Syllabus For

Bachelor of Science in Zoology (Honours)

Under Choice Based Credit System

Academic Session

w.e.f. 2020-2023

For

All Constituents / Affiliated Colleges Under

BINOD BIHARI MAHTO KOYALANCHAL UNIVERSITY,

DHANBAD, JHARKHAND

CONTENT

Proposed Scheme For Choice Based Credit System In B.Sc. Honours Program

SEMESTER I

Course	Course Code	Name of Papers	Full Marks	End Semester (Ext. Marks)	Mid Semester (Int. marks)
Core Papers	ZOO-H-C-101-T (04 Credits, 60 Lectures)	Systematic & Animal Diversity: Non-Chordate	75	60	15
	ZOO-H-C-102-T (04 Credits, 60 Lectures)	Principle of Ecology	75	60	15
	ZOO-H-C-101 & 102 –P (02+02 -04 Credits, 60x2 Lectures)	Practical Based on 101 & 102	50	40	10
Generic Elective	ZOO-H-GE-101-T (04 Credits, 60 Lectures)	Chemistry/ Botany	75	60	15
	ZOO-H-GE-101-P (02 Credits, 30 Lectures)		25	20	05
AECC Ability Enhancement Compulsory Course	ZOO-H-AECC-101-T (02 Credits, 30 Lectures)	Communicative English/ Hindi	50	40	10

SEMESTER II

Course	Course Code	Name of Papers	Full Marks	End Semester	Mid Semester (Int. marks)
Core Papers	ZOO-H-C-203-T (04 Credits, 60 Lectures)	Cell Biology	75	60	15
	ZOO-H-C-204-T (04 Credits, 60 Lectures)	Diversity of Chordates	75	60	15
	ZOO-H-C-203 & 204 –P (02+02=04 Credits, 60x2 Lectures)	Practical Based on 203 & 204	50	40	10
Generic Elective	ZOO-H-GE-202-T (04 Credits, 60 Lectures)	Chemistry/ Botany	75	60	15
	ZOO-H-GE-202-P (02 Credits, 30 Lectures)		25	20	05
AECC Ability Enhancement Compulsory Course	ZOO-H-AECC-202-T (02 Credits, 30 Lectures)	Environmental Science	50	40	10

SEMESTER III

Course	Course Code	Name of Papers	Full Marks	End Semester	Mid Semester (Int. marks)
Core Papers	ZOO-H-C-305-T (04 Credits, 60 Lectures)	Biochemistry	75	60	15
	ZOO-H-C-306-T (04 Credits, 60 Lectures)	Mammalian Physiology	75	60	15
	ZOO-H-C-307-T (04 Credits, 60 Lectures)	Endocrinology	75	60	15
	ZOO-H-C-305 & 306 & 307 –P (02 +02+02 =06 Credits, 60x3 Lectures)	Practical Based on 305 & 306 & 307	75	60	15
Generic Elective	ZOO-H-GE-303-T (04 Credits, 60 Lectures)	Chemistry/ Botany	75	60	15
	ZOO-H-GE-303-P (02 Credits, 30 Lectures)		25	20	05
SEC (Skill Enhancement Course)	ZOO-H-SEC-301-T (02 Credits, 30 Lectures)	-	50	40	10

SEMESTER IV

Course	Course Code	Name of Papers	Full Marks	End Semester	Mid Semester (Int. marks)
Core Papers	ZOO-H-C-408-T (04 Credits, 60 Lectures)	Genetics	75	60	15
	ZOO-H-C-409-T (04 Credits, 60 Lectures)	Evolution & Population Genetics	75	60	15
	ZOO-H-C-410-T (04 Credits, 60 Lectures)	Animal Behaviour	75	60	15
	ZOO-H-C-408 & 409 &410 –P (02+02+02=06 Credits, 60x3 Lectures)	Practical Based on 408 & 409 & 410	75	60	15
Generic Elective	ZOO-H-GE-404-T (04 Credits, 60 Lectures)	Chemistry/ Botany	75	60	15
	ZOO-H-GE-404-P (02 Credits, 30 Lectures)		25	20	05
SEC (Skill Enhancement Course)	ZOO-H-SEC-402-T (02 Credits, 30 Lectures)	-	50	40	10

SEMESTER V

Course	Course Code	Name of Papers	Full Marks	End Semester	Mid Semester (Int. marks)
Core Papers	ZOO-H-C-511-T (04 Credits, 60 Lectures)	Immunology	75	60	15
	ZOO-H-C-512-T (04 Credits, 60 Lectures)	Developmental Biology	75	60	15
	ZOO-H-C-511 & 512 –P (02+02=04 Credits, 60x2 Lectures)	Practical Based on 511 & 512	50	40	10
DSE (Discipline Specific Elective)	ZOO-H-DSE-501 (A/B/C)-T (04 Credits, 60 Lectures)	A/B/C	75	60	15
	ZOO-H-DSE-502-(A/B/C)-T (04 Credits, 60 Lectures)	A/B/C	75	60	15
	ZOO-H-DSE-501(A/B/C) & 502-(A/B/C)-P (02+02=04 Credits, 60x2 Lectures)	Practical Based on DSE 501(A/B/C) & DSE(A/B/C)	50	40	10

SEMESTER VI

Course	Course Code	Name of Papers	Full Marks	End Semester	Mid Semester (Int. marks)
Core Papers	ZOO-H-C-613-T (04 Credits, 60 Lectures)	Molecular biology & Biotechnology	75	60	15
	ZOO-H-C-614-T (04 Credits, 60 Lectures)	Medical Zoology	75	60	15
	ZOO-H-C-613 & 614 –P (02+02=04 Credits, 60x2 Lectures)	Practical Based on 511 & 512	50	40	10
DSE (Discipline Specific Elective)	ZOO-H-DSE-603 (A/B/C)-T (04 Credits, 60 Lectures)	A/B/C	75	60	15
	ZOO-H-DSE-604-(A/B/C)-T (04 Credits, 60 Lectures)	A/B/C	75	60	15
	ZOO-H-DSE-603(A/B/C) & 604-(A/B/C)-P (02+02=04 Credits, 60x2 Lectures)	Practical Based on DSE -603 (A/B/C) & 604-(A/B/C)	50	40	10
	Total Marks	=	2400	1920	480

Note: For DSE Paper in Semester V & VI, the students will have to opt two papers from same group

Semester V

501 A - 502 A

501B – 502 B

501C - 502C

Semester VI

603 A – 604 A

603 B – 604 B

603 C – 604 C

Members of Board of Studies of CBCS under Graduate Syllabus as Per Guidelines of Binod Bihari Mahto Koyalanchal University, Dhanbad

Sl. No.	Name	Signature
1.	Dr. Shailendra Kumar Sinha – Chairman Associate Professor Head University Dept. of Zoology BBMKU, Dhanbad	
2.	Dr. Birendra Kumar, -Invited Member Associate Professor Dean Faculty of Science, BBMKU, Dhanbad	
3.	Dr. Lal Bihari Singh - Member DSW, BBMKU, Dhanbad.	
4.	Dr. K. K. Gupta - Expert Member Associate Professor University Dept. of Zoology, VBU, Hazaribag.	
5.	Dr. Ajay Kumar Choudhary, - Expert Member Associate Professor, University Dept. of Zoology, DSPMU, Ranchi.	
6.	Dr. Navita Gupta - Member Associate Professor, University Dept. of Zoology, BBMKU, Dhanbad.	
7.	Dr. RupamMallik, - Member Assistant Professor, University Dept. of Zoology, BBMKU, Dhanbad.	
8.	Dr, SaritaMurmu, - Member Assistant Professor, University Dept. of Zoology, BBMKU, Dhanbad.	

9. Dr. B. N. Mahto, - Member
Assistant Professor
Dept. of Zoology, Chas College, Chas.

10. Sri S. C. Dan, - Member
Assistant Professor,
Department of Zoology,
R. S. More College, Govindpur.

B.Sc. (Hons.) Zoology

Semester I Core

ZOO – H – C – 101 - T

- In all nine questions are to be set of equal values and five questions are to be answered of which question no. 1 will be compulsory
- Questions will be grouped into two - Group A and Group B.
- Group A will comprise question no. 1, which will consist of two parts A & B. Part A will be MCQ type, covering the entire syllabus and carry one mark each(1x6=6) and part B will comprise a short answer, three marks each (3x2=6). There will be no option in Q. No. 1.
- Rest eight questions will be of long type set from the whole syllabus in Group B. Examinees are required to answer any four from this group. Each carries 12 marks.
- The question no. 9 will be of short notes type each carrying six marks (6x2=12) in which only two should be answered out of four options.

SYSTEMATIC & ANIMAL DIVERSITY: NON- CHORDATE

Credit – 4 **Lectures – 60** **F.M: 75 (60 Ext. + 15 Int.)**

UNIT 1: Systematics

1.1 Binomial and Trinomial Nomenclature

1.2 Species and Species Concept

UNIT 2: Non – Chordates: General Characters and Classification of Different Phyla of Non- Chordates up to Classes with Examples Showing Distinctive and Adaptive Features:

2.1 Protozoa, Porifera, Coelenterata, Helminthes, Annelida, Arthropoda, Mollusca and Echinodermata.

UNIT 3: Non – Chordates: Protista to Pseudocoelomates

3.1 Protozoa: General account of Locomotion, Nutrition and Reproduction

3.2 Porifera:

3.2.1: Canal System in Sponges

3.2.2: Reproduction in Porifera

3.3 Coelenterata:

3.3.1: Structure, Life Cycle and Metagenesis in Obelia.

3.3.2: Polymorphism in Siphonophora

3.3.3: Corals and Coral Reefs: Types, Distribution and Formation

3.4 Ctenophora: General Account and its Significance.

3.5 Aschelminthes:

3.5.1: Morphology and Life Cycle of Ascaris

UNIT 4: Eucoelomates

4.1 Annelida:

4.1.1:Pheretima:segmental organs and metamerism.

4.2 Arthropoda:

4.2.1 Palaemon: Nervous system and Respiratory system.

4.2.2 Larval Forms of Crustacea

4.3 Mollusca:

4.3.1: Respiration in Pila&Unio

4.3.2: Torsion &Detorsion in Gastropods

4.4 Echinodermata:

4.4.1: Water Vascular System in Different Classes of Echinodermata

Books Recommended

Systematics (Animal Taxonomy)

1. Dalela& Sharma: Animal Taxonomy and Museology (1976, Jai PrakashNath).
2. Kapoor: Theory and Practicals of Animal Taxonomy (1988, Oxford & IBH).
3. Simpson: Principles of Animal Taxonomy (1962, Oxford).
4. Roymahoney: Laboratory Techniques in Zoology (1966, Butterworths).
5. Mayer &Ashlock: Principles of Systematic Zoology (1991, McGraw Hill).

Non Chordates

1.Ruppert and Barnes ,RD(2006) Invertebrate Zoology, VIII edition .Holt Saunders International edition
2. Barnes ,R.S.K.,Calow, P.Olive.,Golding,D.W.andSpicer,J.LI.(2002) The Invertebrates; E.J.W, III Edition ,Blackwell Science
3. Barrington,E.J.W.(1979)Invertebrate structure & function .II edition .E.L.B.S and Nelson
4. Boolotian and stiles: College Zoology (10th Ed. 1981,Macmillin)
5. Campbell & Reece: Biology (7th edn. 2005, Pearson
6. Nigam: Biology of Non-chordates (1997, S Chand)
7. Miller and Harley : zoology (6th Ed. 2005,W.C.Brown)
8. Parker & Haswell: Text Book of Zoology, Vol. I (2005, Macmillan)

ONLINE TOOLS AND WEB RESOURCES

- Swayam (MHRD) Portal ·
- Animal Diversity (https://swayam.gov.in/courses/5686-animal-diversity) ·
- Advances in Animal Diversity, Systematics and Evolution (https://swayam.gov.in/courses/5300-zoology) ·
- ePGPathshala (MHRD)Module 10, 18, 19 of the paper P-08 (Biology of Parasitism) https://epgp.inflibnet.ac.in/ahl.php?csrno=35

B.Sc. (Hons.) Zoology

Semester I Core

ZOO – H – C – 102 - T

- In all nine questions are to be set of equal values and five questions are to be answered of which question no. 1 will be compulsory
- Questions will be grouped into two - Group A and Group B.
- Group A will comprise question no. 1, which will consist of two parts A & B. Part A will be MCQ type, covering the entire syllabus and carry one mark each(1x6=6) and part B will comprise a short answer, three marks each(3x2=6). There will be no option in the Q. No. 1.
- Rests eight questions will be of long type set from the whole syllabus in Group B. Examinees are required to answer any four from this group. Each carries 12 marks.
- The question no. 9 will be of short notes type each carrying six marks (6x2=12) in which only two should be answered out of four options.

PRINCIPLE OF ECOLOGY

Credit – 4 **Lectures – 60** **F.M: 75 (60 Ext. + 15 Int.)**

UNIT 1: General Concept

1.1. Definition, Branches and Scope of Ecology

1.2 Abiotic Environmental Factors:Temperature, Light, Water and Oxygen**.**

1.3 Concept of Ecosystem:

1.3.1: Definition, Components, Types of Ecosystem, Pond as an Ecosystem.

1.3.2: Food chain and Food web

1.3.3: Energy flow in Ecosystem

1.3.4: Ecological Pyramids: Pyramid of Number, Biomass and Energy

1.4 Bio-geochemical Cycle:

1.4.1: Gaseous Cycle: Carbon & Nitrogen

1.4.2: Sedimentary Cycle: Phosphorus & Sulphur

UNIT 2: Population & Communities

2.1 Population Characteristics: Density, Natality, Age Structure, Mortality, Biotic Potential.

2.2 Ecological Succession:

2.2.1: Causes, Trends, Types and Process of Succession.

2.2.2: Examples of Succession: Hydrosere, Xerosere and Lithosere.

2.2.3: Theories Pertaining Concept of Climax: Monoclimax and Polyclimax Theory

UNIT 3: Pollution

3.1: Sources and types of Pollutants and their impact: Air, Water & Noise Pollution

3.2 Global Warming:

3.2.1: GreenHouse Gases and its Effects

3.2.2: Ozone Depletion

3.2.3: Acid Rain

UNIT 4: Natural Resources

4.1 Soil and Water Conservation

4.2 Biodiversity:Definition, Levels, Benefits, Hotspots, Threats and Conservation of Biodiversity.

4.3 Renewable and Non- Renewable Source of Energy

Books Recommended

1. Colinvaux ,P.A.(1993). Ecology. II Edition .Wiley Johnandsons,Inc.
2. Kerbs,C,J.(2001),Ecology.Vi Edition ,Benjamin Cuming
3. Odum,E.P.,(2008), Fundamentals of Ecology and field Biology, Harper and Row publishers
4. Ecology Environment and Resources conservation: J.S. Singh, S.p.Singh and S R Gupta , Anamaya Publishers, New Delhi
5. Ecology Concept and application :Manual C MollesJr, McGrawHill

ONLINE TOOLS AND WEB RESOURCES

- Ugmoocs.inflibnet.ac.in/ugmoocs/view_module_ug.php/156
- Swayam (MHRD) Portal.

B.Sc. (Hons.) Zoology

Semester I Core Practical

ZOO – H – C 101 & 102 - P

SYSTEMATICS AND DIVERSITY OF NON- CHORDATES & PRINCIPLE OF ECOLOGY

Credit – 4 **Lectures - 60** **F.M: 50 (40 Ext. + 10 Int.)**

Practical	Marks Distribution
1. Dissection/ Project:	08
2. Slide Preparation:	05
3. Spotting:	2×5=10
a. Slides	(03) 2×3
b. Museum Specimen	(02) 2×2
4. Ecology Expt.	07
5. Class record	05
6. Viva voce	05
	Total=40

Suggested Practicals

1. **Study of Available Museum Specimen of animals**

   Sycon, Physalia, Metridium, Adamsia, Fasciola, Taeniasolium, Nereis, Aphrodite, Arenicola, Pheretima, Sipunculus, Lingula, Chiton, Pila, Unio, Nautilus, Sepia, Loligo, Octopus, Eupagurus, Limulus, millipedes, centipedes, Palaemon, Antedon, Asterias, Echinus, Clypeaster, Holothuria

2. **Study of the following through permanent slide**

   Paramecium (wm), Conjugation of *Paramecium*, *Obelia* colony, Medusa, Gemmules of Sponges, Ephyra larva, Miracidium larva, Sporocyst larva, Redia larva, Cercaria larva, Trochophore larva, Glochidium larva, Nauplius, Zoea larva, Mysis larva, Megalopa larva, Bipinnaria larva, Echinopluteus larva, Ophiopluteus larva, T.S. of earthworm through pharynx, Gizzard, Typhlosole

3. **Dissection:**

   1. Dissection of Digestive, Nervous and Reproductive system of Earthworm

2. Dissection of Digestive and Nervous system of *Palaemon*

4. Mounting

Mounting of Nephridia& Ovary of Earthworm, trachea and salivary gland of *Periplanetaamericana,* Cephalic appendages of *Palaemon*

5. Project

To submit a Project Report on any related topic on life cycles/coral/coral reefs.

6. Ecology

1. Collection & Identification of different biotic componentsof the Pond ecosystem.
2. Study of an aquatic ecosystem-phytoplankton and zooplankton
3. Total hardness, turbidity, alkalinity
4. Determination of PH of water.
5. Estimation of Dissolved and Free Carbon Dioxide of water..
6. Determination of population density in a natural/hypothetical community by quadrat method and calculation of Shannon-Weiner diversity index for the same community.

B.Sc. (Hons.) Zoology

Semester II Core

ZOO – H – C - 203 - T

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- Group A will comprise question no. 1, which will consist of two parts A & B. Part A will be MCQ type, covering the entire syllabus and carry one mark each(1x6=6) and part B will comprise a short answer, three marks each(3x2=6). There will be no option in the Q. No. 1.
- Rests eight questions will be of long type set from the whole syllabus in Group B. Examinees are required to answer any four from this group. Each carries 12 marks.
- The question no. 9 will be of short notes type each carrying six marks (6x2=12) in which only two should be answered out of four options.

CELL BIOLOGY

Credit – 4 **Lectures – 60** **F.M: 75 (60 Ext. + 15 Int.)**

UNIT 1. The Cell and its Organization

1.1 Methods in Cell Biology

1.1.1: Light Microscope

1.1.2: Scanning Electron Microscope (SEM),,Transmission Electron Microscope(TEM)

1.2 Elementary Idea of Prokaryotic and Eukaryotic cells

1.2.1: Differences between Prokaryotic and Eukaryotic Cells

1.3 Cell Membrane

1.3.1: Structure and Functions of Plasma Membrane

1.3.2: Brief Idea of Cell Junctions: Tight junction, Desmosomes, Hemi- desmosomes, & Gap Junction.

1.4 Structure & functions of Cytoplasmic organelles

1.4.1: Endoplasmic Reticulum (SER & RER)

1.4.2: Golgi Complex

1.4.3: Lysosomes

1.4.4: Ribosomes

1.4.5: Mitochondria

UNIT 2. Nucleus

2.1 Nuclear envelope: Ultrastructure and Functions
2.2 Ultrastructure of Chromosome
2.3 Special Type of Chromosomes
2.3.1: Polytene Chromosome
2.3.2: Lampbrush Chromosome

UNIT 3. Cell Division

3.1 Cell Cycle
3.1.1: Phase of Cell Cycle
3.1.2: Brief idea of Cyclin and Cyclin Dependent Kinase in Control of cell.
3.2 Mitosis
3.3 Meiosis
3.4 Comparison between Mitosis & Meiosis

UNIT 4.

4.1 Cancer: Definition, Types, Causes and Characteristics of Cancer Cells
4.2 Apoptosis
4.3 Necrosis

Books Recommended

Cell Biology
1. Alberts *et al*: Essential Cell Biology (1998, Garland)
2. Karp: Cell and Molecular Biology (2008, John Wiley)
3. Lodish*et al*: Molecular Cell Biology (2008, Freeman) 2004
4. Pollard & Earnshaw: Cell Biology (2002, Saunders)
5. Cooper and Hausman: The Cell A Molecular approach (2007, Sinauer)

ONLINE TOOLS AND WEB RESOURCES

- https://swayam.gov.in/course/150-cell-biology ·
- https://swayam.gov.in/courses/5173-biochemistry-and-cell-biology · https://www.jove.com/science-education-library/9/cell-biology · https://www.khanacademy.org/science/biology

B.Sc. (Hons.) Zoology

Semester II Core

ZOO – H – C - 204 - T

- In all nine questions are to be set of equal values and five questions are to be answered of which question no. 1 will be compulsory
- Questions will be grouped into two - Group A and Group B.
- Group A will comprise question no. 1, which will consist of two parts A & B. Part A will be MCQ type, covering the entire syllabus and carry one mark each(1x6=6) and part B will comprise a short answer, three marks each(3x2=6). There will be no option in the Q. No. 1.
- Rests eight questions will be of long type set from the whole syllabus in Group B. Examinees are required to answer any four from this group. Each carries 12 marks.
- The question no. 9 will be of short notes type each carrying six marks (6x2=12) in which only two should be answered out of four options.

DIVERSITY OF CHORDATES

Credit – 4 **Lectures – 60** **F.M: 75 (60 Ext. + 15 Int.)**

UNIT 1. Protochordates& Primitive Chordates

1.1 Hemichordata: General Organization and affinities.

1.2 Urochordata: General organization and Retrogressive Metamorphosis in Herdmania

1.3 Agnatha

1.3.1: General Characters & Classification

1.3.2: Differences between Petromyzon and Myxine.

UNIT 2. Higher Chordates: General Characters and Classification of Following up to Orders Giving Examples

2.1 Amphibia

2.2 Reptilia

2.3 Aves

2.4 Mammalia

UNIT 3. Fish & Amphibia

3.1 Fishes

3.1.1: Differences between Cartilaginous and Bony Fishes

3.1.2: Accessory Respiratory Organs in Teleosts

3.2 Amphibia

3.2.1: Origin & Evolution of Amphibia
3.2.2: Paedogenesis and Neoteny in Axolotl Larva

UNIT 4. Reptilia, Aves, & Mammalia and Comparative Anatomy

4.1 Reptilia

4.1.1: Poisonous and Non- poisonous Snakes of India
4.1.2: Poison Apparatus in Snakes
4.1.3: Biting Mechanism
4.1.4: Types of Venom and Their Toxic Effects

4.2 Aves

4.2.1: Flight Adaptation in Birds
4.2.2: Mechanism of Flight
4.2.3: Flightless Birds (Ratitae or Palaeognathae)

4.3 Mammalia & Primitive Mammals

4.3.1: General and Specialized Characters of Prototheria&Metatheria

4.4 Comparative Anatomy of vertebrate Series

4.4.1: Integument
4.4.2: Heart
4.4.3: Aortic Arches
4.4.4: Kidney

Books Recommended

Diversity of Chordates

1. Miller & Harley: Zoology (6thed. 2005, W.C. Brown
2. Nigam: Biology of Chordates (1997, S Chand)
3. Parker & Haswell, A Text Book of Zoology Vol.II (2005, Macmillan)
4. Purves et al: Life-the Science of Biology, (7thed. 2004, Sinauer)
5. Romer, A.S.,Parsons , T.S .,The vertebrate body ,6th Edison ,CBS publishing ,Japan Ltd. ,1986
6. Sinha, A.K., &Adhikari,S and Ganguli, B.B Biology of Animals Vol.II New Central Agency, Calcutta
7. Young,J.J. The life of Vertebrates ,3rd Edition ,ELBS with oxford press ,1981
8. Vishwanath – vertebrate Zoology

ONLINE TOOLS AND WEB RESOURCES

- https://www.khanacademy.org/science/biology/crash-course-bio-ecology/crash-coursebiology-science/v/crash-course-biology-123 ·
- https://opentextbc.ca/biology2eopenstax/chapter/chordates

B.Sc. (Hons.) Zoology

Semester II Core Practical

ZOO – H – C 203 & 204 - P

Cell Biology & Diversity of Chordates

Credit – 4 **Lectures – 60** **F.M:50 (40 Ext. + 10 Int.)**

Practical	**Marks Distribution**
1. Dissection / Types of beaks and claws/ Powerpoint presentation of any two animals:	**08**
2. Mounting:	**04**
3. Spotting: 2 specimen;2 bones;1 slide	**2×5=10**
4. Preparation of cytological slide	**08**
5. Practical record	**05**
6. Viva voce	**05**
	Total=40

Suggested Practicals

Cell Biology

1. Preparation of temporary stained squash of onion root tip to study various stages of mitosis.
2. Study of slides of prokaryotic-Bacteria
3. Study of slides of Unicellular Eukaryotic cell- *Amoeba, Paramecium, Euglena*
4. Study of various stages of cell division through permanent slides Mitosis and Meiosis
5. Preparation of mitotic slides from onion root tips.
6. Study of Blood cells through slide preparation
7. Study of Barr body through slide preparation from hair follicle/cheek cells of females.

Chordate Diversity

1. **Protochordate:**Balanoglossus, Herdmania

2. **Agnatha:**Petromyzon and Myxine

3. **Pisces:***Scoliodon, Torpedo, Chimaera, Labeorohita, Cirrhinusmrigala, Labeobata, Hippocampus, Exocoetus, Syngnathus, Heteropneutes, Clariasbatrachus, Anabas, Echeneis, Channa, Notopterus*

4. Amphibia:*Necturu, Proteus, Ambystoma, Axolotl larva, Salamandra, Alytes, Hyla*, *Bufo*(Toad*), Rana* (Frog)

5. Reptiles: Kachuga, *Calotes, Draco, Phrynosoma, Chameleon, Typhlops, Najanaja,Bungarus* (Krait), *Vipera*(Chandrabora), *Hydrophis, Crocodylus,* Python.

6. Aves: Columba livia, Psittacula (Parrot), Bubo (Great Horned owl), Alcedo (Kingfisher), Dinopium (Woodpecker), Passer (House Sparrow), Pycnonotus (Bul-Bul), Ostrich model. Types of beaks and claws

7. Mammals: Prototheria Models of Duck-Bill Platypus, Spiny Anteater, *Pteropu*s (Megachiroptera), *Manis* (Pangolin), *Funambulus* (squirrel), *Hystrix*(Porcupine), *Cavia* (Guinea Pig), *Rattusrattus* (rat).

8. Osteology: Bones of Amphibia and Mammal

9. Study of Histological Slides: (Frog & Mammal)

V.S. of Skin, T.S. of**:** Stomach, Intestine, Liver, Spleen, Kidney, Lung

10. Dissection: Dissection of Local Bony Fishes: Afferent, Efferent and Nervous system.

11. **Mounting:** Cycloid and Placoid

12. **Powerpoint presentation** on study of any two animals from two different classes by students (may be included if dissections not given permission).

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Semester III Core

ZOO – H – C - 305 - T

- In all nine questions are to be set of equal values and five questions are to be answered of which question no. 1 will be compulsory
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- Group A will comprise question no. 1, which will consist of two parts A & B. Part A will be MCQ type, covering the entire syllabus and carry one mark each(1x6=6) and part B will comprise a short answer, three marks each(3x2=6). There will be no option in the Q. No. 1.
- Rests eight questions will be of long type set from the whole syllabus in Group B. Examinees are required to answer any four from this group. Each carries 12 marks.
- The question no. 9 will be of short notes type each carrying six marks (6x2=12) in which only two should be answered out of four options.

BIOCHEMISTRY

Credit – 4 **Lectures – 60** **F.M: 75 (60 Ext. + 15 Int.)**

UNIT 1. Biomolecules

1.1 Amino Acids

1.1.1: Nomenclature

1.1.2: Physical Properties

1.1.3: Chemical Properties

1.1.4: Classification

1.1.5: Functions

1.1.6: Peptide Bond

1.2 Protein

1.2.1: Types of Protein:Chemical bond stabilization.

1.2.2: Structure, Organization and Conformation of Primary, Secondary, Tertiary & Quaternary Proteins

1.2.3: Biological Significance

1.3 Carbohydrates

1.3.1: Structure, Classification, Biological Significance of Monosaccharides, Disaccharides and Polysaccharides.

1.4 Lipids

1.4.1: Fatty Acids

1.4.2: Saturated and Unsaturated Fatty Acids

1.4.3: Essential and Non- essential Fatty Acids

1.4.4: Structure, Classification and Biological Significance (Simple, Compound and Derived Lipids)

1.5 Vitamins

1.5.1: Characteristics and Types of Fat Soluble and Water Soluble Vitamins

UNIT 2. Enzymes

2.1 Concept of Enzymes & Co-enzymes
2.2 General Properties of Enzymes
2.3 Nomenclature and Classification of Enzymes
2.4 Mechanism of enzyme action
2.5 Factors Affecting Enzyme Activity

UNIT 3. Nucleic Acids

3.1 Components of Nucleic Acids
3.2 Nucleosides and Nucleotides
3.3 Types of Nucleic Acids
3.3.1: DNA Structure: Watson & Crick Model
3.3.2: Types of RNA: m-RNA, t- RNA & r- RNA

UNIT 4. Metabolic Pathways

4.1 Carbohydrate Metabolism
4.1.1: Glycolysis: Steps and Energetics of Glycolysis
4.1.2: Brief idea of Glycogenesis, Glycogenolysis and Gluconeogenesis
4.1.3: Kreb's Cycle
4.2 Lipid Metabolism
4.2.1: Beta Oxidation of Fatty Acids

Books Recommended

Biochemistry

1. Boyer: Concepts in Biochemistry (3rd ed. 2006, Brooks/Cole)
2. Lehninger, Nelson & Cox: Principles of Biochemistry (4th ed, 2007, Worth),
3. Murray *et al*: Harper's Biochemistry (25th ed. 2000, Appleton & Lange)
4. Stryer: Biochemistry (5th ed. 2001, Freeman)
5. Conn, Stumpf, Bruening&Doi: Principles of Biochemistry (5th ed. 1987, Wiley
6. Harper's illustrated biochemistry

ONLINE TOOLS AND WEB RESOURCES

- CECGurukul (www.cec.nic.in)
- https://www.youtube.com/user/cecedusat/featured.
- National Institute of Science Communication and Information Resources (NISCAIR) (http://www.niscair.res.in/) and National Science Digital Library (NSDL) (www.nsdl.niscair.res.in).
- National Digital Library of India (NDL India; https://ndl.iitkgp.ac.in/).

B.Sc. (Hons.) Zoology

Semester III Core

ZOO – H – C - 306 - T

- In all nine questions are to be set of equal values and five questions are to be answered of which question no. 1 will be compulsory
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- Group A will comprise question no. 1, which will consist of two parts A & B. Part A will be MCQ type, covering the entire syllabus and carry one mark each(1x6=6) and part B will comprise a short answer, three marks each(3x2=6). There will be no option in the Q. No. 1.
- Rests eight questions will be of long type set from the whole syllabus in Group B. Examinees are required to answer any four from this group. Each carries 12 marks.
- The question no. 9 will be of short notes type each carrying six marks (6x2=12) in which only two should be answered out of four options.

MAMMALIAN PHYSIOLOGY

Credit – 4 **Lectures – 60** **F.M: 75 (60 Ext. + 15 Int.)**

UNIT 1. Diet & Digestion

1.1 Concept of BMR(Basal Metabolic Rate)
1.1 Concept of Balanced Diet
1.2 Physiology of Digestion and Absorption
1.2.1: Digestion of Carbohydrate, Fats and Proteins in Gastro-Intestinal Tract
1.2.2: Absorption in Small Intestine
1.2.3: Absorption in Large Intestine

UNIT 2. Physiology of Circulation and Respiration

2.1 Composition and Function of Blood
2.2 Composition and Functions of Lymph
2.3 Blood Clotting Mechanism
2.4 Mechanism and Regulation of Breathing
2.5 Transport of gases
2.5.1: Transport of Oxygen
2.5.2: Oxygen Dissociation Curve
2.5.3: Bohr's Effect
2.5.4: Transport of Carbon Dioxide
2.5.5: Carbon Dioxide Dissociation Curve
2.5.6: Halden's Effect

UNIT 3. Renal & Reproductive Physiology

3.1 Physiologic Anatomy of Kidney
3.2 Physiology of Urine Formation
3.3 Histo-Physiology of Testis

3.4 Histo-Physiology of Ovary
3.5 Menstrual Cycle in Human Female

UNIT 4. Nerve Physiology

4.1 Structure and Types of Neuron
4.2 Origin of Action Potential and its Propagation in Myelinated and Non- Myelinated Nerve Fibres
4.2.1: Saltatory conduction.
4.3 Synapse
4.3.1: Types of Synapse and Synaptic Transmission

Mammalian Physiology

1. Nielson: Animal Physiology – Adaptation and Environment (5th ed. 2008, Cambridge)
2. Marshall and Hughes: Physiology of Mammals and Vertebrates (2nd ed. 1980, Cambridge)
3. Hoar: General and Comparative Physiology (3rd ed., 1987, Prentice Hall)
4. Prosser: Comparative Animal Physiology (4th ed. 1991, Satish Book)
5.C.C.Chaterjee Medical physiology
6.Guyton– a book on medical physiology

ONLINE TOOLS AND WEB RESOURCES

- e portals like SWAYAM and
- http://nsdl.niscair.res.in

B.Sc. (Hons.) Zoology

Semester III Core

ZOO – H – C 307 - T

- In all nine questions are to be set of equal values and five questions are to be answered of which question no. 1 will be compulsory
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- The question no. 9 will be of short notes type each carrying six marks (6x2=12) in which only two should be answered out of four options.

ENDOCRINOLOGY

Credit – 4 **Lectures – 60** **F.M: 75 (60 Ext. + 15 Int.)**

UNIT 1. Hormones

1.1 Hormones, Properties and Classification of Hormones
1.2 Nature and Mechanism of Hormone Action

UNIT 2. Endocrine Glands

2.1 Structure and Histo-Physiology of Pituitary
2.2 Structure and Histo-Physiology of Thyroid
2.3 Structure and Histo-Physiology of Adrenal
2.4 Structure and Histo-Physiology of Endocrine Pancreas

UNIT 3. Disease Related With Hormonal Abnormality

3.1 Gigantism, Dwarfism & Acromegaly
3.2 Cretinism, Goiter & Myxedema
3.3 Diabetes Insipidus & Diabetes Mellitus
3.4 Addison's Disease & Grave Disease

UNIT 4. Gastro-Intestinal Hormones: Sources and Mode of Action

4.1 Gastrin
4.2 Cholecystokinin
4.3 Secretin
4.4 Motilin

Book Recommendation
Endocrinology

1. Hadley: Endocrinology (5th ed. 2000, Prentice Hall)
2. Turner and Bagnara: General Endocrinology, 6th ed.1984, Saunders)
3. Williams
4. Nooris

ONLINE TOOLS AND WEB RESOURCEs

- https://sites.google.com/site/openmeded/specialties/endocrinology
- https://www.endocrine.org/topics

B.Sc. (Hons.) Zoology

Semester III Core Practical

ZOO – H – C 305 & 306 & 307 - P

BIOCHEMISTRY, MAMMALIAN PHYSIOLOGY & ENDOCRINOLOGY

Credit – 4 Lectures – 60 F.M: 75 (60 Ext. + 15 Int.)

Practical	**Marks Distribution**
1. Physiological Experiment:	**10+05=15**
2. Biochemistry practical:	**10+05=15**
3. Spotting:	
a. Slides of general organs (02)	
b. Slides of Endocrine (03)	**5×3=15**
4. Practical record	**08**
5. Viva voce	**07**
	Total=60

Suggested Practicals

Mammalian Physiology

1. Preparation of Haemin Crystal
2. RBC count by using haemocytometer
3. Estimation of Haemoglobin using Sahil's method
4. Record of blood pressure by Sphygmomanometer
5. Determination of Bleeding time in human
6. Determination of Coagulation time in human
7. Study of permanent slide of section of organs: Stomach, lung, liver, kidney, intestine

Biochemistry

1. Detection of biomolecules in the unknown sample-
    a. Glucose
    b. Amino acids
    c. Proteins
    d. Lipids
2. Quantitative estimation of glucose
3. Action of salivary amylase under optimum condition.
4. Separation of Chlorophyll by Chromatography

Endocrinology

1. Study of permanent slide of Endocrine gland: Thymus, Thyroid, Pancreas, Adrenal, Pituitary, testis, ovary and uterus.

B.Sc. (Hons.) Zoology

Semester IV Core

ZOO – H – C 408 - T

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- Group A will comprise question no. 1, which will consist of two parts A & B. Part A will be MCQ type, covering the entire syllabus and carry one mark each(1x6=6) and part B will comprise a short answer, three marks each(3x2=6). There will be no option in the Q. No. 1.
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- The question no. 9 will be of short notes type each carrying six marks (6x2=12) in which only two should be answered out of four options.

GENETICS

Credit – 4 **Lectures – 60** **F.M: 75 (60 Ext. + 15 Int.)**

UNIT 1. Classical Genetics: Mendelism

1.1 **Basics of Mendel's experiments**

1.2 **Types of Genetic Crosses**

1.2.1: Monohybrid Cross
1.2.2: Dihybrid Cross
1.2.3: Test Cross
1.2.4: Back Cross

1.3 **Law of Segregation**

1.4: **Law of Independent Assortment**

UNIT 2. Extension of Mendelism

2.1 Complete Dominance, Incomplete Dominance & Co- dominance
2.2 Lethal Alleles
2.3 Multiple Alleles
2.4 Pleiotropy
2.5 Epistasis
2.6 Linkage and Crossing Over
2.7 Sex- linked Inheritance

UNIT 3. Sex Determination

3.1 Genic Balance Theory
3.1.1: Concept of intersex and Gynandromorph
3.2 Chromosomal Theory of sex Determination: XX/XY, XX/XO and ZZ/ZW Type
3.3 Male Haploid and Female Diploid (Haplodiploid System)

UNIT 4. Mutation

4.1 Concept of Spontaneous and Induced Mutation
4.2 Structure and Numerical alterations of Chromosomes and Related Disorders: Down's Syndrome, Klinefelter syndrome.

Book Recommended

Genetics

1. Brooker: Genetics : Analysis and Principles (1999, Addison-Wesley,)
2. Gardner *et al*: Principles of Genetics (1991, John Wiley)
3. Griffith *et al*: An Introduction to Genetic Analysis (2005, Freeman)
4. Hartl& Jones: Essential Genetics: A Genomic Perspective (2002, Jones &Bartlet)
5. Russell: Genetics (2002, Benjamin Cummings)
6. Snustad& Simmons: Principles of Genetics (2006, John Wiley)
7. Lewin: Genes IX (2008, Jones & Bartlett)

ONLINE TOOLS AND WEB RESOURCES

- https://swayam.gov.in/courses/4922-genetics-and-genomics
- https://www.coursera.org/learn/genetics-evolution
- https://onlinelearning.hms.harvard.edu/hmx/courses/hmx-genetics/
- https://learn.genetics.utah.edu/

B.Sc. (Hons.) Zoology

Semester IV Core

ZOO – H – C 409 - T

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EVOLUTION & POPULATION GENETICS

Credit – 4 Lectures – 60 F.M: 75 (60 Ext. + 15 Int.)

UNIT 1. Geological History And Evidences Of Evolution

1.1 Geological Time, Scale & Geological Era
1.2 Fossils
1.2.1: Types of Fossils
1.2.2 Modes of Formation of Fossils
1.2.3: Age Determination of Fossils
1.3 Fossil History of Evolution of Horse
1.4 Evolution of Man

UNIT 2. Theory & Sources of Evolution

2.1 Lamarckism
2.2 Neo- Lamarckism
2.3 Darwinism
2.4 Neo- Darwinism
2.5 Sources of Variations: Mutation & Recombination
2.6 Reproductive Isolation & Its Role in Evolution

UNIT 3. Population Genetics

3.1 Hardy – Weinberg Law of Equilibrium
3.2 Genetic Drift
3.2.1: Bottle- Neck Phenomenon
3.2.2: Founder's Principle

UNIT 4. Levels & Pattern Of Evolution

4.1 Microevolution
4.2 Macroevolution
4.3 Mega-Evolution
4.4 Basic Pattern of Evolution:
4.4.1: Divergent Evolution,
4.4.2: Adaptive Radiation,
4.4.3: Parallel Evolution
4.4.4: Convergent Evolution

Book Recommendation

Evolution

1. Moody: Introduction to Evolution (1978, Kalyani).
2. Savage: Evolution (1963, Holt, Reinhart and Winston)
3. Rastogi: Organic Evolution (1988, Kedarnath&Ramnath)
4. Strickberger: Evolution (2004, Jones & Bartlett)

ONLINE TOOLS AND WEB RESOURCES

- https://swayam.gov.in/courses/4922-genetics-and-genomics
- https://www.coursera.org/learn/genetics-evolution
- https://onlinelearning.hms.harvard.edu/hmx/courses/hmx-genetics/
- https://learn.genetics.utah.edu/

B.Sc. (Hons.) Zoology

Semester IV Core

ZOO – H – C 410 - T

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ANIMAL BEHAVIOUR

Credit – 4 **Hours of Teaching – 60** **F.M: 75 (60 Ext. + 15 Int.)**

UNIT 1. Introduction to Ethology

1.1 Origin & Study of Animal Behaviour

UNIT 2. Concept & Patterns of Behaviour

2.1 Types of Behaviour
2.1.1: Innate/ Instinct Behaviour
2.1.2: Acquired/ Learned Behaviour
2.2 Patterns of Behaviour: Taxes, Reflexes, Orientation, Instinct, Habituation, Imprinting & Motivation

UNIT 3. Social Organization & Communication

3.1 Social Organization in Honey Bee and Termites
3.2 Communication in Animals
3.2.1: Chemical
3.2.2: Audio
3.2.3: Visual
3.2.4: Tactile

UNIT 4. Miscellaneous

4.1 Migration
4.1.1: Migration in Fishes
4.1.2: Migration in Birds
4.2 Parental Care
4.2.1: Parental Care in Fishes
4.2.2: Parental Care in Amphibia

4.3 Biological Rhythm
4.3.1: Circadian Rhythm
4.3.2: Circannual Rhythm

Book Recommended

Animal Behaviour

1. Drickamer&Vessey : Animal Behaviour – concepts, processes and methods (2nd ed. 1986, Wadsworth,)
2. Freeland: Problems in Practical Advanced Level Biology (1985, Hodder & Stoughton,)
3. Goodenough et al.: Perspectives on Animal Behaviour (1993, Wiley)
4. Grier: Biology of Animal Behaviour (1984, Mosby)
5. Lorenz: The Foundation of Ethology (1981, Springer)
6. Manning & Dawkins: An Introduction to Animal Behaviour (5th ed. 1998, Cambridge).
7. Mcfarland : Animal Behaviour, Psychology, Ethology and Evolution (1985, Pitman).
8. Slater: An Introduction to Ethology (1985, Cambridge).

ONLINE TOOLS AND WEB RESOURCES

- https://www.coursera.org/learn/animal-welfare
- https://www.coursera.org/learn/circadian-clocks

B.Sc. (Hons.) Zoology

Semester IV Core Practical

ZOO – H – C 408 & 409 & 410 - P

GENETICS, EVOLUTION & POPULATION GENETICS AND ANIMAL BEHAVIOUR
Credit – 4 Lectures – 60 F.M: 75 (60 Ext. + 15 Int.)

Practical	Marks Distribution
1. Statistical Verification of Law Of Segregation:	10
2. Identification & Comment On Given Fossil Analogous/Homologous Organ:	10
3. Pedigree Analysis	10
4. Comment On Bee Hive/Termite Mound Specimen Showing Behavior	05
5. Experiment On Geotaxis/Phototaxis	05
6. Sessional Record	10
7. Viva Voce	10
	Total=60

Suggested Practical

Genetics

1. Experiment Verification of Principles of Segregation and Independent Assortment Using Colored Beads and Chi-Square Test.
2. Preparation of Linkage Maps Based on this Data From Drosophila/Maize.
3. Study of Pattern of Inheritance in Human Population of the Traits Rolling Of Tounge And Mid Digital Hair, Hypertrichosis, Widow's Peak
4. Genotype Analysis in the Pedigree Chart of the Victorian Family Affected With Haemophilia
5. Study of Colour Blind by Isihara Chart.

Evolution

1. Genotypic analysis of Taster and Non Taster for PTC in human population to estimate allele frequencies by Hardy –Weinberg equation
2. Fossils study: *Trilobites, Archaeopteryx, Tyrannosaurus rex, stegosaurus*
3. Evolution of Horse-through models
4. Study of Serial homology exhibited by appendages of Prawn.
5. Study of Homologous and Analogous organ

Animal Behaviour

1. Study Of Geo-Taxis, Photo-Taxis, Hygro-Taxis In Animals
2. Locomotory Behavior of Dipteran Larvae (Housefly/Blowfly/Fruitfly)
3. Locomotion on Different Types of Substrata (Writing Paper, Plastic Sheet and Sand Paper)
4. Specimen Showing Behaviour –Prey Mantis, *Hippocampus, Alytes*, Migratory Fish
5. Study of Bee Hive And Mound of Termites

B.Sc. (Hons.) Zoology

Semester V Core

ZOO – H – C 511 - T

- In all nine questions are to be set of equal values and five questions are to be answered of which question no. 1 will be compulsory
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- The question no. 9 will be of short notes type each carrying six marks (6x2=12) in which only two should be answered out of four options.

IMMUNOLOGY

Credit – 4 **Lectures – 60** **F.M: 75 (60 Ext. + 15 Int.)**

UNIT 1. Introduction to Human Immune System and Immunity

1.1 **Types of Immunity**

1.1.1: Innate Immunity

1.1.2: Acquired Immunity

UNIT 2. Cells and Organs of Immune System

2.1 Immuno-Competent Cells and Accessory Cells

2.2 Lymphoid Organs

2.2.1: Primary Lymphoid organs: Thymus, Bone marrow, Bursa Fabricius

2.2.2: Secondary Lymphoid Organs: Lymph Nodes, Spleen, MALT, Tonsils& GALT

UNIT 3. Humoral Immune Response or Antibody Mediated Immune Response (AMI)

3.1 Antigen: Chemical Nature and Structure, Epitope

3.2 Antibody or Immunoglobulin: Types, Structure and Function

3.3 Antigen – Antibody Reaction

UNIT 4. Cell mediated Immunity (CMI)

4.1 Structural Organization of MHC Complex in Mouse and HLA System in Human

4.2 Monoclonal Antibody

4.3 ELISA

- E-content on e-PG Pathshala portal of Government of India: https://epgp.inflibnet.ac.in
- Fundamentals of Immunology;https://www.coursera.org/specializations/immunology

B.Sc. (Hons.) Zoology

Semester V Core

ZOO – H – C- 512 - T

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- The question no. 9 will be of short notes type each carrying six marks (6x2=12) in which only two should be answered out of four options.

DEVELOPMENTAL BIOLOGY

Credit – 4 **Lectures – 60** **F.M: 75 (60 Ext. + 15 Int.)**

UNIT 1. Early Embryonic Development

1.1 Structure of Sperm
1.2 Structure and Types of Egg
1.3 Fertilization: Attraction of Gametes, Fertilizin and Anti Fertilizing Reaction, Capacitation, Acrosomal Reaction, Amphimixis, Cortical Reaction
1.4 Types of Cleavage and Role of Yolk in Cleavage
1.5 Fate Map
1.5.1: Fate Map of Blastula of Amphioxus
1.5.2: Fate Map of Blastula of Frog
1.5.3: Fate Map of Avian Blastula

UNIT 2. Late Embryonic Development

2.1 Extra Embryonic Membrane in Chick
2.2 Placenta: Structure, Types and Functions

UNIT 3. Post Embryonic Development

3.1 Metamorphism Amphibian with Special Reference to Tadpole Larva
3.2 Regeneration
3.2.1: Physiology of Regeneration
3.2.2: Mechanism of Regeneration in Amphibia

UNIT 4. Reproductive Technology

4.1 Collection and Cryopreservation of Gametes
4.2 Artificial Insemination

4.3 Superovulation
4.4 In Vitro Fertilization and Embryo Transfer Technique

Book Recommendation

Developmental Biology

1. Balinsky: An Introduction to Embryology (1981, CBS)
2. Gilbert: Developmental Biology (8th ed., 2006, Sinauer)
3. Wolpert: Principles of Development (3rd ed. 2007, Oxford)

ONLINE TOOLS AND WEB RESOURCES

- https://www.hhmi.org/biointeractive/human-embryonic-development
- https://www.khanacademy.org/science/biology/developmental-biology
- https://ocw.mit.edu/courses/biology/7-22-developmental-biology-fall-2005/index.htm
- https://embryology.med.unsw.edu.au/embryology/index.php/Main_Page

B.Sc. (Hons.) Zoology

Semester V Core Practical

ZOO – H – C 511 & 512 - P

IMMUNOLOGY & DEVELOPMENT BIOLOGY

Credit – 4 **Lectures – 60** **F.M: 50 (40 Ext. + 10 Int.)**

Practical	Marks Distribution
1. Comments on Embryological slides:	02×05= 10
2. Immune cells in Blood Film preparation:	05
3. Histology of slides/photographs of thymus & spleen	05
4. Study of types of placenta through photographs	05
5. Sessional Record	07
6. Viva Voce	08
	Total=40

Suggested Practicals

Developmental biology & Immunology

1. Study of chick embryological slides (21, 24, 28 33, 36, 48 72 and 96 hours of incubation)
2. Study of WM & section of developmental stages of frog through permanent slides Morula, Gastrula, Cleavage, Neurula&Tadpole (Internal and External gills)
3. Preparation of blood film to study various types of blood cells.
4. Demonstration of : ELISA
5. Histological study of spleen, thymus & lymph nodes through slides/photographs
6. Study of different section of placenta (photographs/slides)

B.Sc. (Hons.) Zoology
Semester V
DSE(A/B/C)

ZOO – H – DSE – 501(A) - T

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ECONOMIC ZOOLOGY
Credit – 4 **Lectures – 60** **F.M: 75 (60 Ext. + 15 Int.)**

UNIT 1. **Bee-Keeping and Bee Economy (Apiculture)**

1.1 Varieties of Honey Bees, Stingless Honey Bee and Bee Pasturage
1.2 Setting up an Apiary. Rearing Equipment, Handling of Bees, Artificial Diet
1.3 Diseases of Honey Bee, and Their Management
1.4 Honey Extraction Techniques; Physico-Chemical Analysis Of Honey; Other Beneficial Products From Bee.

Unit 2. **Silk and Silk Production (Sericulture)**

2.1 Different Types of Silk And Silkworms In India
2.2 Rearing Of Bombyx Mori: – Rearing Racks and Trays, Disinfectants, Rearing Appliances, Black Boxing, Chawki Rearing, Bed Cleaning, Mountages, Harvesting Of Cocoons
2.3 Silkworm Diseases & Their Management
2.3.1: Pebrine,
2.3.2: Flacherie
2.4 Silkworm Pests & Parasites and Their Management
2.4.1: Uzi Fly
2.4.2: Dermestid Beetles

Unit 3. Dairy/Poultry Farming

3.1 **Introduction:** Common Breeds of Cattle.
3.2 Commercial Importance of Dairy and Poultry Farming
3.3 Visit To Any Dairy Farm/Poultry Farm.

Unit 4. Lac Culture

4.1 Taxonomy and Identification of Lac Insect
4.2 Economic Importance of Lac,
4.3 Bionomics of Lac Insect, Crops of Lac and Host Plants
4.4 Method of Lac Cultivation, Preparation of Shellac
4.5 Enemies of Lac Insect

Books recommended

1. Prost, P. J. (1962). *Apiculture*. Oxford and IBH, New Delhi.
2. Sericulture, *FAO Manual of Sericulture.*
3. Hafez, E. S. E. (1962). *Reproduction in Farm Animals*, Lea and Fabiger Publishers.
4. Srivastava, C. B. L. (1999). *Fishery Science and Indian Fisheries*.KitabMahal publications, India.
5. Sardar Singh, *Beekeeping in India*, Indian council of Agricultural Research, New Delhi.

ONLINE TOOLS:

1. https://onlinecourses.swayam2.ac.in/cec20_ge23/preview

B.Sc. (Hons.) Zoology
Semester V

ZOO – H – DSE – 502(A) - T

- In all nine questions are to be set of equal values and five questions are to be answered of which question no. 1 will be compulsory
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- Rests eight questions will be of long type set from the whole syllabus in Group B. Examinees are required to answer any four from this group. Each carries 12 marks.

The question no. 9 will be of short notes type each carrying six marks (6x2=12) in which only two should be answered out of four options

BIOSTATISTICS

Credit – 4 **Lectures – 60** **F.M: 75 (60 Ext. + 15 Int.)**

UNIT-1 Sampling (Data collection)

1.1 Primary and Secondary Data
1.2 Frequency Distribution
1.3 Classification & Tabulation
1.4 Representation of Data
1.4.1 Diagrammatic Representation: Histogram & Pie Diagram
1.4.2 Ogive Curve and Polygon Curve

UNIT-2 Measurement of Central Tendency

2.1 Mean
2.2 Median
2.3 Mode

UNIT-3 Measurement of Variation

3.1 Standard Deviation
3.2 Standard Error of Mean
3.3 Coefficient of Variation

UNIT-4 Test of Significance

4.1 Chi Square Test And Student ‘t’ test
4.2 Measurement of Dispersion
4.3 Correlation And Regression

SUGGESTED READINGS:

- **Daniel, W. W (2005): Biostatistics- A foundation for analysis in the Health Sciences, John Wiley & Sons, 7th edition.**

- **Zar, J.H. (2007): Biostatistical Analysis, Pearson Education 4 th edition**

- **Satguru Prasad-Fundamentals of Biostatistics(Biometry),EMKAY Publications,Delhi.**

- **Rastogi,V.B.-Methods in Biostatistics,MedTec,New Delhi.**

ONLINE TOOLS:

1.https://www.youtube.com/playlist?list=PL56E8WS0YZK_34S3Lpisgep0GqD04TTG3

2.https://onlinecourses.nptel.ac.in/noc20_bt28/preview

B.Sc. (Hons.) Zoology

Semester V DSE Practical

ZOO – H – DSE (A) 501 & 502 - P

ECONOMIC ZOOLOGY & BIOSTATISTICS

Credit – 4 **Lectures – 60** **F.M: 50 (40 Ext. + 10 Int.)**

Practical	**Marks Distribution**
1. Identify and Comment upon any two(5x2) **Silk or Tasar Cocoon/Lac stick/Different types of poultry**	**10**
2. Identify and Comment upon two pests(5x2)	**10**
3. Calculate or Present the given data as per instruction	**10**
4. Sessional Work	**05**
5. Viva Voce	**05**
	TOTAL-40

LIST OF PRACTICALS

Economic Zoology

1. Report on Field Visit To Sight Of Sericulture, Apiculture, Lac Culture And Dairy/ Poultry Farm.
2. Study Of Infested Lac Stick, Cocoon, Honey Comb.
3. Study of Paddy Pests, Pests of Sugarcane.

Biostatistics

1. Determination of Mean, Median and Mode.
2. To Perform Chi-SquareTest For A Given Set Of Data.
3. To Learn Graphical Representations Of Statistical Data With The Help Of Computers (eg.MS Excel).
4. Determination of Deviation.

B.Sc. (Hons.) Zoology
Semester V
DSE (A/B/C)

ZOO – H – DSE – 501 (B) - T

- In all nine questions are to be set of equal values and five questions are to be answered of which question no. 1 will be compulsory
- Questions will be grouped into two - Group A and Group B.
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- Rests eight questions will be of long type set from the whole syllabus in Group B. Examinees are required to answer any four from this group. Each carries 12 marks.
- The question no. 9 will be of short notes type each carrying six marks (6x2=12) in which only two should be answered out of four options.

SOLID WASTE MANAGEMENT

Credit – 4 **Lectures – 60** **F.M: 75 (60 Ext. + 15 Int.)**

UNIT 1. Solid & Industrial Waste Management

1.1 Solid Waste:

1.1.1: Sources, Generation, Classification & Chemical Composition
1.1.2: Characterization of Municipal Solid Waste
1.1.3: Hazardous Waste and Biomedical Waste
1.1.4: Impact of Solid Waste on Environment, Human and Plant Health
1.2 Industrial Waste:
1.2.1: Landfill
1.2.2: Thermal Treatment (Pyrolysis and Incineration) Of Waste Material
1.2.3: Effluent Treatment Plant and Sewage Treatment Plant.

UNIT 2. Resource Recovery

2.1 4R- Reduce, Reuse, Recycle And Recover
2.2 Biological Processing
2.2.1: Composting, Anaerobic Digestion, Aerobic Treatment
2.2.2: Reductive Dehalogenation
2.2.3: Mechanical Biological Treatment
2.2.4: Green Techniques for Waste Treatment.

UNIT 3. Integrated Waste Management

3.1 Concept of Integrated Waste Management
3.2 Waste Management Hierarchy; Methods and Importance of Integrated Waste Management

UNIT 4. **Policies for Solid Waste Management**

4.1 Municipal Solid Wastes (Management and Handling) Rules 2000
4.2 Hazardous Wastes Management and Handling Rules 1989
4.3 Bio-Medical Waste (Management and Handling) Rules 1998
4.4 Eco-Friendly or Green Products

SUGGESTED READINGS:

- Acharya, D.B. and Singh, M. Hospital Waste Management. Minerva Press, Delhi. 2003.
- Bhatia, S.C. Solid and Hazardous Waste Management. Atlantic Publishers.2007.
- Blackman, W.C. Basic Hazardous Waste Management. CRC Press, USA. 2001.
- Kreith, F. Handbook of Solid Waste Management. McGraw Hill Publishers, USA. 22,1999
- Moore, J. W. The changing Environment.Springer-Verlag. 1986.

Online Tools:

1. en . wikipedia.org/wiki/waste management
2. http://www.moef.nic.in/legis/hsm/mswmhr.html

B.Sc. (Hons.) Zoology
Semester V
DSE (A/B/C)

ZOO – H – DSE – 502 (B) - T

- In all nine questions are to be set of equal values and five questions are to be answered of which question no. 1 will be compulsory
- Questions will be grouped into two - Group A and Group B.
- Group A will comprise question no. 1, which will consist of two parts A & B. Part A will be MCQ type, covering the entire syllabus and carry one mark each(1x6=6) and part B will comprise a short answer, three marks each(3x2=6). There will be no option in the Q. No. 1.
- Rests eight questions will be of long type set from the whole syllabus in Group B. Examinees are required to answer any four from this group. Each carries 12 marks.
- The question no. 9 will be of short notes type each carrying six marks (6x2=12) in which only two should be answered out of four options.

ANIMAL BEHAVIOUR AND CHRONOBIOLOGY
Credit – 4 **Lectures – 60** **F.M: 75 (60 Ext. + 15 Int.)**

UNIT 1. Patterns of Behaviour

1.1 Stereotyped Behaviours
1.1.1: Orientation
1.1.2: Reflex
1.2 Individual Behavioural Patterns
1.3 Instinct vs. Learned Behaviour
1.4 Fixed Action Patterns:
1.4.1: Associative Learning
1.4.2: Classical and Operant Conditioning
1.4.3: Habituation
1.4.4: Imprinting.

UNIT 2. Social and Sexual Behaviour

2.1 Social Organisation in Termites
2.2 Communication (Dance & Pheromones in Bees)
2.3 Social Behaviour
2.3.1: Altruism (Hamilton's Rule and Concept of Haplodiploidy)
2.3.2: Cooperation and Selfishness

2.4 Sexual Behaviour
2.4.1: Sexual Dimorphism
2.4.2: Mate Choice in Peacock
2.4.3: Intra-Sexual Selection (Male Rivalry in Red Deer)
2.5 Kinship Theory

2.5.1: Relatedness & Inclusive Fitness
2.5.2: Parental Care in Fishes (Nest Building & Coast Benefit)
2.5.3: Conflict Within Families: Parent Offspring Conflict and Sibling Rivalry

UNIT 3. Introduction to Chronobiology

3.1 Historical Developments In Chronobiology
3.2 Biological Oscillation
3.2.1: Concept of Average
3.2.2: Amplitude
3.2.3: Phase and Period
3.3 Biological Clock and Its Adaptive Significance
3.4 Chronotherapy: Role of Melatonin.

UNIT 4. Biological Rhythm

4.1 Types & Characteristics of Biological Rhythm:
4.1.1: Short- And Long- Term Rhythms
4.1.2: Circadian Rhythms;
4.1.3: Tidal Rhythms and Lunar Rhythms,
4.1.4: Circannual Rhythms;
4.1.5: Photic and Non-Photic Zeitgebers;
4.2 Circannual Rhythm in Bird Migration.

SUGGESTED READINGS:

· David McFarland, Animal Behaviour, Pitman Publishing Limited, London, UK

· Manning, A. and Dawkins, M. S, An Introduction to Animal Behaviour, Cambridge,University Press, UK. · John Alcock, Animal Behaviour, Sinauer Associate Inc., USA.

· Paul W. Sherman and John Alcock, Exploring Animal Behaviour, Sinauer Associate Inc., Massachusetts, USA.

· Chronobiology Biological Timekeeping: Jay. C. Dunlap, Jennifer. J. Loros, Patricia J. DeCoursey (ed). 2004, Sinauer Associates, Inc. Publishers, Sunderland, MA, USA

· Insect Clocks D.S. Saunders, C.G.H. Steel, X., Afopoulou (ed.)R.D. Lewis. (3rdEd) 2002 Barens and Noble Inc. New York, USA

· The Clock that times us. 1982. Moore Ed et al.

· Biological Rhythms: Vinod Kumar (2002) Narosa Publishing House, Delhi/ Springer-Verlag, Germany.

ONLINE TOOLS:

1. https://www.coursera.org/learn/animal-welfare2.
   https://www.coursera.org/learn/circadian-clocks

B.Sc. (Hons.) Zoology
Semester V
DSE Practical

ZOO – H – DSE 501 & 502 (B) - P

SOLID WASTE MANAGEMENT AND ANIMAL BEHAVIOUR & CHRONOBIOLOGY
Credit – 4 Lectures – 60 F.M: 50 (40 Ext. + 10 Int.)

Practical	Marks Distribution
1. To identify and Comment upon any two types of nests (5x2) (Through Photographs and Models).	10
2. To Demonstrate Geotaxis/PhototaxisBehaviour in Earthworm OR (5x2) Insect Larvae.	10
3. Project Report based on Municipal Solid Waste(MSW)	10
4. Sessional Work	05
5. Viva Voce	05

TOTAL- 40

LIST OF PRACTICALS

Practicals: Based on The Theory and Field-Based.

1. To Study Nests And Nesting Habits Of The Birds And Social Insects.

2. To Study The Behavioural Responses Of Woodlice To Dry And Humid Conditions (Demonstration Only).

3. To Study Geotaxis Behaviour in Earthworms.

4. To Study the PhototaxisBehaviour in Insect Larvae.

5. Visit to Forest/ Wild Life Sanctuary/Biodiversity Park/Zoological Park to Study Behavioural Activities Of Animals And Prepare A Short Report.

6. Study of Circadian Functions in Humans (Daily Eating, Sleep and Temperature Patterns

B.Sc. (Hons.) Zoology
Semester V
DSE(A/B/C)

ZOO – H – DSE – 501 (C) - T

- In all nine questions are to be set of equal values and five questions are to be answered of which question no. 1 will be compulsory
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- Rests eight questions will be of long type set from the whole syllabus in Group B. Examinees are required to answer any four from this group. Each carries 12 marks.
- The question no. 9 will be of short notes type each carrying six marks (6x2=12) in which only two should be answered out of four options.

MICROBIOLOGY

Credit – 4 **Lectures – 60** **F.M: 75 (60 Ext. + 15 Int.)**

UNIT 1. **Introduction to Microbiology**

1.1 Historical Perspective of Microbiology
1.2 Prokaryotic And Eukaryotic Pathogens
1.3 Bacterial Taxonomy:Basic idea of Hackel and Whittaker's Kingdom Concept.

UNIT 2. **Morphology of Bacteria and Virus**

2.1 Cell Wall: Structure of Peptidoglycan

2.2 Cell Envelope

2.2.1: Cell Membrane,
2.2.2: Differences between Gram- Positive and Gram-Negative Species,
2.2.3: External Capsule
2.2.4: Glycocalyx,

2.3 Plasmids and Episomes
2.4 Bacterial Chromosome: Fundamental Differences with Eukaryotic Chromosome
2.5 Structural Organization:
2.5.1: Prions
2.5.2: Viroids
2.5.3: Viruses

UNIT 3. **Normal Flora**

3.1 Distribution of Normal Flora in the Body:

3.1.2: Intestinal Tract,
3.1.3: Urino-Genital Tract.

3.2 Beneficial Functions And Harmful Effects of Normal Flora.

UNIT 4. **Pathogenicity of Microorganisms**

4.1 Bacterial Pathogenesis:
4.1.2: Bacterial Toxins: Exotoxins, Endotoxins,

4.2 Viral Pathogenesis:
4.2.1: Virus Shedding and Mode of Transmission;

UNIT 5: Infection of Pathogens to Human Populations

5.1 Communicable & Non-Communicable,
5.2 Endemic, Epidemic, Pandemic and Sporadic

UNIT 6 **Diagnostic Microbiology And Bacteria Culture**

6.1 Koch's Postulates,
6.2 Sensitivity and Specificity Of Test Results,
6.3 Principles and Applications:
6.3.1: Simple Staining, Gram-Staining and Acid-Fast Staining,
6.3.2: Collection of Specimens,
6.3.3: Growth Requirements and Growth Factors,
6.3.4: Oxygen Requirement.
6.4 Culture Media:
6.4.1: Simple Media
6.4.2: Complex Media
6.4.3: Selective Media
6.4.4: Enriched Media

SUGGESTED READINGS:

• Johnson, T. R. & Case, C. L.: Lab. Expts. In Microbiology. 2003. Addison Wesley.
• Krieg, N. R. & Holt, J. G. Bergey's Manual of Systematic Bacteriology. Vols 1 – 4. (1984-89). Williams & Wilkins, Baltimore
• Pelczar, M. J., Reid, R. D. and Chan, E. C. S.: Microbiology, TMH.
• Rao, A. S. Introduction to Microbiology, Prentice Hall of India.

ONLINE TOOLS:

1. https://www.youtube.com/watch?v=md_NJDDmfAs&list=PL674370F2CD4C8066

B.Sc. (Hons.) Zoology
Semester V
DSE (A/B/C)

ZOO – H – DSE – 502 (C) - T

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PARASITOLOGY

Credit – 4 **Lectures – 60** **F.M: 75 (60 Ext. + 15 Int.)**

UNIT 1. **Introduction to Parasitology**

1.1 Brief Introduction of Parasitism

1.1.1: Parasite,

1.1.2: Parasitoid

1.1.3: Vectors:

1.1.3.1: Mechanical Vector

1.1.3.2: Biological Vector

1.2 Host Parasite Relationship.

UNIT 2. **Parasitic Protists**

2.1 Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of:

2.1.1: *Giardia intestinalis,*

2.1.2*: Trypanosomagambiense,*

2.1.3*: Leishmaniadonovani*

UNIT 3. **Parasitic Platyhelminthes**

3.1 Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of:

3.1.1: *Schistosomahaematobium,*

UNIT 4. **Parasitic Nematodes**

4.1 Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment Of:

4.1.1: *Ascaris-lumbricoides,*
4.1.2: Ancylostoma-duodenale,

UNIT 5. **Parasitic Arthropods**

5.1 Biology, Importance and Control of Ticks:

5.1.1: *Mites (Sarcoptes),*
5.1.2: *Lice (Pediculus),*
5.1.3: Bug (*Cimex*).
5.2 Parasitoid.

SUGGESTED READINGS:

· Arora, D. R and Arora, B. (2001) Medical Parasitology. II Edition. CBS Publications and Distributors

· E.R. Noble and G.A. Noble (1982) Parasitology: The biology of animal parasites. V Edition, Lea &Febiger

· Ahmed, N., Dawson, M., Smith, C. and Wood, Ed. (2007) Biology of Disease. Taylor and Francis Group

· Parija, S. C. Textbook of medical parasitology, protozoology & helminthology (Text and colour Atlas), II Edition, All India Publishers & Distributers, Medical Books Publishers, Chennai, Delhi

· Rattan LalIchhpujani and Rajesh Bhatia. Medical Parasitology, III Edition, Jaypee Brothers Medical Publishers (P) Ltd., New Delhi

· Meyer, Olsen & Schmidt's Essentials of Parasitology, Murray, D. Dailey, W.C. Brown Publishers.

· K. D. Chatterjee (2009). Parasitology: Protozoology and Helminthology. XIII Edition, CBS Publishers & Distributors (P) Ltd. D

ONLINE TOOLS AND WEB RESOURCES:

- · e portals like SWAYAM.

B.Sc. (Hons.) Zoology

Semester V DSE Practical

ZOO – H – DSE - 501- P & 502 (C) - P

MICROBIOLOGY & PARASITOLOGY

Credit – 4 **Lectures – 60 Hrs.** **F.M: 50 (40 Ext. + 10 Int.)**

Practical	Marks Distribution
1. Study of Parasite/Vector-Any Two(5x2) *Ascaris/Pediculus/Leishmania/Cimax*	10
2. Preparation of liquid/solid Media for the cultivation (5x2) of Bacteria AND Simple Staining/Gram's Staining of Bacteria	10
3. Powerpoint Presentation of Project Report on Water OR Soil Bacteria	10
4. Sessional Record	05
5. Viva Voce	05
	TOTAL- 40

List of Practical

Microbiology

1. Simple staining and Gram's staining of bacteria.

2. Preparation of liquid media (broth) and solid media for routine cultivation of bacteria.

3. Preparation of slant and stab.

4. Pure culture techniques: Spread plate, Pour plate and Streak plate

5. Biochemical test for characterization: Catalase, Nitrate-reduction, Indole production, Methyl Red and Voges-Proskauer Test.

6. Microbiological examination of milk (Methylene blue reductase test), Sugar fermentation test

7. Submission of project report on water or soil bacteria

Parasitology

1.Study of life stages of *Giardia intestinalis, Trypanosomagambiense, Leishmaniadonovani, Plasmodium vivax, Plasmodium falciparum* through permanent slides/micro photographs

2. Study of adult and life stages of *Schistosomahaematobium,* through permanent slides/micro photographs

3. Study of adult and life stages of *Ancylostomaduodenale* through permanent slides/micro photographs.

4. Study of monogenea from the gills of fresh/marine fish [Gills can be procured from fish market as by product of the industry]

5. Study of nematode/cestode parasites from the intestines of Poultry bird [Intestine can be procured from poultry/market as a by-product] & Goat.

B.Sc. (Hons.) Zoology
Semester VI Core

ZOO – H – C - 613 - T

- In all nine questions are to be set of equal values and five questions are to be answered of which question no. 1 will be compulsory
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- Rests eight questions will be of long type set from the whole syllabus in Group B. Examinees are required to answer any four from this group. Each carries 12 marks.
- The question no. 9 will be of short notes type each carrying six marks (6x2=12) in which only two should be answered out of four options.

MOLECULAR BIOLOGY AND BIOTECHNOLOGY
Credit – 4 Lectures – 60 F.M: 75 (60 Ext. + 15 Int.)

UNIT 1. DNA Replication and Gene Expression

1.1 DNA Replication

1.1.1: Central Dogma
1.1.2: Replication of DNA in Prokaryotes
1.2 Gene Expression
1.2.1: Concept of Genetic Code
1.2.2: Mechanism of Transcription in Prokaryotes.
1.2.3: Mechanism of Translation in Prokaryotes

UNIT 2.
2.1 Concept of Operons (Positive and Negative: Inducible & Repressible)
2.2 Concept of Lac Operon

UNIT 3. DNA Damage and Repair
3.1 DNA Damage
3.1.1: DNA Damage by Mutagens
3.1.2: Types of DNA Damage
3.2 DNA Repair
3.2.1: Base Excision Repair
3.2.2: Nucleotide Excision Repair
3.2.3: Double Stranded Break Repair
3.2.4: Thymine Dimer Repair

UNIT 4. Biotechnology
4.1 Cloning Vectors And Enzymes
4.1.1: Enzymology;RestrictionEnzyme,Endonuclease;DNA Polymerase; Ligase.

4.1.2: Cloning Vectors
4.1.3: Dolly- The Transgenic Clone

Recommended Books

Molecular biology & biotechnology

1. B.D.Singh – A Textbook of Biotechnology
2. Alberts *et al*: Molecular Biology of the Cell (2008, Garland)
3. Karp: Cell and Molecular Biology (2008, John Wiley)
4. Lodish*et al*: Molecular Cell Biology (2008, Freeman)

ONLINE TOOLS AND WEB RESOURCES

- https://swayam.gov.in/courses/5065-molecular-biology
- https://swayam.gov.in/courses/4916-molecular-biology
- https://www.youtube.com/user/cecedusat

B.Sc. (Hons.) Zoology

Semester VI Core

ZOO – H – C - 614 - T

- In all nine questions are to be set of equal values and five questions are to be answered of which question no. 1 will be compulsory
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- The question no. 9 will be of short notes type each carrying six marks (6x2=12) in which only two should be answered out of four options.

MEDICAL ZOOLOGY

Credit – 4 **Lectures – 60** **F.M: 75 (60 Ext. + 15 Int.)**

UNIT 1. **Protozoan parasite: Life Cycle, Pathogenicity, prophylaxis and Treatment**

1.1 *Plasmodium vivax*
1.2 *Entamoebahistolytica*
1.3 *Leishmaniadonovani*

UNIT 2. Helminthes Parasites: Life Cycle, Pathogenicity, Prophylaxis and Treatment

2.1 *Taeniasolium*
2.2 *Wuchereriabancrofti*
2.3 *Ancylostomaduodenale*

UNIT 3. Arthropods as Vector of Human Disease

3.1 Mode of Transmission of Disease by Arthropod
3.2 Bionomic & Disease Transmitted By
3.2.1: Phlebotomusargentipes: Kala-azar
3.2.2: tse-tsefly: Sleeping Sickness
3.2.3: Culex (Female): Filaria
3.2.4: Aedes: Dengue

UNIT 4. Human disease caused by viruses & bacteria: Causative agents & pathogenicity

4.1 Diseases caused by Viruses
4.1.1: Air-Borne Viral Disease: Chicken Pox, COVID
4.1.2: Arthropod Borne Viral Disease: Yellow Fever
4.2 Disease Caused By Bacteria

4.2.1: Air Borne Bacterial Disease: Tuberculosis & Diphtheria
4.2.2: Food & Water Borne bacterial Disease: Cholera & Typhoid

4.3 Eradication Program: Pulse-Polio, National AIDS Control Program, National; Filarial Control Program (NFCP) & National Malaria eradication program (NMEP)

Book Recommendation

Medical Zoology

1. Parasitology by K.D.Chatterjee 21 edition

ONLINE TOOLS AND WEB RESOURCES

- https://www.skillstat.com/tools/ecg-simulator
- https://www.youtube.com/watch?v=ZoGfQM5JCnI
- https://www.youtube.com/watch?v=Qbnz4_qed9Q&t=276s
- https://www.youtube.com/watch?v=djAxjtN_7VE
- https://www.youtube.com/watch?v=9SUHgtREWQc&t=188s
- https://www.youtube.com/watch?v=fHUzVqoDnts

B.Sc. (Hons.) Zoology

Semester VI Core Practical

ZOO – H – C- 613 & 614 - P

IMMUNOLOGY & DEVELOPMENT BIOLOGY

Credit – 4 **Lectures – 60** **F.M: 50 (40 Ext. + 10 Int.)**

Practical	**Marks Distribution**
1. Comments on transgenic animals/cloned animals Photographs / maize specimens/photographs of Transposition (2)	**5×2= 10**
2. Spotting on specimens & slides of Ascaris/ Taenia /mosquito Parasite Protozoa: 2 specimens 2 slides	**4×2.5=10**
3. Sessional Record	**10**
4. Viva Voce	**10**
	Total=40

Suggested Practicals

Molecular biology & Biotechnology

1. Demonstration of DNA separation on Gel
2. Use of micropipette
3. Protein estimation by Colorimeter
4. Study of transposition through Maize specimens/Photographs
5. Study of cloned animals through photographs
6. Study of transgenic animals through photographs

Medical Zoology

1. Study of pathogenic protozoa by photographs/Slides (*Entamoebahistolytica*, *Leishmaniadonovani, Trypanosoma*)
2. Museum specimens of helminthes parasites (*Taenia, Ascaris*)
3. Mosquito mouth parts (Anopheles, Culex)
4. Study of Epidemic typhus ticks by photographs

B.Sc. (Hons.) Zoology
Semester VI
DSE (A/B/C)

ZOO – H – DSE – 603 (A) - T

- In all nine questions are to be set of equal values and five questions are to be answered of which question no. 1 will be compulsory
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- Rests eight questions will be of long type set from the whole syllabus in Group B. Examinees are required to answer any four from this group. Each carries 12 marks.
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WILDLIFE CONSERVATION AND MANAGEMENT

Credit – 4 **Lectures – 60** **F.M: 75 (60 Ext. + 15 Int.)**

UNIT1. Introduction to WildLife

1.1 Values of Wildlife - Positive and Negative
1.2 Conservation Ethics
1.3 Causes of Depletion
1.4 Importance of Conservation
1.5 World Conservation Strategies.

UNIT 2. Evaluation and Management of Wildlife

2.1 Habitat Analysis,
2.2 Physical Parameters:
2.2.1: Topography
2.2.2: Geology
2.2.3: Soil and Water
2.3 Biological Parameters:
2.3.1: Food, Cover, Forage, Browse
2.3.2: Cover Estimation
2.4 Standard Evaluation Procedures:
2.4.1: Remote Sensing
2.4.2: GIS

UNIT 3: Population Estimation

3.1 Faecal Analysis of Ungulates and Carnivores
3.2.1: Faecal Samples
3.2.2: Slide Preparation
3.2 Hair Identification
3.3 Pug Mark
3.4 Census Method.

UNIT 4:Wildlife Management And Planning

4.1 Ecotourism / Wildlife Tourism in Forests

.

4.2 Common Diseases of Wild Animal
4.3 National Parks & Sanctuaries
4.4 Tiger Conservation –
4.4.1: Tiger Reserves in India
4.4.2: Management Challenges in Tiger Reserve.

SUGGESTED READINGS:

· Techniques for Wildlife Census in India: A Field Manual by W A Rdgers

· Wildlife Ecology, Conservation, and Management by A. R. E. Sinclair and Graeme James Caughley

· Conservation biology in theory and practice by Graeme James Caughley

· Sutherland, W.J. (2000). The Conservation Handbook: Research, Management and Policy. Blackwell Sciences

· Hunter M.L., Gibbs, J.B. and Sterling, E.J. (2008). Problem-Solving in Conservation Biology and Wildlife Management: Exercises for Class, Field, and Laboratory. Blackwell Publishing

Online Tools and Web Resources:

- https://swayam.gov.in/courses/4687-july-2018-wildlife-conservation
- https://swayam.gov.in/courses/5364-jan-2019-wild-life-ecology
- https://papaco.org/mooc-on-species-conservation/
- https://www.iucn.org/theme/protected-areas/our-work/capacity-development/moocs
- https://www.zsl.org/united-for-wildlife-free-conservation-courses
- https://wildlife.org/next-generation/career-development/online-courses/
- https://www.openlearning.com/umtmooc/courses/wildlife-management

B.Sc. (Hons.) Zoology
Semester VI
DSE (A/B/C)

ZOO – H – DSE – 604 (A) - T

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- Questions will be grouped into two - Group A and Group B.
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AGRO CHEMICAL AND PEST MANAGEMENT
Credit – 4 Lectures – 60 F.M: 75 (60 Ext. + 15 Int.)

UNIT-1 Fundamentals of Pest management

1.1 Pest: Definition, Types of Pest According to Damage (Sub-Economic, Occasional, Perennial)
1.2 Economic Threshold.

UNIT-2 Practical Approach To Pest Management

2.1 Integrated Pest Management:
2.2.1: Cultural,
2.2.2: Biological,
2.2.3: Chemical,
2.2.4: Genetic Control.
2.2 Agrochemicals:
2.3.1: Common Pesticides and Insecticides,

2.3.2: Mode of Their Action.

UNIT-3 Study of Pest in Laboratory and Field

3.1 Visit to Agriculture Field to Study Biology, Damage and Management Practices of Pests of Agriculture Crops.
3.2 Rearing Of Stored Grain Pests and Study of Different Stages.
3.3 Role of Pheromone in Pest Surveillance.

Book Recommended

Agro chemical & Pest Management

1. Pradhan, S. (1969). *Insect Pests of Crops*.National Book Trust, India Book House.
2. Atwal, A.S. (1993) Agricultural pest of India and South East Asia. Kalyani Pub., New Delhi.
3. Dennis, S. Hill. (2005) Agricultural Insect pests of the tropics and their management, Cambridge University press.
4. Pedigo L. P. (2002). *Entomology and Pest Management,* Prentice Hall Publication
5. Robert F. Norris, Edward P. Caswell-Chen and Marcos Kogan, *Concepts of Integrated Pest Management*, Prentice Hall of India.

Online Tools and Web Resources:

- https://online courses.swayam2.ac.in/cec20_bt13/preview

B.Sc. (Hons.) Zoology

Semester VI DSE Practical

ZOO – H – DSE - 603 & 604 (A) – P

WILDLIFE CONSERVATION & MANAGEMENT AND AGRO CHEMICAL AND PEST MANAGEMENT

Credit – 4 **Lectures – 60** **F.M: 50 (40 Ext. + 10 Int.)**

Practicals	**Marks Distribution**
1. Identification of wild fauna on the basis of pugmark/Dung etc.	**10**
2. Quadrant method of flora study	**05**
3. Collection, preservation and slide preparation of pests	**05**
4. Study of infested plants / part of the plant	**05**
5. Project Report on Field Study	**05**
6 Sessional work	**05**
7. viva voce	**05**

TOTAL- 40

List of Practicals:-

1. Identification of Flora, Mammalian Fauna, Avian Fauna, Herpeto-Fauna.

2. Demonstration of Basic Equipment Needed In Wildlife Studies Use, Care And Maintenance (Compass, Binoculars, Spotting Scope, Range Finders, Global Positioning System, Various Types Of Cameras And Lenses)

3. Familiarization and Study of Animal Evidences in the Field; Identification of Animals through Pug Marks, Hoof Marks, Scats, Pellet Groups, Nest, Antlers Etc

4. Demonstration of Different Field Techniques for Flora And Fauna

5. PCQ, Ten Tree Method, Circular, Square & Rectangular Plots, Parker's 2 Step And Other Methods For Ground Cover Assessment, Tree Canopy Cover Assessment, Shrub Cover Assessment.

6. Trail / Transect Monitoring For Abundance and Diversity Estimation Of Mammals And Bird (Direct And Indirect Evidences)

AGRO CHEMICAL AND PEST MANAGEMENT PRACTICAL

1. Collection Preservation and Slide Preparation of Pest.
2. Study of Infested Plants / Part of the Plant.
3. Study of Instrument Used In Pest Management.
4. Trip to ICAR Governing Field of Your Locality.

B.Sc. (Hons.) Zoology
Semester VI
DSE (A/B/C)

ZOO – H – DSE – 603 (B) - T

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- Rests eight questions will be of long type set from the whole syllabus in Group B. Examinees are required to answer any four from this group. Each carries 12 marks.
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BIOLOGY OF INSECTS

Credit – 4 **Lectures – 60** **F.M: 75 (60 Ext. + 15 Int.)**

UNIT 1: Insect Taxonomy

1.1 Basis of Insect Classification;
1.2 Classification of Insects Up To Orders (Ruppert And Barnes, 1994)

UNIT 2: General Morphology of Insects

2.1 External Features;
2.1.1: Head – Eyes, Types of Antennae, Mouth Parts With Respect To Feeding Habits
2.1.2: Thorax: Wings and Wing Articulation,
2.1.3: Types of Legs Adapted to Diverse Habitat
2.1.4: Abdominal Appendages and
2.1.5: Genitalia

UNIT 3: Physiology of Insects

3.1 Structure and Physiology of Insect Body Systems -
3.1.1: Digestive,
3.1.2: Respiratory,
3.1.3: Endocrine And
3.1.4: Nervous System
3.2 Photoreceptors: Types, Structure and Function
3.3 Metamorphosis:
3.3.1: Types
3.3.2: Neuro-endocrine Control of Metamorphosis

UNIT 4: Insect Society

4.1 Social Insects with Special Reference to Termites
4.2 Trophallaxis in Social Insects: Ants, Termites and Bees

UNIT 5: Insect Plant Interaction

5.1 Host-Plant Selection by Phytophagous Insects,

5.2 Major Insect Pests in Paddy

UNIT 6: Insects as Vectors

6.1 Insects as Mechanical and Biological Vectors,

6.2 Brief Discussion on House Flies and Mosquitoes as Important Vectors

SUGGESTED READINGS:-

A general textbook of entomology, Imms , A. D., Chapman & Hall, UK

The Insects: Structure and function, Chapman, R. F., Cambridge University Press, UK

Principles of Insect Morphology, Snodgrass, R. E., Cornell Univ. Press, USA

Introduction to the study of insects, Borror, D. J., Triplehorn, C. A., and Johnson, N. F., M Saunders College Publication, USA

The Insect Societies, Wilson, E. O., Harward Univ. Press, UK

Host Selection by Phytophagous insects, Bernays, E. A., and Chapman, R. F., Chapman and Hall, New York, USA

Physiological system in Insects, Klowden, M. J., Academic Press, USA

The Insects, An outline of Entomology, Gullan, P. J. , and Cranston, P. S., Wiley Blackwell, UK

Insect Physiology and Biochemistry, Nation, J. L., CRC Press

Online Tools and Web Resources:

- https://epgp.inflibnet.ac.in/
- https://swayam.gov.in/Home

B.Sc. (Hons.) Zoology
Semester VI
DSE (A/B/C)

ZOO – H – DSE – 604 (B) - T

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ANIMAL CELL BIOTECHNOLOGY

Credit – 4 **Lectures – 60** **F.M: 75 (60 Ext. + 15 Int.)**

UNIT 1: Introduction

1.1 Concept and Scope of Biotechnology

UNIT 2: Techniques in Gene manipulation

2.1 Recombinant DNA Technology, Restriction Endonucleases.
2.2 Cloning Vectors & Their Features:
2.2.1: Plasmids,
2.2.2: Phage Vectors,
2.2.3: Cosmids,
2.2.4: Phagemids,
2.2.5: BAC, YAC, and HAC.
2.3 Construction of Genomic Libraries and cDNA Libraries
2.4 Transformation Techniques:
2.4.1: Cloning In Bacteria
2.4.2: Screening of Clone

UNIT 3: Animal Cell Culture

3.2 Culture Media
3.2.1: Natural and Synthetic,
3.3 Stem Cells
3.4 Cryopreservation of Cultures.
3.5 Molecular Biology Techniques
3.5.1: Agarose and SDS PAGE.
3.5.2: Gel Electrophoresis,
3.5.3: Blotting: Southern, Northern and Western,
3.5.4: Concept of PCR And its Application.

UNIT 4: Fermentation

4.1 Different Types of Fermentation:

4.1.1: Submerged & Solid State;
4.1.2: Batch, Fed Batch & Continuous;
4.1.3: Types of Bioreactor: Stirred Tank, Air Lift, Fixed Bed and Fluidized.
4.2 Downstream Processing:
4.2.1: Filtration
4.2.2: Centrifugation,
4.2.3: Extraction,
4.2.4: Lyophilization.

UNIT 5: Application In Health

5.1 Hybridoma Technology,
5.2 Production of Recombinant Proteins: Insulin and Growth Hormones.

SUGGESTED READINGS:-

· A general text book of entomology, Imms , A. D., Chapman & Hall, UK

· The Insects: Structure and function, Chapman, R. F., Cambridge University Press, UK

· Principles of Insect Morphology, Snodgrass, R. E., Cornell Univ. Press, USA

· Introduction to the study of insects, Borror, D. J., Triplehorn, C. A., and Johnson, N. F., M Saunders College Publication, USA

· The Insect Societies, Wilson, E. O., Harward Univ. Press, UK

· Host Selection by Phytophagous insects, Bernays, E. A., and Chapman, R. F., Chapman and Hall, New York, USA

· Physiological system in Insects, Klowden, M. J., Academic Press, USA

· The Insects, An outline of Entomology, Gullan, P. J. , and Cranston, P. S., Wiley Blackwell, UK

Insect Physiology and Biochemistry, Nation, J. L., CRC Press

Online Tools and Web Resources:

- https://epgp.inflibnet.ac.in/
- https://swayam.gov.in/Home

B.Sc. (Hons.) Zoology

Semester VI DSE Practical

ZOO – H – DSE 603 & 604 (B) – P

BIOLOGY OF INSECTS & ANIMAL CELL BIOTECHNOLOGY

Credit – 4 Lectures – 60. F.M: 50 (40 Ext. + 10 Int.)

Practicals	**Marks Distribution**
Mounting and Identification of any two-(5x2)	**10**
Antennae/Legs/Mouth Parts of Insects	
1. Identification of following Techniques through Photographs(5x2) Southern/Northern/Western Blotting/PCR	**10**
2. Project Report on Animal Cell Culture	**10**
3. Sessional Record	**05**
4. Viva Voce	**05**
	TOTAL- 40

Biology of Insect Lab

List of Practical

1. Study of Life Cycle of Mosquito

2. Study of Different Kinds of Antennae, Legs and Mouth Parts of Insects

3. Mounting of Insect Wings of Any Insects

4. Methodology of Collection, Preservation and Identification of Insects.

5. Morphological Studies of Various Castes of *Apis,* Ant-*Camponotus,* Termite-*Odontotermes*

6. Study of Major Insect Pests of Paddy and Their Damages

7. Study of Mulberry Silk Moths as Beneficial Insects.

Animal Cell Biotechnology Lab,

List of Practical

1. Packing and Sterilization of Glass and Plastic Wares for Cell Culture.

2. Preparation of Culture Media.

3. Preparation of Genomic DNA from E. coli/animals/ humans.

4. Plasmid DNA isolation (pUC 18/19) and DNA Quantitation Using Agarose Gel Electrophoresis (by using lambda DNA as standard).

5. Techniques: Western Blot, Southern Hybridization, DNA Fingerprinting, PCR, DNA Microarrays (By Photograph)

B.Sc. (Hons.) Zoology
Semester VI
DSE(A/B/C)

ZOO – H – DSE – 603 (C) - T

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REPRODUCTIVE BIOLOGY

Credit – 4 **Lectures – 60** **F.M: 75 (60 Ext. + 15 Int.)**

UNIT 1: Reproductive Endocrinology

1.1 Mechanism of Action of Steroid and Glycoprotein Hormones.
1.2 Hypothalamo – Hypophyseal – Gonadal Axis,
1.3 Regulation of Gonadotropin Secretion in Human (Male and Female);
1.4 Reproductive System:
1.4.1: Development and Differentiation of Gonads,
1.4.2: Genital Ducts and External Genitalia

UNIT 2: Functional Anatomy of Male Reproduction

2.1 Histo-Architecture of Testis in Human
2.2 Spermatogenesis and Its Hormonal Regulation
2.3 Androgen Synthesis and Metabolism
2.4 Accessory Glands Functions

UNIT 3: Functional Anatomy of Female Reproduction

3.1 Histo-Architecture of Ovary in Human
3.2 Oogenesis and Its Hormonal Regulation
3.3 Reproductive Cycles:Estrous And Menstrual Cycle.
3.4 Hormonal Control and Regulation of Implantation and Gestation.
3.5 Mechanism and Hormonal Regulation of Parturition and Lactation.

UNIT 4: Reproductive Health
4.1 Infertility in Male and Female: Causes, Diagnosis and Management

Books Recommended

1. Austin, C.R. and Short, R.V. reproduction in Mammals. Cambridge University Press.
2. Degroot, L.J. and Jameson, J.L. (eds). Endocrinology. W.B. Saunders and Company.
3. Knobil, E. et al. (eds). The Physiology of Reproduction. Raven Press Ltd.
4. Hatcher, R.A. et al. The Essentials of Contraceptive Technology. Population Information Programme. A general text book of entomology, Imms , A. D., Chapman & Hall, UK

5 · The Insects: Structure and function, Chapman, R. F., Cambridge University Press, UK

6 · Principles of Insect Morphology, Snodgrass, R. E., Cornell Univ. Press, USA

7 · Introduction to the study of insects, Borror, D. J., Triplehorn, C. A., and Johnson, N. F., M Saunders College Publication, USA

8 ·The Insect Societies, Wilson, E. O., Harward Univ. Press, UK

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10 · Physiological system in Insects, Klowden, M. J., Academic Press, USA

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12· Insect Physiology and Biochemistry, Nation, J. L., CRC Press

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B.Sc. (Hons.) Zoology
Semester VI
DSE(A/B/C)

ZOO – H – DSE – 604 (C) - T

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FISHERIES AND AQUACULTURE

Credit – 4 **Lectures – 60** **F.M: 75 (60 Ext. + 15 Int.)**

UNIT 1: Introduction and Classification

1.1 General Description of Fish
1.2 Account of Systematic Classification of Fishes (Up To Classes)

UNIT 2: Morphology and Physiology

2.1 Types of Fins and Their Modifications;
2.2 Locomotion in Fish
2.4 Types of Scales
2.6 Gills and Gas Exchange
2.7 Swim Bladder: Types and Role in Respiration, Buoyancy
2.8 Electric Organ
2.9 Bioluminescence

UNIT 3: Fisheries

3.1 Inland Fisheries
3.2 Marine Fisheries
3.3 Fishing Crafts and Gears
3.4 Depletion of Fisheries Resources

Unit 4: Aquaculture

4.1 Carp Culture of India
4.2 Pen and Cage Culture;

4.3 Polyculture
4.4 Composite Fish Culture
4.5 Brood Stock Management
4.6 Induced Breeding of Fish:
4.6.1: Hypophysation
4.7 Fishery By-Products

UNIT 5: Fish in Research

5.1 Transgenic Fish
5.1.1: Zebrafish as a Model Organism in Research

SUGGESTED READINGS:-

1 · A general text book of entomology, Imms , A. D., Chapman & Hall, UK

2 · The Insects: Structure and function, Chapman, R. F., Cambridge University Press, UK

3 · Principles of Insect Morphology, Snodgrass, R. E., Cornell Univ. Press, USA

4 · Introduction to the study of insects, Borror, D. J., Triplehorn, C. A., and Johnson, N. F., M Saunders College Publication, USA

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6 · Host Selection by Phytophagous insects, Bernays, E. A., and Chapman, R. F., Chapman and Hall, New York, USA

7 · Physiological system in Insects, Klowden, M. J., Academic Press, USA

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B.Sc. (Hons.) Zoology

Semester VI DSE Practical

ZOO – H – DSE 603 & 604 (C)– P

REPRODUCTIVE BIOLOGY & FISHERIES & AQUACULTURE

Credit – 4 **Lectures – 60** **F.M: 50 (40 Ext. + 10 Int.)**

Practicals	**Marks Distribution**
1. Study of animal House	**10**
2. Study of Permanent Slides Of rats/human/aquaculture	
i) Slides of rats/Human (03) ii) Aquaculture (03)	**(6x2) 12**
3. Project Report	**08**
4. Sessional Record	**05**
5. Viva Voce	**05**

TOTAL- 40

Reproductive Biology Lab

List of Practical

1.Study of Animal House: Set Up And Maintenance Of Animal House, Breeding Techniques, Care Of Normal And Experimental Animals (Only Demonstration Through Chart).

2. Examination of Histological Sections from Photomicrographs/ Permanent Slides of Rat/Human: Testis, Epididymis and Accessory Glands of Male Reproductive Systems; Ovary, Fallopian Tube, Uterus (Proliferative and Secretory Stages), Cervix and Vagina

FISHERIES AND AQUACULTURE LAB
LIST OF PRACTICAL

1. Morphometric and Meristic Characters of Fishes
2. Identification of *Petromyzon, Myxine, Pristis, Exocoetus, Hippocampus, Gambusia, Labeo, Heteropneustes, Anabas*
3. Study of Different Types of Scales (Through Permanent Slides/ Photographs).
4. Study of Crafts and Gears Used In Fisheries (Photographs)
5. Water Quality Criteria for Aquaculture: Assessment of Ph, Alkalinity, Salinity.
6. Study of Air Breathing Organs in *Channa, Heteropneustes, Anabas* and *Clarias*
7. Project Report on a Visit to Any Fish Farm/ Pisciculture Unit/Zebrafish Rearing Lab