introduction

The syllabus for Zoology at undergraduate level using the Choice Based Credit system has been framed in compliance with model syllabus given by UGC. While framing the syllabus as per the UGC guideline, the topics have been kept as generic as possible in order to provide enough freedom to the individual Universities to detail out their own syllabus as per their own infrastructure, expertise and strength.

The main objective of framing this new syllabus is to give the students a holistic understanding of the subject giving substantial weightage to both the core content and techniques used in Zoology.

Keeping in mind and in tune with the changing nature of the subject, adequate emphasis has been given on new techniques and understanding of the subject.

The syllabus has also been framed in such a way that the basic skills of subject are taught to the students, and everyone might not need to go for higher studies and the scope of securing a job after graduation will increase.

There is wide deviation in the infrastructure, be it physical or in human resource, in the form of teachers' expertise and ability and aspiration of the students. Hence, University is free to choose the Electives as per their infrastructural strengths and offer at least 6 to 7 electives.

While the syllabus is in compliance with UGC model curriculum, it is necessary that Zoology students should learn “Immunology” as one of the core courses rather than as elective while. Also, an important elective on “Microbiology” has been added.

Project Work may be introduced instead of the 4th Elective with a credit of 6 split into 2+4, where 2 credits will be for continuous evaluation and 4 credits reserved for the merit of the dissertation.
## 2. Scheme for CBCS Curriculum

### 2.1 Credit Distribution across Courses

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*Tutorials of 1 Credit will be conducted in case there is no practical component*
## Scheme for CBCS Curriculum

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<td>III</td>
<td>Core course – V</td>
<td>Diversity of Chordates</td>
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<td>Core course - V Practical</td>
<td>Diversity of Chordates Lab</td>
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<td>Core course – VI</td>
<td>Animal Physiology: Controlling and Coordinating Systems</td>
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<td>Core course - VI Practical</td>
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<td>Core course - VII</td>
<td>Fundamentals of Biochemistry</td>
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<td>Core course - VII Practical</td>
<td>Fundamentals of Biochemistry Lab</td>
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<td>Skill Enhancement Course – 1</td>
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<td></td>
<td>Generic Elective - 3 Practical</td>
<td>TBD</td>
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<tr>
<td>IV</td>
<td>Core course – VII</td>
<td>Comparative Anatomy of Vertebrates</td>
<td>4</td>
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<tr>
<td>Core course - VII Practical</td>
<td>Comparative Anatomy of Vertebrates Lab</td>
<td>2</td>
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<tr>
<td>Core Course IX</td>
<td>Animal Physiology : Life Sustaining Systems</td>
<td>4</td>
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<tr>
<td>Core Course IX Practical</td>
<td>Animal Physiology : Life Sustaining Systems Lab</td>
<td>4</td>
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<tr>
<td>Core Course X</td>
<td>Immunology</td>
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<td>Core Course X Practical</td>
<td>Immunology Lab</td>
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<tr>
<td>Skill Enhancement Course – 2</td>
<td>TBD</td>
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<tr>
<td>Generic Elective - 3</td>
<td>TBD</td>
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<td>Generic Elective - 3 Practical</td>
<td>TBD</td>
<td>2</td>
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<td>V</td>
<td>Core Course-XI</td>
<td>Molecular Biology</td>
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<tr>
<td>Core Course-XI Practical</td>
<td>Molecular Biology</td>
<td>4</td>
<td></td>
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<tr>
<td>Core Course-XII</td>
<td>Principles of Genetics</td>
<td>4</td>
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<td>Core Course-XII Practical</td>
<td>Principles of Genetics Lab</td>
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<td>TBD</td>
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<td>TBD</td>
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<tr>
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<td>Core Course-XIII</td>
<td>Developmental Biology</td>
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<td>Core Course-XIII Practical</td>
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<td>Core Course-XIV</td>
<td>Evolutionary Biology</td>
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<td>Core Course-XIV Practical</td>
<td>Evolutionary Biology Lab</td>
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<td>Discipline Specific Elective - 1</td>
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<td>4</td>
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<td>TBD</td>
<td>2</td>
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</tr>
</tbody>
</table>
### 2.3 Choices for Discipline Specific Electives

**Discipline Specific Elective - 1 to 4**

<table>
<thead>
<tr>
<th>Animal Behavior &amp; Chronobiology</th>
<th>Animal Biotechnology</th>
<th>Biology of Insecta</th>
<th>Endocrinology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fish and Fisheries</td>
<td>Microbiology</td>
<td>Parasitology</td>
<td>Wild Life Conservation &amp; Management</td>
</tr>
<tr>
<td>Reproductive Biology</td>
<td></td>
<td></td>
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</tbody>
</table>

### 2.4 Choices for Skill Enhancement Courses

**Skill Enhancement Course-1 & Skill Enhancement Course-2**

<table>
<thead>
<tr>
<th>Apiculture</th>
<th>Aquarium Fish Keeping</th>
<th>Medical Diagnostics Techniques</th>
<th>Sericulture</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3. Core Subjects Syllabus

3.1 Core T1 - Non-chordates I: Protista to Pseudocoelomates

<table>
<thead>
<tr>
<th>Non-Chordates I: Protists to Pseudocoelomates</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unit 1: Basics of Animal Classification</strong></td>
</tr>
<tr>
<td>1. Definitions: Classification, Systematics and Taxonomy: Taxonomic Hierarchy, Taxonomic types</td>
</tr>
<tr>
<td>2. Codes of Zoological Nomenclature; Principle of priority; Synonymy and Homonymy; Six kingdom concept of classification (Carl Woese)</td>
</tr>
<tr>
<td>3. Diversity of non-chordate and its significance</td>
</tr>
<tr>
<td>4. Evolution of coelom</td>
</tr>
<tr>
<td><strong>Unit 2: Protista</strong></td>
</tr>
<tr>
<td>1. Protozoa:</td>
</tr>
<tr>
<td>a. General characteristics and classification up to phylum (according to Levine et. al., 1981) Locomotion in Euglena, Paramoecium and Amoeba; Conjugation in Paramoecium.</td>
</tr>
<tr>
<td>b. Life cycle and pathogenicity of Plasmodium vivax and Entamoeba histolytica</td>
</tr>
<tr>
<td><strong>Unit 3: Metazoa</strong></td>
</tr>
<tr>
<td>a. Evolution of symmetry and segmentation of Metazoa</td>
</tr>
<tr>
<td><strong>Unit 4: Porifera</strong></td>
</tr>
<tr>
<td>General characteristics and classification up to classes (Hyman)</td>
</tr>
<tr>
<td>Canal system and spicules in sponges</td>
</tr>
<tr>
<td><strong>Unit 5: Cnidaria</strong></td>
</tr>
<tr>
<td>1. General characteristics and classification up to classes</td>
</tr>
<tr>
<td>2. Metagenesis in Obelia &amp; Aurelia</td>
</tr>
<tr>
<td>3. Polymorphism in Siphonophora</td>
</tr>
<tr>
<td>4. Corals and coral reef diversity, function &amp; conservation</td>
</tr>
<tr>
<td><strong>Unit 6: Ctenophora</strong></td>
</tr>
<tr>
<td>General characteristics</td>
</tr>
<tr>
<td><strong>Unit 7: Platyhelminthes</strong></td>
</tr>
<tr>
<td>1. General characteristics and classification up to classes</td>
</tr>
<tr>
<td>2. Life cycle and pathogenicity and control measures of Fasciola hepatica and Taenia solium</td>
</tr>
<tr>
<td><strong>Unit 8: Nematoda</strong></td>
</tr>
<tr>
<td>1. General characteristics and classification up to classes</td>
</tr>
<tr>
<td>2. Life cycle, pathogenicity and control measures of Ascaris lumbricoides and Wuchereria bancrofti</td>
</tr>
<tr>
<td>3. Parasitic adaptations in helminthes</td>
</tr>
</tbody>
</table>

**Note:** Classification to be followed from Barnes and Ruppert 1994, 6th Edition

**Reference Books**
Mandal FB (2015),
3.2 Core PI - Non-Chordates I Lab

Non-Chordates I: Protists to Pseudocoelomates

Practicals

1. Identification of following specimen
   a. Amoeba, Euglena, Entamoeba, Opalina, Paramecium, Plasmodium,
   b. Sycon, Neptune's Cup, Fasciola, Taenia and Ascaris
   c. Physalia, Millepora, Aurelia, Tubipora, Corallium, Alcyonium, Gorgonia, Metridium, Pennatula, Fungia, Madrepora.

2. Whole mount preparation of Euglena, Amoeba, and Paramoecium.

3. Staining and mounting of any protozoa/helminth from gut of cockroach.

4. Submission of Laboratory Note Book

Distribution of Marks:

Full marks: 15

1. Identification with reasons (any three):
   (From Item No. 1; maximum one from each group)
   9 [3×3]

2. Staining/Mounting (any one) (From Item no. 2 and 3):
   4 [2+1+1]

3. Submission of Laboratory note book:
   2

Note:

Q1. Sc. name :1 mark, Reasons: 2 marks
Q2. Staining: 2 marks, Drawing: 1 mark, labelling: 1 mark

Suggested readings:

3.3 Core T2 - Perspectives in Ecology

Perspectives in Ecology

Unit 1: Introduction to Ecology

Unit 2: Population
Unitary and Modular populations
Population: Characteristics, growth forms, geometric, exponential and logistic growth, equation and patterns, r and K strategies
Population regulation - density-dependent and independent factors
Population Interactions, Gause's Principle with laboratory and field examples, Lotka-Volterra equation for competition.

Unit 3: Community
Community characteristics: species diversity, abundance, dominance, richness
Concept of community stratification, Ecotone and edge effect. Ecological succession with one example (Forest)

Unit 4: Ecosystem
Types of ecosystem w.r.t forest and marine ecosystem; Food chain: Detritus and grazing food chains, Linear and Y-shaped food chains, Food web, Energy flow through the ecosystem, Ecological pyramids and Ecological efficiencies
Biogeochemical cycle w.r.t. Nitrogen cycle
Agro ecosystem and its impact

Unit 5: Applied Ecology
Concept of wild life
Wildlife Conservation (in-situ and ex-situ conservation)
Management strategies for tiger conservation; Wild life protection act (1972)

Reference Books
Robert Leo Smith Ecology and field biology Harper and Row publisher
3.4 Core P2 - Perspectives in Ecology Lab

**Perspectives in Ecology**

**Practicals**

1. Determination of population density in a natural/hypothetical community by quadrate method and calculation of Shannon-Weiner diversity index for the same community

2. Study of an aquatic ecosystem: Zooplankton, Measurement of turbidity/penetration of light, determination of pH, and Dissolved Oxygen content (Winkler's method), Chemical Oxygen Demand and free CO₂

3. Report on a visit to National Park/Biodiversity Park/Wild life sanctuary

4. Submission of Laboratory Note Book

---

**Distribution of Marks:**

<table>
<thead>
<tr>
<th>Description</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Experiment (from Item no. 1):</td>
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</tr>
<tr>
<td>2. Experiment (from Item no. 2; pH or free O₂ or free CO₂ estimation)</td>
<td>5 (2+3)*</td>
</tr>
<tr>
<td>3. Report on Excursion:</td>
<td>3</td>
</tr>
<tr>
<td>4. Submission of Laboratory note book:</td>
<td>2</td>
</tr>
</tbody>
</table>

*Note

Q 2. Principle: 2 marks and result: 3 marks

**Suggested Reading**


3.5 Core T3 - Non-Chordates II

Non-Chordates II: Coelomates

Unit 1: Introduction
Coelom: types and significance
Concept of metamereism
Metamerism in Annelida

Unit 2: Annelida
1. General characteristics and classification up to classes
2. Excretion in Annelida through nephridia.

Unit 3: Arthropoda
1. General characteristics and classification up to classes
2. Respiration (Gills in prawn and trachea in cockroach)
3. Metamorphosis in Lepidopteran Insects.
4. Social life in termite
5. Compound eye in cockroach and prawn

Unit 4: Onychophora
General characteristics and Evolutionary significance of Peripatus

Unit 5: Mollusca
1. General characteristics and Classification up to classes
2. Nervous system and torsion in Gastropoda
3. Feeding and respiration in Pila sp

Unit 6: Echinodermata
1. General characteristics and Classification up to classes
2. Water-vascular system in Astéries
3. Larval forms in Echinodermata
4. Affinities with Chordates

Unit 7: Hemichordata
1. General characteristics of phylum Hemichordata.
2. Relationship with non-chordates and chordates: Evolutionary significance

Note: Classification to be followed from Barnes and Ruppert 1994, 6th Edition

Reference Books
Mandal FB (2015), Human Parasitology, 2nd Edition, PHI Learning
Non-Chordates II: Coelomates

Practicals

1. Identification of following specimens:
   a. Aphrodite, Nereis, Heteronereis, Sabella, Serpula, Chaetopterus, Phereetima, Hinudinia
   b. Carcinoscorpius, Palamaeus, Palamaemon, Daphnia, Balanus, Sacculina, Cancer, Eupagurus, Scolopendra, Peripatus
   c. Chiton, Dentalium, Pila, Doris, Unio, Pinctada, Sepia, Octopus, Nautilus, Asterias, Ophiura, Echinus, Cucumaria and Antedon

2. Identification of T.S. through pharynx, gizzard, and typhlosolar intestine of earthworm

3. Dissection, drawing and labelling of digestive system and septal nephridia of earthworm

4. a. Mounting of mouth parts of Periplaneta
   b. Dissection: digestive system and nervous system of Periplaneta


6. Submission of Laboratory Note Book

Distribution of Marks

Full marks: 15

1. Identification with reasons (any three):
   7 [3+3+1]*
   (Two from Item No. 1 and one from Item no.2.)

2. Dissection (any one) (From Item no. 3 or 4):
   4[2+1+1]*

3. Submission of a project report along with the life cycle stages
   of any insect (Item no. 5)
   2

4. Submission of laboratory note book:
   2

*Note:

Q1. For Item (1), Sc. name: 1 mark and Reasons: 2 marks. For Item (2) 1 mark is allotted for both identification and characters.

Q2. Dissection: 2 marks; drawing and labelling: 1 mark each

Suggested Reading

3.7 Core T4 - Cell Biology

**Cell Biology**

**Unit 1: Overview of Cell**
Basic structure of Prokaryotic and Eukaryotic cell

**Unit 2: Plasma Membrane**
1. Ultra structure of Plasma membrane: Fluid mosaic model
2. Transport across membrane: Active and Passive transport, Facilitated transport
3. Cell junctions: Tight junctions, Gap junctions, Desmosomes

**Unit 3: Cytoplasmic organelles**
2. Mitochondria: Structure, Semi-autonomous nature, Endosymbiotic hypothesis, Mitochondrial Respiratory Chain, Chemi-osmotic hypothesis
3. Peroxisomes: Structure and Functions
4. Protein sorting and mechanisms of vesicular transport

**Unit 4: Nucleus**
1. Structure of Nucleus: Nuclear envelope, Nuclear pore complex, Nucleolus
2. Chromatin: Euchromatin and Heterochromatin and packaging (nucleosome)

**Unit 5: Cell Division**
1. Cytoskeletal structures,
2. Centrosome structure and function
3. Accessory proteins of microfilament & microtubule
4. A brief idea about molecular motors
5. Mitosis and Meiosis: Basic process and their significance

**Unit 6: Cell cycle and cancer**
1. Cell cycle and its regulation
2. Cancer (Concept of oncogenes and tumor suppressor genes with special reference to p53, Retinoblastoma and Ras and APC.

**Unit 7: Cell Signalling**
1. Cell signalling transduction pathways; Types of signalling molecules and receptors
2. GPCR and Role of second messenger (cAMP)
3. Extra cellular matrix-cell interactions
4. Apoptosis

**Reference Books**
3.8 Core P4 - Cell Biology Lab

Cell Biology

Practicals

1. Drawing of ultrastructure of cell and different organelles (from photographs provided)
2. Familiarization with the student's light microscope and stereo-binocular microscope; preparation of aceto-orcein/ acetocarmine stain
3. Preparation of temporary stained squash of onion root tip to study various stages of mitosis
4. Preparation and identification of various stages of meiosis from grasshopper testis
5. Preparation of permanent slides of Barr body from cheek epithelium
6. Submission of Laboratory Note Book

Distribution of Marks

<table>
<thead>
<tr>
<th>Description</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Identification of any ideal stages of mitosis and meiosis (any two):</td>
<td>4 (2+2)*</td>
</tr>
<tr>
<td>2. Squash preparation, staining and identification of any stage from mitosis or meiosis</td>
<td>5 (3+2)*</td>
</tr>
<tr>
<td>3. Preparation of Barr body</td>
<td>4 (3+1)*</td>
</tr>
<tr>
<td>4. Submission of laboratory note book</td>
<td>2</td>
</tr>
</tbody>
</table>

*Note:
Q1. Identification of the stage: ½ mark and characters: 1½ marks
Q2. Preparation: 3 marks; identification and drawing: 2 marks
Q3. Preparation: 3 marks and drawing: 1 mark.

Suggested Reading

3.9 Core T5 - Diversity of Chordata

Diversity of Chordata

Unit 1: Introduction to Chordates
Concept of Phylum Chordata
Diversity of Chordata and its significance

Unit 2: Urochordata and Cephalochordata
1. General characteristics and classification of Urochordata and Cephalochordata up to Classes.
2. Retrogressive metamorphosis in *Ascidia*.
3. Chordate Features and Feeding in *Branchiostoma*

Unit 3: Origin of Chordata
1. Diploseudula concept and the Echinoderm theory of origin of chordates
2. Advanced features of vertebrates

Unit 4: Agnatha
General characteristics and classification of cyclostomes up to order

Unit 5: Pisces
1. General characteristics and classification of Chondrichthyes and Osteichthyes up to Subclasses
2. Accessory respiratory organ, migration and parental care in fishes

Unit 6: Amphibia
1. General characteristics and classification up to living Orders.
2. Metamorphosis and parental care in Amphibia

Unit 7: Reptilia
1. General characteristics and classification up to living Orders.
2. Poison apparatus and biting mechanism in snakes

Unit 8: Aves
1. General characteristics and classification up to Sub-Classes
2. Exoskeleton and migration in birds
3. Principles and aerodynamics of flight

Unit 9: Mammals
1. General characters and classification up to living orders
2. Affinities and phylogeny of Monotremata
3. Exoskeletal derivatives of mammals
4. Adaptive radiation in marsupials
5. Echolocation in micro chiropterans and cetaceans

Unit 10: Zoogeography
Plate tectonic and Continental drift theory; Zoogeographical realms; distribution of birds and mammals in major six realms

Note: Classifications for Protochordata, Agnatha, Reptilia, Aves and Mammalia to be followed from Young (1981), for Pisces to be followed from Romer (1959), for Amphibia to be followed from Nobel (1924).
Reference Books

3.10 Core P5 - Diversity of Chordata Lab  

Diversity of Chordata

Practicals

1. Identification of following specimen
   a. Balanoglossus, Branchiostoma
   b. Petromyzon, Myxine
   c. Scoliodon, Pristis, Torpedo, Chimaera, Mystus, Heteropneustes, Labeo, Exocoetus, Echeneis, Anguilla, Hippocampus, Anabas
   d. Necturus, Bufo, Hyla, Alytes, Axolotl, Tylototriton,
   e. Chelone, Hemidactylus, Uromastix, Chamaeleon, Ophiosaurus, Draco, Bungarus, Vipera, Naja, Hydrophis
   f. Pteropus, Funambulus, Bandicota

2. Dissect out Pecten from Fowl head

3. Dissect out brain and pituitary of carp

4. Submission of Laboratory Note Book

Distribution of marks

<table>
<thead>
<tr>
<th>Full marks: 15</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Identification with reasons (any three): (From Item no. 1; maximum 1 from each group)</td>
</tr>
<tr>
<td>2. Dissection (any one) (From Item no. 2 or 3)</td>
</tr>
<tr>
<td>3. Submission of laboratory note book:</td>
</tr>
</tbody>
</table>

*Note:

Q1. Sc. Name: 1 mark; Reasons: 2 marks
Q2. Dissection: 2 marks, drawing and labelling :1 mark each

Suggested Reading

Animal Physiology: Controlling & Coordinating Systems

Unit 1: Tissues
Classification, structure and functions of epithelial tissue, connective tissue, muscular tissue and nervous tissue

Unit 2: Bone and Cartilage
Structure and types of bones and cartilages

Unit 3: Muscular System
Histology of different types of muscle; Ultra structure of skeletal muscle; Molecular and chemical basis of muscle contraction; Characteristics of muscle fibre

Unit 4: Nervous System
Structure of neuron, propagation of nerve impulse across the myelinated and unmyelinated nerve fibers; Types of synapse. Synaptic transmission and Neuromuscular junction, role of neurohormone in vertebrates

Unit 5: Reproductive System
Histology of testis and ovary, Spermatogenesis, Oogenesis and their significance, fertilization
Physiology of Reproduction (estrus and menstrual cycle)

Unit 6: Endocrine System
1. Classification of hormones; Mechanism of Hormone action
2. Histology and function of pituitary, thyroid, pancreas and adrenal
3. Signal transduction pathways for steroid and non-steroid hormones in brief
4. Placental hormones

Reference Books

Vasudeva and Mishra (2014). Inderbir Singh’s Text book of Human Histology 7th Edn Jaypee Publisher N. Delhi
Animal Physiology: Controlling & Coordinating Systems

List of Practical

1. Identification of permanent slides: TS of Mammalian Skin, Cartilage, Bone, Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid, Intestine, Lung, Liver and Kidney
2. Recording of simple muscle twitch by Kymograph
3. Preparation of temporary mounts: Squamous epithelium, Striated muscle fibres and nerve cells
4. Microtomy: Preparation and submission of permanent slide of mammalian (Goat/white rat) tissues (any two).
5. Submission of Laboratory Note Book

Distribution of Marks

Full marks: 15

1. Identification with reasons (any two; From Item no. 1): 6 [3+3]
2. Experiment from Item no. 2 or preparation (tissue sectioning/ staining) from Item no.4: 4
3. Mounting (any one from Item no. 3): 2
4. Submission of permanent slide (any two mammalian tissues): 1
5. Laboratory note book: 2

*Note:
Q1. Identification: 1 mark, Reasons: 2 marks

Suggested Reading

3.13 Core T7 - Fundamentals of Biochemistry

Fundamentals of Biochemistry

Unit 1: Introduction to biochemistry and its scope

Unit 2: Carbohydrates
1. Structure and Biological importance: Monosaccharides, Disaccharides, Polysaccharides; Derivatives of Monosaccharides
2. Carbohydrate metabolism: Glycolysis, Citric acid cycle, Pentose phosphate pathway, Gluconeogenesis

Unit 3: Lipids
2. Lipid metabolism: β-oxidation of fatty acids

Unit 4: Proteins
1. Amino acids: Structure, classification, General -and Electro chemical properties of α-amino acids; Physiological importance of essential and non-essential amino acids
2. Proteins: Bonds stabilizing protein structure; Levels of organization
3. Protein metabolism: Transamination, Deamination, Urea cycle, Fate of carbon skeleton of Gluconogenic and Ketogenic amino acids

Unit 5: Nucleic Acids
1. Structure: Purines and pyrimidines, Nucleosides, Nucleotides, Nucleic acids
2. Types of DNA and RNA, Complementarity of DNA, Hypo- Hyperchromaticity of DNA
3. Basic concept of nucleotide metabolism

Unit 6: Enzymes
Nomenclature and classification; Cofactors; Specificity of enzyme action; Isozymes; Mechanism of enzyme action; Enzyme kinetics; Michaelis- Menten equation, Lineweaver-Burk plot; Factors affecting rate of enzyme-catalyzed reactions; Enzyme inhibition; Allosteric enzymes and their kinetics

Unit 7: Oxidative Phosphorylation in mitochondrial matrix
Redox systems; Review of mitochondrial respiratory chain, Inhibitors and un-couplers of Electron Transport System

Reference Books
3.14 Core P7 - Fundamentals of Biochemistry Lab

Fundamentals of Biochemistry Lab

Practicals

1. Qualitative tests of functional groups in carbohydrates (Benedict), proteins (Biuret) and lipids (Saponification).
2. Quantitative estimation of protein by Lowry Method
3. Study the enzymatic activity of salivary amylase (Effect of temperature)
5. Submission of Laboratory Note Book

Examination Pattern:

<table>
<thead>
<tr>
<th>Practical</th>
<th>Full marks: 15</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Qualitative Test</td>
<td>3</td>
</tr>
<tr>
<td>2. Quantitative estimation of protein</td>
<td>6</td>
</tr>
<tr>
<td>3. Experiment</td>
<td>4</td>
</tr>
<tr>
<td>4. Submission of laboratory note book</td>
<td>2</td>
</tr>
</tbody>
</table>

*Note:

Q1. Principle: 1 mark and result 2 marks
Q2. Principle 2 marks and result 4 marks
Q3. Principle 1 mark and result 3 marks

Suggested Reading:

3.15 Core T8 - Comparative Anatomy of Vertebrates  
4 Credits

**Comparative Anatomy of Vertebrates**

**Unit 1: Integumentary System**
Structure, function and derivatives of integument in amphibian, birds and mammals

**Unit 2: Skeletal System**
General idea of axial and appendicular skeleton; Basic idea of jaw suspension and visceral arches.

**Unit 3: Digestive System**
Ruminating stomach; dentition in mammals

**Unit 4: Respiratory System**
Respiratory organs in fish, amphibian, and birds

**Unit 5: Circulatory System**
Comparative account of heart and aortic arches

**Unit 6: Urinogenital System**
Archinephros, Pronephros, Mesonephros and Metanephros
Evolution of urinogenital ducts, Types of mammalian uteri

**Unit 7: Nervous System**
Comparative account of brain, Cranial nerves in mammals

**Unit 8: Sense Organs**
Classification of receptors

**Reference Books**


Comparative Anatomy of Vertebrates

Practicals

1. Identification of disarticulated skeleton of Toad, Pigeon and Guinea pig [Skull, Vertebrae (Atlas, Axis) and typical vertebrae of procoelous, heterocoelous and acoelous type]; Pectoral girdle, Pelvic girdle, Skull of Dog
2. Identification of carapace and plastron of turtle (Model/Chart)
3. Staining and mounting of placoid, cycloid and ctenoid scales
4. Dissection: Afferent branchial arterial system and IX and Xth cranial nerves of carp
5. Submission of Laboratory Note Book

Examination Pattern:

<table>
<thead>
<tr>
<th>Examination</th>
<th>Full marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Identification with reasons (any three; From Item no. 1,2)</td>
<td>6 (2+2+2)*</td>
</tr>
<tr>
<td>2. Mounting and staining (Item no. 3).</td>
<td>2</td>
</tr>
<tr>
<td>3. Dissection (any one; From Item no. 4):</td>
<td>5 [3+1+1]*</td>
</tr>
<tr>
<td>4. Submission of laboratory note book:</td>
<td>2</td>
</tr>
</tbody>
</table>

*Note:
Q1. Identification: ½ mark and reasons: 1½ marks
Q2. 3 marks for dissection and 1 mark each for drawing and labelling

Suggested Readings:

Animal Physiology: Life Sustaining Systems

Unit 1: Physiology of Digestion
Structural organisation and functions of gastrointestinal tract and associated glands: Mechanical and chemical digestion of food along with the role of digestive enzymes; absorption of Carbohydrates, Lipids, Proteins and Nucleic Acids

Unit 2: Physiology of Respiration
Mechanism of Respiration, transport of Oxygen and Carbon dioxide in blood, Dissociation curves and the factors influencing it, carbon monoxide poisoning

Unit 3: Physiology of Circulation
1. Components of Blood and their functions; Structure and functions of haemoglobin
2. Haemostasis; Blood clotting system
3. Haemopoiesis; Basic steps and its regulation
4. Blood groups; ABO and Rh factor

Unit 4: Physiology of Heart
1. Structure of mammalian heart, Coronary Circulation, Structure and working of conducting myocardial fibres, Origin and conduction of cardiac impulses
2. Cardiac Cycle and cardiac output
3. Blood pressure and its regulation

Unit 5: Thermoregulation & Osmoregulation
1. Physiological classification of vertebrates based on thermal biology.
2. Osmoregulation in aquatic vertebrates
3. Extra-renal osmoregulatory organs in vertebrates

Unit 6: Renal Physiology
Structure of Kidney and its functional unit, Mechanism of urine formation, Regulation of acid-base balance

Reference Books
Sherwood, L. (2013). Human Physiology from cells to systems. 8th Edn., Brooks & Cole
Animal Physiology: Life Sustaining Systems Lab

Practicals

1. Enumeration of red blood cells and white blood cells using haemocytometer (TC)
2. Estimation of haemoglobin using Sahli's haemoglobinometer
3. Determination of ABO Blood group
4. Preparation of haemin crystals
5. Recording of blood pressure using a sphygmomanometer
6. Submission of Laboratory Note Book

Distribution of Marks

<table>
<thead>
<tr>
<th>Examination Pattern</th>
<th>Full marks: 15</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Experiment (any one; From Item no. 1 or 2):</td>
<td>8 [6+2] *</td>
</tr>
<tr>
<td>2. Experiment (any one; From Item no. 3 or 4 or 5):</td>
<td>5 [(3+1+1)/(4+1)] *</td>
</tr>
<tr>
<td>3. Submission of laboratory note book:</td>
<td>2</td>
</tr>
</tbody>
</table>

*Note:
Q1. For preparation 6 marks and for result 2 marks
Q2. For item no. (3 and 4): preparation 3 marks and 1 mark each for drawing and labelling. For item no. (5), 4 marks for procedure and 1 mark for comment.

3.19 Core T 10 Immunology

Immunology

Unit 1: Overview of Immune System
Basic concepts of health and diseases, Historical perspective of Immunology

Unit 2: Innate and Adaptive Immunity
Anatomical barriers, Inflammation, Cell and molecules involved in innate immunity, Adaptive immunity (Cell mediated and humoral).

Unit 3: Antigens
Antigenicity and immunogenicity, Immunogens, Adjuvants and haptens, Factors influencing immunogenicity, B and T-Cell epitopes

Unit 4: Immunoglobulins
Structure and functions of major classes of immunoglobulins, Antigen- antibody interactions, Immunoassays (ELISA and RIA), Hybridoma technology, concept of monoclonal antibody

Unit 5: Major Histocompatibility Complex
Structure and functions of MHC molecules. Structure of T cell Receptor and its signalling

Unit 6: Cytokines
Types, properties and functions of cytokines.

Unit 7: Complement System
Components and pathways of complement activation.

Unit 8: Hypersensitivity
Gell and Coombs’ classification and brief description of various types of hypersensitivities.

Unit 9: Immunology of diseases
Malaria, Filariasis, and Tuberculosis

Unit 10: Vaccines
Various types of vaccines. Active & passive immunization (Artificial and natural).

Reference Books

Khan FH (2011) The Elements of Immunology Pearson
3.20 Immunology Lab

**Immunology**

**Practicals**

1. Identification of lymphoid organs of human (Model/Photograph).
2. Identification of histological slides: T.S of spleen, thymus and lymph nodes
3. Preparation of stained blood film to study various types of white blood cells.
4. Clotting time (CT), Bleeding time (BT) of human blood
5. Submission of Laboratory Note Book

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**Distribution of Marks**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Identification with reasons (any two; From Item no. 1 &amp; 2)</td>
</tr>
<tr>
<td>2.</td>
<td>Preparation of stained blood film (from item 3)</td>
</tr>
<tr>
<td>3.</td>
<td>Experiment (any one; From Item no. 4)</td>
</tr>
<tr>
<td>4.</td>
<td>Laboratory note book</td>
</tr>
</tbody>
</table>

**Full marks: 15**

- 1. Identification with reasons (any two; From Item no. 1 & 2) 4 (2+2) *
- 2. Preparation of stained blood film (from item 3) 6 (4+1+1) *
- 3. Experiment (any one; From Item no. 4) 3 (2+1) *
- 4. Laboratory note book 2

**Note:**

Q1. Identification: ½ mark and reasons: 1½ marks
Q2. 4 marks for preparation and 1 mark each for identification and drawing
Q3. Experiment: 2 marks and result: 1 mark
3.21 Core T11 - Molecular Biology

Molecular Biology

Unit 1: Overview of molecular Biology
Emergence, Historical growth of the discipline and scope

Unit 2: Nucleic Acids
Salient features of DNA and RNA Watson and Crick Model of DNA

Unit 3: DNA Replication
Mechanism of DNA Replication in Prokaryotes, Semi-conservative, bidirectional and discontinuous Replication, RNA priming, Replication of telomeres

Unit 4: Transcription
Mechanism of Transcription in prokaryotes and eukaryotes, Transcription factors, Difference between prokaryotic and eukaryotic transcription.

Unit 5: Translation
Mechanism of protein synthesis in prokaryotes, fidelity of protein synthesis, aminoacyl tRNA synthetases and charging of tRNA; Proteins involved in initiation, elongation and termination of polypeptide chain; Genetic code, Degeneracy of the genetic code and Wobble Hypothesis; Inhibitors of protein synthesis; Difference between prokaryotic and eukaryotic translation

Unit 6: Post Transcriptional Modifications and Processing of Eukaryotic RNA
Capping and Poly A tail formation in mRNA; Split genes: concept of introns and exons, splicing mechanism, alternative splicing, and RNA editing

Unit 7: Gene Regulation
Regulation of Transcription in prokaryotes: lac operon and trp operon; Regulation of Transcription in eukaryotes: Activators, enhancers, silencer, repressors, miRNA mediated gene silencing, Genetic imprinting

Unit 8: DNA Repair Mechanisms
Types of DNA repair mechanisms, Rec BCD model in prokaryotes, nucleotide and base excision repair, SOS repair

Unit 9: Molecular Techniques
Basic concept of PCR, Western and Southern blot, Northern Blot

Reference Books
Verma & Agarwal. Cell Biology, Genetics, Molecular Biology, Evolution & Ecology. S. Chand
3.22 Core P II - Molecular Biology Lab

Molecular Biology Lab

Practicals

1. Study and interpretation of electron micrograph/photograph showing
   a. Lampbrush chromosome
   b. DNA replication
   c. Transcription
   d. Split gene

2. Preparation of polytene chromosome from Chironomus or Drosophila larva

3. Preparation of solid culture media (LB) and growth of E.coli by spreading and Streaking methods

4. Submission of Laboratory Note Book

Examination Pattern: 

<table>
<thead>
<tr>
<th>Question</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Identification with reasons (any two; From Item no.1)</td>
<td>5 (2½ ×2) *</td>
</tr>
<tr>
<td>2. Preparation of polytene chromosome (Item no 2)</td>
<td>8 (6+1+1) *</td>
</tr>
<tr>
<td>3. Submission of laboratory note book:</td>
<td>2</td>
</tr>
</tbody>
</table>

*Note:

Q1. Identification: 1 mark and reasons: 1½ marks

Q2. Preparation: 6 marks and drawing and labelling:1 mark each
3.23 Core T 12 Principles of Genetics

Principles of Genetics

Unit 1: Mendelian Genetics and its Extension
History of Genetics and its scope
Principles of inheritance; Incomplete dominance and co-dominance; Epistasis Multiple alleles; Lethal alleles; Pleiotropy; sex-linked, sex-influenced and sex-limited inheritance; Polygenic Inheritance.

Unit 2: Linkage, Crossing Over and Chromosomal Mapping
Linkage and Crossing Over; molecular basis of crossing over; Measuring recombination frequency and linkage intensity using three-factor crosses; Interference and coincidence

Unit 3: Mutations
Types of gene mutations (Classification), Types of chromosomal aberrations (Classification with one suitable example of each), Non-disjunction and variation in chromosome number; Molecular basis of mutations in relation to UV light and chemical mutagens

Unit 4: Sex Determination
1. Mechanisms of sex determination in Drosophila, Genic balance theory
2. Sex determination in human
3. Dosage compensation in Drosophila & Human
4. Environmental factors and sex determination

Unit 5: Extra-chromosomal Inheritance
1. Criteria for extra chromosomal inheritance, Antibiotic resistance in Chlamydomonas,
2. Kappa particle in Paramoecium
3. Shell spiralling in snail

Unit 6: Recombination in Bacteria and Viruses
Conjugation, Transformation, Transduction, Complementation test in Bacteriophage

Unit 7: Transposable Genetic Elements
Transposons in bacteria, Ac-Ds elements in maize, LINE, SINE, Alu elements in humans

Reference Books

**Principles of Genetics Lab**

**Practicals**

1. Identification of chromosomal aberration in Drosophila (inversion, ring chromosome, paracentric inversion) and man (Normal karyotype, Down, Klinefelter’s, Turner, Cri-du-Chat syndrome) from photograph

2. Chi-square analyses

3. Linkage maps based on Drosophila crosses

4. Pedigree analysis of some human inherited traits

5. Demonstration of techniques of handling Drosophila, identifying males and females; observing wild type and mutant flies (slide/photograph), and setting up cultures

6. Submission of Laboratory Note Book

**Distribution of marks**

<table>
<thead>
<tr>
<th></th>
<th>Full marks: 15</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Identification with reasons (any two; From Item no.1)</td>
<td>5 (2 ½ ×2)*</td>
</tr>
<tr>
<td>2. Any one problem (From Item no. 2 or 3 or 4):</td>
<td>8</td>
</tr>
<tr>
<td>3. Submission of laboratory note book:</td>
<td>2</td>
</tr>
</tbody>
</table>

*Note:

Q1. Identification: 1 mark for reasons: 1½ marks

**Suggested reading**

Developmental Biology

Unit 1: Introduction
Basic concepts: Phases of Development, Cell cell interaction, Differentiation and growth, Differential gene expression

Unit 2: Early Embryonic Development
Gametogenesis; Spermatogenesis, Oogenesis; Types of eggs, Egg membranes; Fertilization (External and Internal), prevention of polyspermy; Planes and patterns of cleavage; Types of Blastula; Fate maps (including Techniques); Early development of frog and chick up to gastrulation; Embryonic induction and organizers

Unit 3: Late Embryonic Development
Fate of Germ Layers; Extra-embryonic membranes in birds; Implantation of embryo in human, Placenta (Structure, types and functions)

Unit 4: Post Embryonic Development
Development of brain and Eye in Vertebrate
Brief idea of regeneration

Unit 5: Implications of Developmental Biology
Teratogenesis: Teratogenic agents and their effects on embryonic development; In vitro fertilization, Stem cell (ESC), Basic concept of Amniocentesis

Reference Books

Dudek, R.W. And Fix, J.D. (2013). BRS Embryology, 3rd Edn. Lippincot Williams Wilkins
Developmental Biology

Practicals

1. Identification of whole mounts of developmental stages of chick through permanent slides: 24, 48 and 72 hours of incubation.
2. Identification of the developmental stages and life cycle of Drosophila from stock culture
3. Identification of different sections of placenta (epitheliochorial, endotheiochorial and hemochorial) (photomicrograph/ slides)
4. Project report on Drosophila culture/chick embryo development
5. Submission of Laboratory Note Book

Distribution of marks

Full marks: 15

1. Identification with reasons (any three) (From Item no. 1, 2 & 3) 9 (3× 3) *
2. Project Report (From Item no. 4): 4
3. Laboratory note book: 2

*Note:

Q1. Identification: 1 mark and reasons: 2 marks
### Evolutionary Biology

**Unit 1**
Basic concept of origin of life, Evolution of life forms and present state of biodiversity

**Unit 2**
Historical review of Evolutionary concepts, Lamarkism, Darwinism and Neo Darwinism

**Unit 3**
1. Geological time scale, Fossil records of hominids (from Australopithecus to Homo sapiens), evolution of horse
2. Neutral theory of molecular evolution, Molecular clock

**Unit 4**
Sources of evolutionary variations: Heritable variations and their role in evolution

**Unit 5**
1. Population genetics: Hardy-Weinberg Law (statement and derivation of equation, application of law to bi-allelic Population); Evolutionary forces upsetting H-W equilibrium; Natural selection (concept of fitness, types of selection, selection coefficient, mode of selection heterozygous superiority).
2. Genetic Drift mechanism (founder's effect, bottleneck phenomenon)
3. Role of migration and mutation in changing allele frequencies.

**Unit 6**
Species concept, Isolating mechanisms, modes of speciation
Adaptive radiation, macroevolution (exemplified by Galapagos finches), microevolution

**Unit 7**
Basic concept of extinctions, Back ground and mass extinctions (causes and effects), detailed example of K-T extinction

**Unit 8**
Origin and Evolution of Man, comparative account of hominin characteristics and primate characteristics

**Unit 9**
Phylogenetic trees, Convergent & Divergent evolution.

### Reference Books

Evolutionary Biology

Practicals

1. Identification of major group of fossils from models/ pictures (Petrified fossil, molds, casts, carbon film, trace fossil)
2. Study of homology and analogy from suitable specimens (Birds and mammals)
3. Study and verification of Hardy-Weinberg Law by chi square analysis
5. Submission of Laboratory Note Book

Distribution of marks

<table>
<thead>
<tr>
<th></th>
<th>Full marks: 15</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Identification with reasons (any two) (From Item no. 1 &amp; 2)</td>
<td>4 (2× 2)*</td>
</tr>
<tr>
<td>2. One Problem (From Item no. 3):</td>
<td>5</td>
</tr>
<tr>
<td>3. Project report (From Item no.4)</td>
<td>4</td>
</tr>
<tr>
<td>4. Submission of laboratory note book:</td>
<td>2</td>
</tr>
</tbody>
</table>

*Note:

Q1. Identification: 1 mark and reasons: 1 marks
4. Discipline Specific Electives Subjects Syllabus

4.1 DSE T1 - Animal Behaviour and Chronobiology 4 Credits

Animal Behaviour and Chronobiology

Unit 1: Introduction to Animal Behaviour
Origin and history of Ethology, Proximate and ultimate causes of behaviour, Methods and recording of a behaviour
Role of behaviour in conservation biology

Unit 2: Patterns of Behaviour
Stereotyped Behaviours (Orientation, Reflexes); Individual Behavioural patterns; Instinct vs. Learned Behaviour; Associative learning, classical - and operant conditioning, Habituation, Imprinting.

Unit 3: Social and Sexual Behaviour
Social Behaviour: Concept of Society; various modes of animal communication
Altruism; Insects' society with Honey bee as example; Foraging in honey bee and the waggle dance.
Sexual Behaviour: Asymmetry of sex, Sexual dimorphism, Mate choice, Intra-sexual selection (male rivalry), Inter-sexual selection (female choice), Sexual conflict in parental care.

Unit 4: Introduction to Chronobiology
Biological oscillation
Adaptive significance of biological clocks

Unit 5: Biological Rhythm
Types and characteristics of biological rhythms: Short- and Long- term rhythms; Circadian rhythms; Tidal rhythms and Lunar rhythms; Circannual rhythms; Concept of synchronization and masking; Photic and non-photic zeitgebers; Photoperiod and regulation of seasonal reproduction of vertebrates; Role of melatonin and serotonin

Reference Books

Vinod Kumar (2002), Biological Rhythms, Narosa Publishing House, Delhi/ Springer-Verlag, Germany.
4.2 DSE PI - Animal Behaviour and Chronobiology Lab  

Animal Behaviour and Chronobiology Lab

Practicals

1. Study of nests and nesting habits of the birds and social insects.
2. Study of the behavioural responses of wood lice to dry and humid conditions.
3. Study of geotaxis behaviour in earthworm.
4. Study of the phototaxis behaviour in insect larvae.
5. Study of circadian functions in humans (daily eating, sleep and temperature patterns).
6. Visit to Forest/Wild life Sanctuary/Biodiversity Park/Zoological Park to study behavioural activities of animals and prepare a short report.
7. Submission of Laboratory Note Book

Distribution of marks

<table>
<thead>
<tr>
<th>Item</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>One experiment (From 3 or 4)</td>
<td>3</td>
</tr>
<tr>
<td>Project report (any one from item no. 1 or 2)</td>
<td>5</td>
</tr>
<tr>
<td>Report on excursion (Item 6)</td>
<td>5</td>
</tr>
<tr>
<td>Laboratory note book (From 3,4 or 5)</td>
<td>2</td>
</tr>
</tbody>
</table>

Full marks: 15
4.3 DSE T2 Biology of Insecta

**Biology of Insecta**

**Unit 1: Introduction**
General Features of Insects
Success of Insects on the Earth
Role of insect in human welfare

**Unit 2: Insect Taxonomy**
Basis of insect classification; Classification of insects up to orders (according to Ruppert and Barnes)

**Unit 3: General Morphology of Insects**
1. External Features; Head - Eyes, Types of antennae, Mouth parts w.r.t. feeding habits
2. Thorax: Wings and wing articulation, Types of Legs adapted to diverse habitat; spiracles and genitalia

**Unit 4: Physiology of Insects**
1. Structure and physiology of insect - Integumentary, digestive, excretory, circulatory, respiratory, endocrine, reproductive, and nervous system
2. Photoreceptors: Types, Structure and Function
3. Types of metamorphosis along with neuroendocrine control

**Unit 5: Insect Society**
1. Social insects with special reference to termites
2. Trophallaxis in social insects such as ants

**Unit 6: Insect Plant Interaction**
Theory of co-evolution; role of allelochemicals in host plant mediation; Host-plant selection by phytophagous insects

**Unit 7: Insects as Vectors**
Brief discussion on Diptera as a carrier of disease and control

**Note:** Classification to be followed from IMMS A. D. (1938)

**Reference Books**
Hati A. K (2010) Medical Entomology, Allied Book Agency,
Klowden, M. J (2013) Physiological system in Insects, Academic Press, USA
Wilson, EO (1971) The Insect Societies, Harvard Univ. Press, UK
## Biology of Insecta

### Practicals
1. Identification of life cycle of Mosquito
2. Identification of different kinds of antennae, legs and mouth parts of insects (Cockroach, Praying Mantis, Mosquito)
3. Mounting of wings, larval spiracles and genitalia of any insects (House Fly)
5. Project report: morphological studies of various castes of Apis sp, Camponotus sp, Odontotermes sp
6. Identification of any three major insect pests of paddy (Scirpophaga, Leptocoriza, and Hispa) and their damages
7. Identification of Mulberry silk moth (life cycle stages)
8. Submission of Laboratory Note Book.

### Distribution of marks

<table>
<thead>
<tr>
<th>Task</th>
<th>Full marks: 15</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Spot identification with economic importance (any 2; one from each Item no.6 &amp; 7)</td>
<td>4 (2×2)*</td>
</tr>
<tr>
<td>2. Identification with reason (any two, from 1 and 2)</td>
<td>4 (2×2)*</td>
</tr>
<tr>
<td>3. Mounting (any one from Item no. 3)</td>
<td>2</td>
</tr>
<tr>
<td>4. Project report (any one from Item 5 )</td>
<td>3</td>
</tr>
<tr>
<td>5. Submission of laboratory note book:</td>
<td>2</td>
</tr>
</tbody>
</table>

*Note

Q 1. 1 mark for identification and 1 mark for economic importance.

Q2. ½ mark for identification and 1½ mark for reasons.
4.5 DSE T3 – Endocrinology

Endocrinology

Unit 1: Introduction to Endocrinology
General idea of Endocrine systems, Classification, Characteristic and Transport of Hormones, Neurosecretions and Neurohormones;

Unit 2: Epiphysis, Hypothalamo-hypophysial Axis
1. Structure of pineal gland, Secretions and their functions in biological rhythms and reproduction.
2. Structure and functions of hypothalamus and Hypothalamic nuclei, Regulation of neuroendocrine glands, Feedback mechanisms

Unit 3: Peripheral Endocrine Glands
1. Structure, Hormones, Functions and Regulation : Thyroid gland, Parathyroid, Adrenal, Pancreas, Ovary and Testis
2. Hormones in homeostasis; Disorders of endocrine glands

Unit 4: Regulation of Hormone Action
1. Mechanism of action of steroidal, non-steroidal hormones with receptors
2. Bioassays of hormones using RIA & ELISA
3. Estrous cycle in rat and menstrual cycle in human

Reference Books
David O Norris (2013) Vertebrate Endocrinology, Elsevier
Endocrinology Lab

Practicals

1. Dissect and display of Endocrine glands in laboratory bred rat.
2. Identification of all the endocrine glands, Pituitary, Pineal, Thyroid, Parathyroid, Adrenal, Pancreas, Testis, Ovary through permanent slides
3. Tissue fixation, embedding in paraffin, microtomy and slide preparation of any endocrine gland
4. Demonstration of hormone assay through ELISA from teaching Kit
5. Submission of laboratory Note Book

Distribution of marks

<table>
<thead>
<tr>
<th>Full marks: 15</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Identification of endocrine gland from dissected specimen (any one, Item 1)</td>
</tr>
<tr>
<td>2. Identification with reasons (any two) (From Item no.2)</td>
</tr>
<tr>
<td>2. Microtomy (Tissue sectioning/staining) (From item 3)</td>
</tr>
<tr>
<td>3. Submission of laboratory note book:</td>
</tr>
</tbody>
</table>

*Note

Q1. 1 mark for identification and 1 mark for function
Q2. ½ mark for identification and 1½ mark for characters.

Suggested reading

Fish and Fisheries

Unit 1: Introduction and Classification
1. General description of fish
2. Feeding habit, habitat and manner of reproduction

Unit 2: Morphology and Physiology
Types of fins and their modifications; Locomotion in fish; Hydrodynamics; Types of Scales, Use of scales in Classification and determination of age of fish; Gills and gas exchange; Swim Bladder: Types and role in Respiration, buoyancy; Osmoregulation in Elasmobranchs; Reproductive strategies (special reference to Indian fish); Electric organ, Bioluminescence

Unit 3: Fisheries
Inland Fisheries; Marine Fisheries; Environmental factors influencing the seasonal variations in fish catches in the Arabian Sea and the Bay of Bengal; Fishing crafts and Gears; Depletion of fisheries resources; Application of remote sensing and GIS in fisheries

Unit 4: Aquaculture
Sustainable Aquaculture; Extensive, semi-intensive and intensive culture of fish; Pen and cage culture; Polyculture; Composite fish culture; Brood stock management; Induced breeding of fish; Management of finfish hatcheries; Preparation and maintenance of fish aquarium; Preparation of compound diets for fish; Role of water quality in aquaculture; Fish diseases: Bacterial, viral and parasitic; Preservation and processing of harvested fish, Fishery by-products

Unit 5: Fish in research
Transgenic fish
Zebrfish as a model organism in research

Note: Classification to be followed from: Romer A. S. (1959)

Reference Books
Fish and Fisheries Lab

Practicals

1. Identification of *Petromyzon, Myxine, Pristis, Chimaera, Exocoetus, Hippocampus, Gambusia, Labeo, Heteropneustes, Anabas*
2. Identification of different types of scales (through permanent slides).
3. Morphometric and meristic characters of fishes
4. Water quality criteria for Aquaculture: Assessment of pH, conductivity, Total solids, Total dissolved solids
5. Dissect and display of air breathing organs in *Channa, Heteropneustes, Anabas* and *Clarias*
6. Project Report on a visit to any fish farm/pisciculture unit/zebrafish rearing Lab.
7. Submission of Laboratory Note Book.

Distribution of Marks

Full marks: 15

1. Identification with reasons (any three)
   (two from Item No. 1 & one from Item 2) 6 \([2 \times 3]\) *
2. One dissection from Item 5 or one experiment from Item 4: 3
3. Project Report 4
4. Submission of laboratory note book: 2

*Note
Q1. ½ mark for identification and 1½ marks for characters. In case of Item (1) only genus characters have to be mentioned

Suggested Readings

## Parasitology

### Unit 1: Introduction to Parasitology
Brief introduction of Parasitism, Parasite, Parasitoid and Vectors (mechanical and biological vector) and parasitic disease of human; Host parasite relationship

### Unit 2: Parasitic Protozoans
Study of *Giardia intestinalis*, *Trypanosoma gambiense*, *Leishmania donovani*: Morphology, Life Cycle, Epidemiology, Pathogenicity, and control.

### Unit 3: Parasitic Platyhelminthes
Study of *Schistosoma haematobium*, *Taenia sajinata*: Morphology, Life Cycle, Epidemiology, Pathogenicity and control

### Unit 4: Parasitic Nematodes
Study of *Ascaris lumbricoides*, *Ancylostoma duodenale*, *Wuchereria bancrofti* and *Trichinella spiralis*: Morphology, Life Cycle, Epidemiology, Pathogenicity and control
Nematode plant interaction; Gall formation

### Unit 5: Parasitic Arthropods
Biology, importance and control of ticks (Soft tick *Omithodoros*, Hard tick *Ixodes*), mites (*Sarcoptes*), Lice (*Pediculus*), Flea (*Xenopsylla*) and Bug (*Cimex*)

### Unit 5: Parasite Vertebrates
Brief account of vampire ground finch, Vampire bat

### Reference Books


Parasitology Lab

List of Practicals

1. Identification of life cycle stages of *Giardia* sp., *Trypanosoma* sp, *Leishmania* sp through permanent slides/micro photographs
2. Identification of adult and life stages of *Schistosoma* sp, through permanent slides/micro photographs
3. Identification of adult and life stages of *Ancylostoma* sp, through permanent slides/micro photographs
4. Identification of plant parasitic root knot nematode, *Meloidogyne* through permanent slides/micro photographs
5. Identification of *Pediculus* sp, and *Cimex* sp through permanent slides/photographs
6. Identification of monogenea from the gills of fresh/marine fish [Gills can be procured from fish market]
7. Identification of nematode/cestode parasites from the intestines of fowl
8. Submission of a brief report on any parasite on vertebrates
9. Submission of Laboratory Note Book

Distribution of marks

Full marks: 15

1. Identification with reasons (any three) (From Item 1,2,3,4,5) 6 (2×3)*
2. Temporary preparation of any parasite from gill of fish/ intestine of fowl 5 [3+1+1]*
   (From Item 6 or 7)
3. Project Report (Item 8) 2
4. Submission of laboratory note book 2

*Note
Q1. Maximum 1 from each group. ½ mark for identification and 1½ marks for characters. only genus characters have to be mentioned.
Q2. For dissection 3 marks and 1 mark each for drawing and labelling
5. Skill Enhancement Course

5.1 SEC T1 – Apiculture 2 Credits

Apiculture

Unit 1: Biology of Bees
History, Classification and Biology of Honey Bees
Social Organization of Bee Colony

Unit 2: Rearing of Bees
Artificial Bee rearing (Apiary), Beehives - Newton and Langstroth
Bee Pasturage
Selection of Bee Species for Apiculture
Bee Keeping Equipment
Methods of Extraction of Honey (Indigenous and Modern)

Unit 3: Diseases and Enemies
Bee Diseases and Enemies
Control and Preventive measures

Unit 4: Economic Importance
Products of Apiculture Industry and its Uses (Honey, Bees Wax, Propolis), Pollen etc

Unit 5: Entrepreneurship in Apiculture
Bee Keeping Industry - Recent Efforts, Modern Methods in employing artificial Beehives for cross pollination in horticultural gardens

Reference Books

Bisht D.S., Apiculture, ICAR Publication.
Singh S., Beekeeping in India, Indian council of Agricultural Research, New Delhi.
5.2 SEC T2 Sericulture

<table>
<thead>
<tr>
<th>Sericulture</th>
<th>2 Credits</th>
</tr>
</thead>
</table>

Unit 1: Introduction
Sericulture: Definition, history and present status: Silk route
Types of silkworms, Distribution and Races
Exotic and Indigenous races
Mulberry and non-mulberry Sericulture

Unit 2: Biology of Silkworm
Life cycle of Bombyx mori
Structure of silk gland and secretion of silk

Unit 3: Rearing of Silkworms
Selection of mulberry variety and establishment of mulberry garden
Rearing house and rearing appliances.
Disinfectants: Formalin, bleaching powder, RKO
Silkworm rearing technology: Early age and Late age rearing
Types of mountages
Spinning, harvesting and storage of cocoons

Unit 4: Pests and Diseases
Pests of silkworm: Uzi fly, dermestid beetles and vertebrates
Pathogenesis of silkworm diseases: Protozoan, viral, fungal and bacterial
Control and prevention of pests and diseases

Unit 5: Entrepreneurship in Sericulture
Prospectus of Sericulture in India: Sericulture industry in different states, employment, potential in mulberry and non-mulberry sericulture
Visit to various sericulture centres.

Reference Books

Manual on Sericulture; Food and Agriculture Organisation, Rome 1976
Handbook of Practical Sericulture: S.R. Ullal and M.N. Narasimhanna CSB, Bangalore
Silkworm Rearing and Disease of Silkworm, 1956, Ptd. By Director of Ptg., Stn. & Pub. Govt. Press, Bangalore
Appropriate Sericultural Techniques; Ed. M. S. Jolly, Director, CSR & TI, Mysore.
Improved Method of Rearing Young age silkworm; S. Krishnaswamy, reprinted CSB, Bangalore, 1986
5.3 SEC T3 Aquarium Fish Keeping

| Aquarium Fish Keeping | 2 Credits |

Unit 1: Introduction to Aquarium Fish Keeping

The potential scope of Aquarium Fish Industry as a Cottage Industry, Exotic and Endemic species of Aquarium Fishes

Unit 2: Biology of Aquarium Fishes

Common characters and sexual dimorphism of Fresh water and Marine Aquarium fishes such as Guppy, Molly, Sword tail, Gold fish, Angel fish, Blue morph, Anemone fish and Butterfly fish

Unit 3: Food and feeding of Aquarium fishes

Use of live fish feed organisms. Preparation and composition of formulated fish feeds, Aquarium fish as larval predator

Unit 4: Fish Transportation

Live fish transport - Fish handling, packing and forwarding techniques.

Unit 5: Maintenance of Aquarium

General Aquarium maintenance - budget for setting up an Aquarium Fish Farm as a Cottage Industry
6. Generic Elective

6.1 GE T1- Animal Diversity

<table>
<thead>
<tr>
<th>Animal Diversity</th>
<th>4 Credits</th>
</tr>
</thead>
</table>

Unit 1: Protozoa
Protozoa
General characters of Protozoa; Life cycle of Plasmodium

Unit 2: Porifera
General characters and canal system in Porifera

Unit 3: Cnidaria
General characters of Cnidarians and polymorphism in siphonophorans

Unit 4: Aceolomates
General characters of Helminthes

Unit 5: Pseudocoelomates
General characters of Nematoda
Parasitic adaptations

Unit 6: Annelida
General characters of Annelida
Metamerism

Unit 7: Arthropoda
General characters
Social life in insects (Termite)

Unit 8: Mollusca
General characters of mollusc
Pearl Formation
Unit 9: Echinodermata
General characters of Echinodermata
Water Vascular system in Starfish

Unit 10: Urochordata and Cephalochordata
Salient features

Unit 11: Pisces
General Characters
Osmoregulation, Migration of Fish

Unit 12: Amphibia
General characters, Adaptations for terrestrial life, Parental care

Unit 13: Reptilia
General Characters
Amniotes; Origin of reptiles. Terrestrial adaptations in reptiles.

Unit 14: Aves
General Characters
The origin of birds; Flight adaptations

Unit 15: Mammalia
General Characters
Early evolution of mammals; Primates; Dentition in mammals.

Reference Books

6.2 GE P1 - Animal Diversity Lab

Animal Diversity Lab 2 Credits

List of Practical

1. Identification of following specimens:

2. Identification of following Permanent Slides:
   Cross section of Ascaris (male and female), T. S. of Earthworm passing through typhlosolar intestine, Bipinnaria and Pluteus larva.

3. Temporary mounts of:
   a. Septal & pharyngeal nephridia of earthworm.
   b. Unstained mounts of Placoid, cycloid and ctenoid scales.

4. Dissections: Digestive and nervous system of Cockroach, Afferent branchial arterial system of carp/lata

5. Submission of Laboratory Note Book

Distribution of marks

Full marks: 15

1. Identification with reasons (any three):
   6 [2×3]*
   [From Item 1 (any two) and Item 2 (any one)]

2. Dissection (From Item 4)
   5 [3+1+1]*

3. Mounting (any one) (From Item 3):
   2

4. Submission of laboratory note book:
   2

*Note

Q 1. ½ mark for identification and 1½ marks for characters
Q 2. 3 marks for dissection and 1 mark each for drawing and labelling
Unit 1: Aquatic Biomes

Brief introduction to the aquatic biomes: Freshwater ecosystem (lakes, wetlands, streams and rivers), estuaries, intertidal zones, oceanic pelagic zone, marine benthic zone

Unit 2: Freshwater Biology


Streams: Different stages of stream development, Physico-chemical environment, Adaptation of hill-stream fishes.

Unit 3: Marine Biology

Salinity and density of Sea water, Continental shelf, Adaptations of deep sea organisms, Coral reefs, Sea weeds.

Unit 4: Management of Aquatic Resources

Causes of pollution: Agricultural, Industrial, Sewage, Thermal and Oil spills, Eutrophication, Management and conservation (legislations), Sewage treatment Water quality assessment- BOD and COD.

Reference Books

Anathakrishnan : Bioresources Ecology 3rd Edition
Goldman : Limnology, 2nd Edition
Trivedi and Goyal: Chemical and biological methods for water pollution studies Welch: Limnology Vols. I-II
6.4 GE P2 - Aquatic Biology Lab

Aquatic Biology Lab

List of Practical

1. Identify the important zooplanktons present in a lake ecosystem.
2. Determine the amount of Turbidity/transparency, Dissolved Oxygen, and Free Carbon dioxide, Alkalinity (carbonates & bicarbonates) in water collected from a nearby lake / water body.
3. Instruments used in limnology (Secchi disc, Van Dom Bottle, Conductivity meter, Turbidity meter, PONAR grab sampler) and their significance.
4. A Project Report on a visit to a Sewage treatment plant/Marine bio-reserve/Fisheries Institute/freshwater ecosystem
5. Submission of Laboratory Note Book

Distribution of marks

<table>
<thead>
<tr>
<th>Full marks: 15</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Identification with reasons (any three) [From Item 1 and Item 3]</td>
</tr>
<tr>
<td>2. One experiment (pH/ free CO₂)</td>
</tr>
<tr>
<td>3. Project Report (From Item 4):</td>
</tr>
<tr>
<td>4. Submission of laboratory note book:</td>
</tr>
</tbody>
</table>

*Note
Q 1. ½ mark for identification and 1½ marks for characters
Q 2. For Principle 2 marks and for result 3 marks
Environment and Public Health

Unit 1: Introduction

Sources of Environmental hazards, Hazard identification and accounting, Fate of toxic and persistent substances in the environment, Dose response evaluation, Exposure assessment, Persistent organic pollutant

Unit 2: Climate Change

Greenhouse gases and global warming, Acid rain, Ozone layer destruction, Effect of climate change on public health

Unit 3: Pollution

Air, water, Land, noise pollution sources and effects, Pollution control

Unit 4: Waste Management Technologies

Sources of waste, types and characteristics, Sewage disposal and its management, Solid waste disposal, Biomedical waste handling and disposal, e-waste management, nuclear waste handling and disposal, Waste from thermal power plants.

Unit 5: Diseases

Causes, symptoms and control of tuberculosis, Asthma, Cholera, Minamata disease, typhoid, filariasis

Reference Books

Environment and Public Health Lab

List of Practical

1. To determine pH, Cl, SO₄, NO₃ in soil and water samples from different locations by using soil and water testing kit.
2. Submission of laboratory Note Book

<table>
<thead>
<tr>
<th>Examination Pattern:</th>
<th>Full marks: 15</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. One experiment with water sample</td>
<td>6 [2+2+2]*</td>
</tr>
<tr>
<td>2. One experiment with soil sample</td>
<td>7 [2+3+2]*</td>
</tr>
<tr>
<td>3. Submission of laboratory note book</td>
<td>2</td>
</tr>
</tbody>
</table>

*Note

Q 1. 2 marks each for procedure, result and comment
Q 2. 3 marks for procedure and 2 marks each for result and comment
Insect Vectors and Diseases

Unit 1: Introduction to Insects
General Features of Insects, Morphological features, Head - Eyes, Types of antennae, Mouth parts

Unit 2: Concept of Vectors
Brief introduction to Vectors (mechanical and biological vectors), Reservoirs, Host-vector relationship, Adaptations as vectors, Host specificity

Unit 3: Insects as Vectors
General features of orders with insects as vectors - Diptera, Siphonaptera, Siphunculata, Hemiptera

Unit 4: Dipteran as Disease Vectors
1. Mosquitoes, Sand fly, Houseflies
2. Study of mosquito-borne diseases - Malaria, Dengue, Chikungunya, Filariasis
3. Study of sand fly-borne diseases - Leishmaniasis
4. Study of house fly as important mechanical vector, Myiasis
5. Control of mosquitoes, Sand fly, house fly

Unit 5: Siphonaptera as Disease Vectors
Fleas as important insect vectors; Host-specificity, Study of Flea-borne diseases - Plague, Typhus fever; Control of fleas

Unit 6: Siphunculata as Disease Vectors
Human louse (Head, Body and Pubic louse) as important insect vectors; Control of human louse

Unit 7: Hemiptera as Disease Vectors
Bugs as insect vectors; Blood-sucking bugs; Chagas disease, Bed bugs as mechanical vectors, Control and prevention measures

Reference Books

6.8 GE P4 - Insect Vectors and Diseases Lab

Insect Vectors and Diseases Lab 2 Credits

List of Practical

1. Identification of following insect vectors through permanent slides/ photographs: Aedes, Culex, Anopheles, Pediculus, Cimex, Phlebotomus, Musca through permanent slides
2. Mounting of different kinds of mouth parts of insects (Mosquito/Cockroach)
3. Study of different diseases transmitted by above insect vectors
4. Submission of a project report on any one of the aforesaid insect vectors and disease transmitted
5. Preparation of laboratory note book

Distribution of marks

Full marks: 15

1. Identification with reasons (any three) [From Item 1] 9 [3×3]*
2. Mounting of mouth parts (From Item 2) 2
3. Project Report (From Item 4): 2
4. Laboratory note book: 2

*Note
Q 1. ½ mark for identification, 1½ marks for characters and 1 mark for name of the disease transmitted
Credit Distribution across Courses

*Tutorials of 1 Credit will be conducted in case there is no practical component

All Pass courses will have 3 subjects/disciplines of interest. Student will select 4 core courses each from discipline of choice including Zoology as one of the disciplines. The details for core courses available in Zoology have been detailed in Section 3 of this document

Student will select 2 core courses each from discipline of choice including Zoology as one of the disciplines. The details for elective courses available in Zoology have been detailed in Section 4 and 6 of this document

Student may also choose Skill Enhancement courses in Zoology. The details for skill enhancement courses available in Zoology have been detailed in Section 5 of this document

Scheme for CBCS Curriculum