UNIVERSITY OF GOUR BANGA

Scheme of ZOOLOGY (Hons.) Syllabus (UG) in CBCS System

B.Sc.(Hons.) in Zoology

Gross outline of the Course Structure under CBCS

Academic Semesters	Courses					Credits	Marks
	Discipline Core (DC)	Generic Elective (GE)	Discipline Specific Elective (DSE)	Ability Enhancement Compulsory (AEC)	Skill Enhancement (SEC)		
SEM-I	DC1(6) DC2(6)	GE-1 (6)	--	ENVS (2)	--	20	200
SEM-II	DC3(6) DC4(6)	GE-2 (6)	--	Communicative English/Communicative Bengali/MIL (2)	--	20	200
SEM-III	DC5(6) DC6(6) DC7(6)	GE-3 (6)	--	--	--	24	200
SEM-IV	DC8(6) DC9(6) DC10(6)	GE-4 (6)	--	--	--	24	200
SEM-V	DC11(6) DC12(6)	--	DSE-1 (6) DSE-2 (6)	--	SEC-1 (2)	26	250
SEM-VI	DC13(6) DC14(6)	--	DSE-3 (6) DSE / DP -4(6)	--	SEC-2 (2)	26	250
Total	--	--	--	--	--	140	1300

Description of the course structure Credit and Marks

Types of Courses	Core Courses		Elective Courses				Compulsory courses			
			Generic Elective (GE)		Discipline specific Elective(DSE)		Skill enhancement Course		Ability enhancement course	
	Theory	Practical	Theory	Practical	Theory	Practical	Theory	Practical	Theory	Practical
Number of courses	14	14	04	04	04	04	02	00	02	00
Credit/course	04	02	04	02	04	02	02	00	02	00
Total	56	28	16	08	16	08	04	00	04	00

Total Credit: 140

Course Structure in CBCS in Zoology (H)

Subject	Semester	Paper code	Description of the subject content	Credit	Marks
Discipline Course (DC)	SEM-I	ZOOL-H-DC1-T	Non-Chordate-I (Theory)	04	25+10*
	SEM-I	ZOOL-H-DC1-P	Non-Chordate-I (Practical)	02	15
	SEM-I	ZOOL-H-DC2-T	Non-Chordate-II (Theory)	04	25+10*
	SEM-I	ZOOL-H-DC2-P	Non-Chordate-II (Practical)	02	15
	SEM-II	ZOOL-H-DC3-T	Diversity of Chordates(Theory)	04	25+10*
	SEM-II	ZOOL-H-DC3-P	Diversity of Chordates(Practical)	02	15
	SEM-II	ZOOL-H-DC4-T	Comparative Anatomy of Vertebrates(Theory)	04	25+10*
	SEM-II	ZOOL-H-DC4-P	Comparative Anatomy of Vertebrates (Practical)	02	15
	SEM-III	ZOOL-H-DC5-T	Cell Biology and Principles of Genetics (Theory)	04	25+10*
	SEM-III	ZOOL-H-DC5-P	Cell Biology and Principles of Genetics (Practical)	02	15
	SEM-III	ZOOL-H-DC6-T	Ecology and Conservation Biology (Theory)	04	25+10*
	SEM-III	ZOOL-H-DC6-P	Ecology and Conservation Biology(Practical)	02	15
	SEM-III	ZOOL-H-DC7-T	Developmental Biology and Reproductive Biology (Theory)	04	25+10*
	SEM-III	ZOOL-H-DC7-P	Developmental Biology and Reproductive Biology (Practical)	02	15
	SEM-IV	ZOOL-H-DC8-T	Biochemistry (Theory)	04	25+10*
	SEM-IV	ZOOL-H-DC8-P	Biochemistry (Practical)	02	15
	SEM-IV	ZOOL-H-DC9-T	Animal Physiology: Life sustaining System(Theory)	04	25+10*
	SEM-IV	ZOOL-H-DC9-P	Animal Physiology: Life sustaining System(Practical)	02	15
	SEM-IV	ZOOL-H-DC10-T	Systematics and Evolution (Theory)	04	25+10*
	SEM-IV	ZOOL-H-DC10-P	Systematics and Evolution (Practical)	02	15
	SEM-V	ZOOL-H- DC11-T	Histology and Endocrinology (Theory)	04	25+10*
	SEM-V	ZOOL-H-DC11-P	Histology and Endocrinology(Practical)	02	15
	SEM-V	ZOOL-H-DC12-T	Economic Zoology and Industrial Zoology (Theory)	04	25+10*
	SEM-V	ZOOL-H-DC12-P	Economic Zoology and Industrial Zoology (Practical)	02	15
	SEM-VI	ZOOL-H-DC13-T	Parasitology and Immunology (Theory)	04	25+10*
	SEM-VI	ZOOL-H-DC13-P	Parasitology and Immunology (Practical)	02	15
	SEM-VI	ZOOL-H-DC14-T	Molecular Biology (Theory)	04	25+10*
	SEM-VI	ZOOL-H-DC14-P	Molecular Biology (Practical)	02	15
Generic Elective (GE)	SEM-I	(Subject)-GE1-T	To be opted from the pool of subjects (Theory)	04	25+10*
	SEM-I	(Subject)-GE1-P	To be opted from the pool of subjects (Practical)	02	15
	SEM-II	(Subject)-GE2-T	To be opted from the pool of subjects (Theory)	04	25+10*
	SEM-II	(Subject)-GE3-P	To be opted from the pool of subjects (Practical)	02	15
	SEM-III	(Subject)-GE3-T	To be opted from the pool of subjects (Theory)	04	25+10*
	SEM-III	(Subject)-GE4-P	To be opted from the pool of subjects (Practical)	02	15
	SEM-IV	(Subject)-GE4-T	To be opted from the pool of subjects (Theory)	04	25+10*
	SEM-IV	(Subject)-GE4-P	To be opted from the pool of subjects (Practical)	02	15

Continued…

Course Structure in CBCS Zoology(H)

Discipline Specific Elective (DSE)	SEM-V	ZOOL-H-DSE1-T-A/B	Animal Biotechnology (or) Microbiology(Theory)		04		25+10*	
	SEM-V	ZOOL-H-DSE1-P-A/B	Animal Biotechnology (or) Microbiology(Practical)		02		15	
	SEM-V	ZOOL-H-DSE2-T-A/B	Biostatistics (or) Bioinformatics (Theory)		04		25+10*	
	SEM-V	ZOOL-H-DSE2-P-A/B	Biostatistics (or) Bioinformatics (Practical)		02		15	
	SEM-VI	ZOOL-H-DSE3-T-A/B	Animal Behaviour and Chronobiology (or) Toxicology, Environmental Biology and Public health (Theory)		04		25+10*	
	SEM-VI	ZOOL-H- DS E3-P-A/B	Animal Behaviour and Chronobiology (or) Toxicology, Environmental Biology and Public Health (Practical)		02		15	
	SEM-VI	ZOOL-H-DSE4-T/DP	Biology of Insects (Theory)	(or) Project Work	04	06	25+10*	50
	SEM-VI	ZOOL-H-DSE4-P	Biology of Insects (Practical)		02		15	
Ability enhancement course (AEC)	SEM-I	ZOOL-H-AEC 1	Environmental Studies (Theory)		02		40+10*	
	SEM-II	ZOOL-H-AEC2	Communicative Languages (Theory)		02		40+10*	
Skill Enhancement Course (AEC)	SEM-V	ZOOL-H-SEC 1-A/B	Sericulture (or) Apiculture (Theory)		02		40+10*	
	SEM-VI	ZOOL-H-SEC2-A/B	Aquarium Fish keeping (or) Medical Diagnostic Technique (Theory)		02		40+10*	

(*)Internal Assessment

Meaning of the Terms and Abbreviations

- **Core Course (C):** A course that should compulsorily be studied by a candidate as a core requirement of the programme.
- **Elective Course:** A Course which may be very specific or specialized or advanced or supportive to the discipline/ subject of study. These are of three types:

  Discipline Specific Elective Course (DSE): A course, which may be offered by the main discipline/subject of study.

  Generic Elective (GE) Course: An elective course, chosen from related or unrelated discipline/subject of study.

  Dissertation/Project (D.P): An elective course designed to acquire special/advanced knowledge with an advisory support by a teacher/faculty member.

- **Ability Enhancement Compulsory Course (AEC)**: The course designed for knowledge enhancement consisting of Environmental studies, English Communication/MIL.
- **Skill Enhancement Course (SEC):** These courses are designed to provide value-based and/or skill-based knowledge relating to the main discipline.
- **MCQ:** Multiple Choice Questions (Each questions may carries either one or two marks).
- **MIL:** Modern Indian Language*
- **DQ :** Descriptive questions
- **IA:** Internal Assessment (By the respective Department of the Colleges).
- A course comprises Lectures (L)/Tutorials (T)/ Practical (P)/Project Work (D.P)/Viva (V)/Seminar (S)/Term Paper (TP).
- **TEE:** Term End Examination

Discipline Core (DC) Courses in Zoology (H)

ZOOL DC1:Non-Chordates I (Protists to Pseudo-coelomates)

[Allotted Marks- 50 (Theory: 25+ Practical: 15+ Internal Assessment: 10)]

- **Theory (Full marks = 25)[ZOOL-H-DC1-T]**

Unit 1: Basics of Animal Classification: Six kingdom concept of classification (Carl Woese)

Unit 2: Protista: General characteristics and classification up to phylum; Locomotion in *Euglena*, *Paramoecium* and *Amoeba*; Conjugation in *Paramoecium*; Life cycle and pathogenicity of *Plasmodium vivax* and *Entamoeba histolytica.*

Unit 3: Porifera: General characteristics and classification up to classes; Canal system, cell types and spicules in sponges.

Unit 4: Cnidaria: General characteristics and classification up to classes; General morphology and metagenesis in *Obelia*; Metagenesis in *Aurelia;* Polymorphism in *Cnidaria*; Corals and coral reef diversity, function & conservation.

Unit 5: Ctenophora: General characteristics and evolutionary significance.

Unit 6: Platyhelminthes: General characteristics and classification up to classes; Life cycle, pathogenicity, parasitic adaptations and control measures of *Fasciola hepatica* and *Taenia solium.*

Unit 7: Nemathelminthes: General characteristics and classification up to classes; Life cycle, pathogenicity, parasitic adaptations and control measures of *Ascaris lumbricoides* and *Wuchereria bancrofti*

- **Practical (Full marks = 15))[ZOOL-H-DC1-P]**

Group A: Laboratory experimentation (= 10marks)

1. Study of whole mount of *Euglena, Amoeba* and *Paramoecium*
2. **Identification:**

a. *Amoeba, Euglena, Entamoeba, Opalina, Paramecium, Plasmodium vivax* and *Plasmodium falciparum* (from the prepared slides).
b. *Sycon*, Neptune's Cup, *Obelia, Physalia, Millepora, Aurelia, Tubipora, Corallium, Alcyonium, Gorgonia, Metridium, Pennatula, Fungia, Meandrina, Madrepora, Porpitta, Vellela.*
c. Adult *Fasciola hepatica*, *Taenia solium* and *Ascaris lumbricoides.*

3. **Staining/mounting**: Any protozoa/helminth from gut of cockroach.

Group: B : Laboratory note book and Viva voce (2+3=5 marks)

Periodic updating of laboratory note book and Viva-voce covering mostly the experimental works allotted during the final examination.

- **Internal Assessment (Full marks = 10*)[ZOOL-H-DC1-IA]**
  (*To be done by the Concerned College)

ZOOL DC2: Non-Chordates II (Coelomates)

[Allotted Marks- 50 (Theory: 25+ Practical: 15+ Internal Assessment: 10)]

- **Theory (Full marks = 25)[ZOOL-H-DC2-T]**

Unit 1: Introduction: Evolution of coelom and metamerism.

Unit 2: Annelida: General characteristics and classification up to classes: Type study of *Pheretima* sp. (morphology, locomotion, circulation and reproduction), Excretion in Annelida.

Unit 3: Arthropoda: General characteristics and classification up to classes; Respiration in Arthropoda (gills in prawn and trachea in cockroach), Metamorphosis in Lepidopteran insects, Vision in insects.

Unit 4: Onychophora: General characteristics and evolutionary significance.

Unit 5: Mollusca: General characteristics and classification up to classes; Nervous system and torsion in Gastropoda; Feeding and respiration in *Pila* sp.

Unit 6: Echinodermata: General characteristics and classification up to classes; Water-vascular system in Asteroidea; Larval forms in Echinodermata; Affinities with Chordates.

Unit 7: Hemichordata: General characteristics of phylum Hemichordata; Relationship with non-chordates and chordates.

- **Practical (Full marks = 15)[ZOOL-H-DC2-P]**

Group A : Laboratory experimentation (=10 marks)

1. **Study of following specimens:**
   a. **Annelids** - *Aphrodite, Nereis, Heteronereis, Sabella, Serpula, Chaetopterus, Pheretima, Hirudinaria*
   b. **Arthropods** - *Limulus, Palamnaeus, Palaemon, Daphnia, Balanus, lepas, Sacculina, Carcinus, Eupagurus, Buthus, Scolopendra, Julus, Bombyx, Periplaneta*, termites and honey bees,,*Peripatus*,
   c. Onychophora
   d. **Molluscs** - *Chiton, Dentalium, Pila, Doris, Helix, Unio, Mytilus, Ostrea, Pinctada, Sepia, Octopus, Nautilus, Loligo.*
   e. **Echinodermates** - Pentaceros/Asterias, *Ophiura, Clypeaster, Echinus, Cucumaria* and *Antedon.*
2. **Mounting** of mouth parts of *Periplaneta* Sp. dissection of digestive system and nervous system of *Periplaneta* (demonstration).
3. **Submission** of field report on visit of any area of Zoological importance.

Group B : Laboratory note book and Viva voce (2+3= 5 marks)

Periodic updating of laboratory note book and Viva-voce covering mostly the experimental work allotted during examination

- **Internal Assessment (Full marks = 10)* [ZOOL-H-DC2-IA]**
  (*To be done by the Concerned College)

ZOOL DC3: Diversity of Chordates

[Allotted Marks- 50 (Theory: 25+ Practical: 15+ Internal Assessment: 10)]

- **Theory (Full marks = 25) [ZOOL-H-DC3-T]**

Unit 1: Introduction to Chordates: General characteristics and outline classification of Phylum Chordata **(Young, 1981).**

Unit 2: Protochordata: (i) General Characteristics and classification of sub-phylum Urochordata and Cephalochordata up to Classes. (Young,1981), (ii) Retrogressive metamorphosis in Ascidia, (iii) Chordate Features and Feeding in *Branchiostoma*.

Unit 3: Origin of Chordata:(i) Dipleurula concept and the Echinoderm theory of origin of chordates, (ii) Advanced features of vertebrates over Protochordata.

Unit 4: Agnatha: General characteristics and classification of Cyclostomes up to Order, Ammoecoete larva.

Unit 5: Pisces:(i) General characteristics and classification of Chondrichthyes and Osteichthyes up to Subclasses. (Romer, 1959), (ii) Accessory respiratory organs in fishes (iii) Dipnoi-distribution characteristic features and evolutionary significance and migration,(iii) Swim bladder and scales in fishes.

Unit 6: Amphibia: General characteristics and classification up to living Orders (Duellman and Trueb 1986), (ii) Metamorphosis , neoteny and paedogenesis

Unit 7: Reptilia: (i) General characteristics and classification up to living Orders. (Young 1981),(ii) Poison apparatus and biting mechanism in snake, snake venom and method of treatment of snake biting,(ii) *Sphenodon*- present status

Unit 8: Aves: (i) General characteristics and classification up to Sub-Classes. (Young, 1981), (ii) Exoskeleton and migration in birds, (ii) Principles and aerodynamics of flight, (iv) *Archaeopteryx*-a connecting link.

Unit 9: Mammals: (i) General characters and classification up to living Infra class (Young,1981), (ii) Affinities of Prototheria, (iii) Adaptive radiation in mammals with reference to locomotory appendages, (iv) Echolocation in Chiropterans and Cetaceans.

- **Practical (Full marks = 15) [ZOOL-H-DC3-P]**

Group A Laboratory experimentation (= 10 marks)

1. **Identification of the following specimen:**
   i. **Protochordata:** *Balanoglossus*, *Herdmania*, *Branchiostoma, Doliolum.*
   ii. **Agnatha:** *Petromyzon*, *Myxine.*
   iii. **Fishes:** *Scoliodon*, *Sphyrna*, *Pristis*, *Torpedo*, Chimaera, *Mystus*, *Heteropneustes*, *Clarias*, *Catla*, *Labeo*, *Cirrhinus*, *Puntius, Exocoetus*, *Echeneis*, *Anguilla*, *Hippocampus*, *Tetrodon/Diodon*, *Anabas*, Flat fish, *Channa, Notopterus.*
   iv. **Amphibia:** *Necturus, Bufo, Rana, Hyla, Alytes, Axoltl, Tylototriton, Ambystoma.*
   v. **Reptilia:** *Chelone, Trionyx, Hemidactylus, Varanus, Uromastix, Chamaeleon, Ophiosaurus, Draco, Bungarus, Vipera, Naja, Hydrophis, Crocodylus*; Key for identification of poisonous and non-poisonous snakes.
   vi. **Mammalia:** Bat (insectivorous and frugivorous), *Funambulus.*
2. Dissection of brain and pituitary of Labeo, Urino-genital system of Tilapia/Labeo and Pecten from Fowl head (demonstration only).

Group B: Laboratory note book and viva-voce (2+3=5 marks)

Periodic updating of laboratory note book and Viva-voce covering mostly the experimental work allotted during final examination

- **Internal Assessment (Full marks = 10)*)[ZOOL-H-DC3-IA]**

(*To be done by the Concerned College)

ZOOL DC4: Comparative Anatomy of Vertebrates

[Allotted Marks- 50 (Theory: 25+ Practical: 15+ Internal Assessment: 10)]

- **Theory (Full marks = 25))[ZOOL-H-DC4-T]**

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

Unit 2: Skeletal System: Overview of axial and appendicular skeleton; Jaw suspension; Visceral arches.

Unit 3: Digestive System: Comparative anatomy of stomach; Dentition in mammals.

Unit 4: Respiratory System: Respiratory organs in fishes, amphibian, birds and mammals.

Unit 5: Circulatory System: General plan of circulation; Comparative account of heart and aortic arches.

Unit 6: Urinogenital System: Comparative anatomy of kidney; Evolution of urinogenital ducts; Types of mammalian uteri.

Unit 7: Nervous System: Comparative account of brain; Cranial nerves in mammals (Origin distribution and nature)

- **Practical (Full marks = 15) [ZOOL-H-DC4-P]**

Group A: Laboratory experimentation (10 marks)

1. Preparation and study of placoid, cycloid and ctenoid scales through permanent slides/photographs.
2. Study of disarticulated skeleton of toad, pigeon and guinea pig.
3. Identification of mammalian skulls: One herbivorous (Guinea pig) and one carnivorous (Dog) animal, Rana, Bufo, Chelone, Calotes, Pigeon

Group B : Laboratory note book and Viva voce(2+3=5 marks)

Periodic updating of laboratory note book and viva-voce covering mostly the experimental work allotted during examination

- **Internal Assessment (Full marks = 10)* [ZOOL-H-DC4-IA]**

(*To be done by the Concerned College)

ZOOL DC5: Cell Biology and Principles of Genetics

[Allotted Marks- 50 (Theory: 25+ Practical: 15+ Internal Assessment: 10)]

- **Theory (Full marks = 25) [ZOOL-H-DC5-T]**

Group A: Cell Biology (=12.5 marks)

Unit 1: Overview of Cells - Basic structure of prokaryotic and eukaryotic cells, viruses, viroid, Prion.

Unit 2: Plasma Membrane - (i) Ultra structure and composition of plasma membrane: Fluid mosaic model,(ii) Transport across membrane: active and passive transport, facilitated transport.

Unit 3: Cytoplasmic organelles - (i) Structure and functions: Endoplasmic reticulum, Golgi apparatus, Lysosomes, (ii) Protein sorting and mechanisms of vesicular transport, (iii) Mitochondria: Structure and function, semi-autonomous nature, endosymbiotic hypothesis, (iv) Centrosome: Structure and functions

Unit 5: Cytoskeleton - Types, structure and functions of cytoskeleton.

Unit 6: Nucleus - (i) Structure of nucleus: Nuclear envelope, nuclear pore complex, nucleolus, (ii) Chromatin: Euchromatin and hetrochromatin and packaging (nucleosome), (iii) Structure of chromosome, (iv) Introduction to polytene and lampbrush chromosome.

Unit 7: Cell division- (i) Cell cycle and its regulation, (ii) Mitosis and meiosis: Basic process and their significance

Unit 8: Cell Signaling-(i) Cell signaling transduction pathways; Types of signaling molecules and receptors, (ii) GPCR and role of second messenger (cAMP), (iii) Extracellular matrix-cell interactions

Group B: Principles of Genetics (= 12.5 marks)

Unit 1: Mendelian Genetics and its Extension-(i) Principles of inheritance, incomplete dominance and co-dominance, multiple alleles (with special reference to blood group), lethal alleles, pleiotropy, gene interactions, (ii) Sex-linked, sex-influenced and sex-limited inheritance, polygenic inheritance (brief idea).

Unit 2: Linkage, Crossing Over and Chromosomal Mapping-Linkage, somatic crossing over, cytological basis of crossing over, molecular mechanism of crossing over.

Unit 3: Mutations- (i) Types of gene mutations (classification), types of chromosomal aberrations (classification with one suitable example of each), (ii) Non-disjunction and variation in chromosome number

Unit 4: Sex Determination: (i) Mechanisms of sex determination in *Drosophila, (ii)* Sex determination in human, (iii) Dosage compensation in *Drosophila* & human

Unit 5: Extra-chromosomal Inheritance and Maternal effect- (i) Criteria for extra chromosomal inheritance, (ii) Kappa particle in *Paramoecium, (iii)* Shell spiralling in snail.

Practical (Full Marks = 15) [ZOOL-H-DC5-P]

Group A: Laboratory experimentation (=10 marks)

1. Preparation of temporary stained squash of onion root tip to study various stages of mitosis
2. Study of various stages of meiosis from grasshopper testis.
3. Preparation of permanent slide to demonstrate: DNA by *Feulgen* reaction and cell viability study by trypan blue staining.
4. Permeability of plasma membrane: Effect of isotonic, hypotonic and hypertonic solutions on RBC.
5. Measurement of cell diameter by stage and ocular micrometer and drawing by camera lucida.
6. Cytochemical demonstration (Preparation of permanent slides). (i.)DNA by Feulgen reaction. (ii). Mucopolysaccharides by PAS reaction. (iii). Proteins by Mercurobromophenol blue. (iv). DNA and RNA by Methyl Green Pyronin
7. Chi-square analyses (based on dihybrid cross).
8. Identification of chromosomal aberration in *Drosophila* and human (by photograph).
9. Identification of various mutants of *Drosophila*. (by photographs only)
10. Linkage maps based on data from crosses of *Drosophila*.(based on the three point test crosses)
11. Pedigree analysis of some human inherited trait from the supplied data.
12. Study of human karyotype **(Subject to UGC guideline).**
13. Test for colour blindness in human from provided diagrams/ charts.

Group B: Laboratory note book and Viva voce(2+3= 5 marks)

Periodic updating of laboratory note book and viva-voce covering mostly the experimental works allotted during examination

Internal Assessment (Full marks = 10)* [ZOOL-H-DC5-IA]

(*To be done by the Concerned College)

ZOOL DC6: Ecology and Conservation Biology

[Allotted Marks- 50 (Theory 25+ Practical 15+ Internal Assessment 10)]

Theory (Full marks = 25) [ZOOL-H-DC6-T]

Group A: Perspective of Ecology (= 12.5 marks)

Unit 1: Introduction to Ecology- History of ecology, autecology and synecology, levels of organization, laws of limiting factors, limiting factors: temperature and light.

Unit 2: Population-(i) Population density, natality, birth rate and mortality,(ii) Unique and group attributes of population: demographic factors, life tables, fecundity tables, survivorship curves, dispersal and dispersion,(iii) Geometric, exponential and logistic growth, equation and patterns, *r* and *k* strategies, population regulation - density-dependent and independent factors, (iv) Population interactions, Gause's principle with laboratory and field examples, Lotka-Volterra equation for competition, intra- and inter-specific interaction.

Unit 3: Community- (i) Community characteristics: Species diversity, abundance, dominance, richness, diversity indices, (ii) Vertical stratification, ecotone and edge effect, ecological succession with example.

Unit 4: Structure of Ecosystem -(i) Types of ecosystem with examples in details, 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. (ii) Nutrient and biogeochemical cycles with an example of nitrogen cycle.

Group B: Conservation Biology (= 12.5 marks)

Unit 1: Introduction to Biodiversity & Conservation- Types and level of biodiversity, Mega-biodiversity countries, Biodiversity Hotspots, Flagship species, Keystone species, Wild life conservation (*In-situ* and *ex-situ* conservation), Concept of protected areas, Red data book, IUCN categories, Indian Wildlife act-1972 and schedule. Importance and

values of wild life causes of depletion of wild life and related conservation strategies of Tiger, Gibbon, Lion and Rhino.

Unit 2: Man and Wildlife- Causes and consequences of human-wildlife conflicts; mitigation of conflict – an overview; management of excess population.

Practical (Full Marks = 15) [ZOOL-H-DC6-P]

Group A: Laboratory experimentation (= 10 marks)

1. Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided.
2. Determination of population density in a natural/hypothetical community by quadrate method and calculation of Shannon-Weiner diversity index for the same community.
3. Study of an aquatic ecosystem: Estimation of population density of phytoplankton and zooplankton, measurement of area, temperature, turbidity/penetration of light, determination of pH, and dissolved oxygen content (Winkler's method), chemical oxygen demand, CO_2 and alkalinity.
4. Report on a visit to National park/Biodiversity park/Wild life sanctuary/ Biodiversity study of any place of ecological interest.

Group: B : Laboratory note book and Viva voce (2+3=5 marks)

Periodic updating of laboratory note book and Viva-voce covering mostly the experimental works allotted during final examination.

Internal Assessment (Full marks = 10)* [ZOOL-H-DC6-IA]

(*To be done by the Concerned College)

ZOOL CC7: Developmental Biology and Reproductive Biology

[Allotted Marks- 50 (Theory: 25+ Practical: 15+ Internal Assessment: 10)]

Theory (Full marks = 25) [ZOOL-H-DC7-T]

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 in sea urchin, role of yolk in cleavage, blocks to

polyspermy; planes and patterns of cleavage; fate maps (frog and chick); 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 chick, placenta (structure, types and functions of placenta)

Unit 4: Post Embryonic Development-(i) Development of brain and eye in chick, (ii) Regeneration: Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each).

Unit 5: Implications of Developmental Biology-(i) Teratogenesis: Teratogenic agents and their effects on embryonic development; in vitro fertilization, stem cell (ESC), amniocentesis

Unit 6: **Reproductive Endocrinology-** (i) Mechanism of action of steroids and glycoprotein hormones. hypothalamo – hypophyseal – gonadal axis, regulation of gonadotrophin secretion in human (male and female),(ii) Reproductive system: development and differentiation of gonads, genital ducts and external genitalia.

Unit 7: Reproductive Health- (i) Infertility in male and female: causes, diagnosis and management, (ii) Assisted reproductive technology: sex selection, sperm banks, frozen embryos, in vitro fertilization,(iii) Modern contraceptive technologies

Practical (Full marks = 15) [ZOOL-H-DC7-P]:

Group A: Laboratory Experimentation (= 10 marks)

1. **Study of whole mounts** of developmental stages of chick through permanent slides: Primitive streak 24, 48, 72, and 96 hours of incubation
2. **Study of the developmental stages** and life cycle of *Drosophila* from stock culture.
3. Study of different sections of placenta (photomicropgraph/slides).
4. **Project report** on *Drosophila* culture/Chick embryo development/ Metamorphosis of Frog **(Subject to UGC guideline)**.
5. **Study of live gametes** of white rat **(Subject to UGC guideline)**.
6. **Examination of vaginal smear from rats (Subject to UGC guideline).**
7. **Examination of histological sections** from photomicrographs/permanent slides of rat/human: testis, epididymis and accessory glands of male reproductive systems; Sections of ovary, fallopian tube **(Subject to UGC guideline).**

Group: B : Laboratory note book and Viva voce (2+3 = 5marks)

Periodic updating of laboratory note book and Viva-voce covering mostly the experimental works allotted during final examination.

Internal Assessment (Full marks = 10) [ZOOL-H-DC7-IA]*

(*To be done by the Concerned College)

ZOOL DC8: Biochemistry

[Allotted Marks- 50 (Theory: 25+ Practical: 15+ Internal Assessment: 10)]

Theory (Full marks = 25 marks) [ZOOL-H-DC8-T]

Unit 1: Carbohydrates - (i) Structure and biological importance: Monosaccharides, disaccharides, polysaccharides; Derivatives of monosachharides,(ii) Carbohydrate metabolism: Glycolysis, citric acid cycle, pentose phosphate pathway, gluconeogenesis, glycogenolysis and neoglucogenesis

Unit 2: Lipids - (i) Structure and significance: Physiologically important saturated and unsaturated fatty acids, tri-acylglycerols, phospholipids, sphingolipid, glycolipids, steroids, eicosanoids and terpinoids, (ii) Lipid metabolism: β-oxidation of fatty acids.

Unit 3: Proteins - (i) Amino acids: Structure, classification, general properties of α-amino acids; Physiological importance of essential and non-essential amino acid, (ii) Proteins: Bonds stabilizing protein structure; Levels of organization; Classification of protein , Protein metabolism: Transamination, deamination, urea cycle, fate of c-skeleton of glucogenic and ketogenic amino acids.

Unit 4: Nucleic Acids - (i) Structure: Purines and pyrimidines, nucleosides, nucleotides, nucleic acids ,(ii) Basic concept of nucleotide metabolism.

Unit 5: Enzymes - (i) Nomenclature and classification; Cofactors and co-enzymes; Specificity of enzyme action; Isozymes, (ii) Mechanism of enzyme action; Enzyme kinetics; derivation of Michaelis-Menten equation, Lineweaver-Burk plot,(iii) Factors affecting rate of enzyme-catalyzed reactions; Enzyme inhibition; Regulatory enzymes.

Unit 6: Oxidative Phosphorylation- Redox systems; Review of mitochondrial respiratory chain, inhibitors and un-couplers of electron transport system.

Practical (Full marks = 15) [ZOOL-H-DC8-P]

Group A: Laboratory experimentation (= 10marks)

1. Qualitative tests of carbohydrates, proteins and lipids.
2. Paper chromatography of amino acids.
3. Colour tests of functional groups in protein solutions.
4. Quantitative estimation of Protein by Lowry Method
5. Demonstration of proteins separation by SDS-PAGE.
6. To study the salivary amylase action.
7. Effect of pH on the action of salivary amylase.
8. To perform the Acid and Alkaline phosphatase assay from serum/ tissue.

Group: B : Laboratory note book and Viva voce (2+3 = 5marks)

Periodic updating of laboratory note book and viva-voce covering mostly the experimental works allotted during final examination.

Internal Assessment (Full marks = 10)* [ZOOL-H-DC8-IA]

(*To be done by the Concerned College)

ZOOL DC9: Animal Physiology: Life sustaining system (Full marks = 50)

(Allotted Marks- 50 Theory: 25+ Practical: 15+ Internal Assessment: 10)

Theory (Full marks = 25) [ZOOL-H-DC9-T]

Unit 1: Tissues - (i) Structure, location, classification and functions of epithelial tissue, connective tissue, muscular tissue and nervous tissue.

Unit 2: Bone and Cartilage -Structure and types of bones and cartilages, ossification

Unit 3: Nervous System - Structure of neuron, resting membrane potential, origin of action potential and its propagation across the myelinated and unmyelinated nerve fibers; Types of synapse, synaptic transmission and neuromuscular junction; Reflex action and its types

Unit 4: Muscular system - Ultra structure of skeletal muscle; Characteristics of muscle fiber; Molecular and chemical basis of muscle contraction; Characteristics of muscle fibre

Unit 5: Physiology of Respiration - Mechanism of breathing, respiratory volumes and capacities, transport of oxygen and carbon dioxide in blood, dissociation curves and the factors influencing it, respiratory pigments; carbon monoxide poisoning, control of transpiration

Unit 6: Physiology of Circulation - Components of blood and their functions; structure and functions of haemoglobin; haemostasis; blood clotting system, fibrinolytic system; haemopoiesis; basic steps and its regulation.

Unit 7: Physiology of Heart - Structure of mammalian heart, coronary circulation, structure and working of conducting myocardial fibres, origin and conduction of cardiac impulses; ECG, cardiac cycle and cardiac output; blood pressure and its regulation

Unit 8: Thermoregulation & Osmoregulation - Physiological classification based on thermal biology; thermoregulation of homeotherms; osmoregulation in aquatic vertebrates; extra renal osmoregulatory organs in vertebrates.

Unit 9: Renal Physiology - Histology of kidney and nephrons, mechanism of urine formation, glomerular filtration, tubular secretion, plasma clearance and counter current mechanism

Practical (Full marks = 15) [ZOOL-H-DC9-P]

Group A: Laboratory experimentation (=10 marks)

1. Recording of simple muscle twitch with electrical stimulation (or virtual representation).
2. Demonstration of the unconditioned reflex action (deep tendon reflex such as knee jerk reflex).
3. Preparation of temporary mounts: Squamous epithelium, striated muscle fibres and nerve cells **(Subject to UGC guideline)**.
4. Study of permanent slides of mammalian skin, cartilage, bone, spinal cord, nerve cell, pituitary, pancreas, testis, ovary, adrenal, thyroid and parathyroid.
5. Microtomy: Preparation of permanent slide of any five mammalian (goat/white rat) tissue **(Subject to UGC guideline).**

6. Recording of frog's heart beat under in situ and perfused condition**(Subject to UGC guideline)** .
7. Differential Count (D.C).
8. Enumeration of red blood cells and white blood cells using haemocytometer (T.C).
9. Estimation of haemoglobin using Sahli's haemoglobinometer.
10. Preparation of haemin and haemochromogen crystals.
11. Recording of blood pressure using a sphygmomanometer.
12. C.T/B.T

Group B : Laboratory note book and Viva voce (2+3= 5marks)

Periodic updating of laboratory note book and viva-voce covering mostly the experimental works allotted during final examination.

Internal Assessment (Full marks = 10)* [ZOOL-H-DC9-IA]

(*To be done by the Concerned College)

ZOOL DC10: Systematics and Evolution (Full marks = 50)

[Allotted Marks- 50 (Theory: 25+ Practical: 15+ Internal Assessment: 10)]

Theory (Full marks = 25) [ZOOL-H-DC10-T]

Group A: Systematics (=12.5 marks)

Unit 1: Definition of taxonomy, micro- and macro taxonomy, systematic, Linnean hierarchy, cladistics, hierarchy, taxonomic types

Unit 2: Principles of Binomial nomenclature.

Unit 3: Species concept: Types and modes, type concept, primary and secondary types- definition and application.

Unit 4: General idea and code of zoological nomenclature, principles of priority, synonym and homonym.

Unit 5: Cytological, biochemical and molecular taxonomy: Basic ideas.

Group B: Evolution (=12.5marks)

Unit 1: Evidences of organic evolution- Study of comparative anatomy, embryology, paleontology, biochemistry, physiology and molecular biology.

Unit 2 : Origin of life, chemogeny, RNA world

Unit 3: Historical review of evolutionary concepts, Lamarkism, Darwinism and natural selection and Neo-Darwinism

Unit 4: Geological time scale, Evolution of horse.

Unit 5: Sources of variations and their role in evolution.

Unit 6 : Population genetics- Hardy-Weinberg law (statement and derivation of equation, application of law to human population); genetic drift mechanism (founder's effect, bottleneck phenomenon).

Unit 7: Species- Species concept, isolating mechanisms, modes of speciation; adaptive radiation/macroevolution (exemplified by mammals and Galapagos finches).

Unit 8: Abolition of species- Extinctions, Back ground and mass extinctions (causes and effects), detailed example of K-T extinction.

Unit 9: Animal distribution- Pattern of animal distribution, factors affecting animal distribution, zoogeographical realms and their faunal peculiarities; Plate tectonic and continental drift theory.

Practical (Full marks = 15) [ZOOL-H-DC10-P]

Group A: Laboratory experimentation (=10 marks)

1. **Cladistic analysis** on the supplied data.
2. **Morphometric analysis** of the wing, antenna, leg of insect for taxonomic categorization.
3. **Analysis of RFLP and RAPD** data in connection with molecular taxonomy on supplied data.
4. **Allozyme analysis** in relation to morphology and taxonomy
5. **Dichotomous key** preparation for insect identification at genus level
6. **Mapping of the distribution** of endangered species on supplied data.
7. **Study of homology** and analogy from suitable specimens

8. **Study of fossils** from models / pictures.
9. Study and verification of Hardy-Weinberg Law by chi-square analysis.
10. Graphical representation and interpretation of data of height/ weight of a sample of 100 humans in relation to their age and sex.
11. Distribution of animals in Zoogeographical realm by map pointing method.
12. Pedigree analysis of some human inherited traits.

Group: B - Laboratory note book and Viva voce (2+3= 5marks)

Periodic updating of laboratory note book and viva-voce covering mostly the experimental works allotted during examination.

Internal Assessment (Full marks = 10)* [ZOOL-H-DC10-IA]

(*To be done by the Concerned College)

ZOOL DC11: Histology and Endocrinology

(Allotted Marks- 50 (Theory: 25+ Practical: 15+ Internal Assessment: 10)

Theory (Full marks = 25) [ZOOL-H-DC11-T]

Unit1: Muscular system-Histology of different types of muscle, Ultra structure of skeletal muscle.

Unit:2: Histo-architechture of liver and its function.

Unit 3: Introduction to Endocrinology- General idea of endocrine systems, classification, characteristic and transport of hormones, neurosecretions and neurohormones.

Unit 4: Epiphysis, Hypothalamo-hypophysial Axis-(i) Structure of pineal gland, secretions and their functions in biological rhythms and reproduction, (ii) Structure and functions of hypothalamus and hypothalamic nuclei, regulation of neuro-endocrine glands, feedback mechanisms, (iii) Structure of pituitary gland, hormones and their functions, hypothalamo-hypophysial portal system, disorders of pituitary gland.

Unit 5: Peripheral Endocrine Glands- (i) Structure, hormones, functions and regulation of thyroid gland, parathyroid, adrenal, pancreas, ovary and testis, (ii) Hormones in homeostasis, disorders of endocrine glands.

Unit 6: Regulation of Hormone Action- (i) Mechanism of action of steroidal, non-steroidal hormones with receptors, (ii)Bioassays of hormones using RIA & ELISA,(iii) Estrous cycle in rat and menstrual cycle in human, (iv) Multifaceted role of vasopressin & oxytocin. hormonal regulation of parturition.

Unit 7: Functional anatomy of male and female reproductive system-(i) Histo-architechture of testis and ovary, Steroidogenesis and functions of different testicular and ovarian hormone.

Practical (Full marks = 15) [ZOOL-H-DC11-P]:

Group: A –Laboratory Experimentation (= 10 marks)

1. Study of animal house: set up and maintenance of basic animal house, breeding techniques, care taken for normal and experimental animals.
2. Examination of vaginal smear rats from live animals **(Subject to UGC guideline)**.
3. Tissue fixation, embedding in paraffin, microtomy and slide preparation of any endocrine gland **(Subject to UGC guideline)**.
4. Examination of sections of mammalian skin, Cartilage, Bone, Spinal cord, Nerve cell, Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid **(Subject to UGC guideline).**
5. Examination of histological sections from photomicrographs/ permanent slides of rat/human: testis, epididymis and accessory glands of male reproductive systems; Sections of ovary, Fallopian tube, Uterus **(Subject to UGC guideline)**.
6. Double staining of prepared histological slides **(Subject to UGC guideline)**.
7. Dissect and display of endocrine glands in laboratory bred rat **(Subject to UGC guideline).**
8. Study of the permanent slides of all the endocrine glands **(Subject to UGC guideline)**.
9. Tissue fixation, embedding in paraffin, microtomy and slide preparation of any endocrine gland **(Subject to UGC guideline)**.
10. Estimation of plasma level of any hormone using ELISA.
11. Designing of primers of any hormone.

Group B- Laboratory note book and Viva voce (2+3= 5marks)

Periodic updating of laboratory note book and Viva-voce covering mostly the experimental works allotted during the final examination.

Internal Assessment (Full marks = 10)* [ZOOL-H-DC11-IA]

(*To be done by the Concerned College)

Paper ZOOL DC12: Economic Zoology and Industrial Zoology

[Allotted Marks- 50 (Theory: 25+ Practical: 15+ Internal Assessment: 10)]

Theory (Full marks = 25) [ZOOL-H-DC12-T]

Unit 1: **Aquaculture:** Composite fish culture, Induced breeding of fish, types of hatcheries, Prawn culture (Fresh Water), Pearl culture, Fish diseases

Unit 2: **Elementary idea on Agricultural insect pests** : Categorization of insect pests; basic idea on economic threshold level (ETL) and economic injury level (EIL).

Unit 3: **Major insect pests**: Life history, damage and control measures of the following pests *a) Leptocorisa* sp.,*b) Scirpophaga* sp *c) Anomis* sp. *d) Autocharis* sp. *e) Sitophilus oryzae*

Unit 4: **IPM and Insect Pest Management**-Elementary idea about IPM, components, strategy and approaches, pest surveillance, sampling methods and forecasting. Elementary idea about GMO and its application on pest management.

Unit 5: **Insecticides**: Types of insecticides, insecticide residues in food stuff, phyto-toxicity due to insecticide application, first aid antidotes. Evaluation of insecticide toxicity, insecticide synergism, potentiation and antagonism, insect pest resurgence, bio-rational insecticides.

Unit 6: **Animal Husbandry**: Types of Cattle breeds, Artificial insemination.

Unit 7: **Poultry Farming:** Types of poultry breeds, management of breeding stocks and broiler, poultry diseases and control.

Unit 8: **Preservation of fish:** Causes of fish spoilage and prevention (Drying. Salting pickling and smoking, freezing) use of ice in storage, Harvest limit for sustainable fishery.

Unit 9: **Processing of lac, silk and honey:** Study on the life cycle of lac insect, silk moth and honey bee and their enemies. Process of production of lac, silk and honey at commercial level and preservation techniques.

Practical (Full marks = 15) [ZOOL-H-DC12-P]

Group A : Laboratory Experimentation (= 10 marks)

1. Identification of different types of bees (Queens, Drones and Worker bees) with characters.
2. Identification of different types of silk moths with characters.
3. Identification of different types of pearls with characters.
4. Identification of different types of fish diseases with characters.
5. Identification of different types of scales in fishes with characters.
6. Identification of different types of fins with characters.
7. Study of different modified structures of fishes (Saw of sawfish, Hammer of hammer head fish, tail of sharks etc.).
8. Identification of various types of natural silks.
9. Visit to a sericulture farm/ poultry farm/ apiary.

Group B : Laboratory note book updating and Viva voce (2+3=5 marks)

Periodic updating of laboratory note book and Viva-voce covering mostly the experimental works allotted during final examination.

Internal Assessment (Full marks = 10)* [ZOOL-H-DC12-IA]

(*To be done by the Concerned College)

ZOOL DC13: Parasitology and Immunology

[Allotted Marks- 50 (Theory: 25+ Practical: 15+ Internal Assessment: 10)]

Theory (Full marks = 25) [ZOOL-H-DC13-T]

Group A: Parasitology (=12.5 marks)

Unit 1: Introduction to parasitology- Brief introduction of Parasitism, Parasite, Parasitoid and Vectors (mechanical and biological vector) Host parasite relationship.

Unit 2: Parasitic Protists: Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Giardia intestinalis*, *Trypanosoma gambiense*, *Leishmania donovani.*

Unit 3: Parasitic Platyhelminthes: Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Schistosoma haematobium*, *Taenia saginata.*

Unit 4: Parasitic Nematodes: Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Ancylostoma duodenale*, and *Trichinella spiralis*, *Brugia malayi*, *Meloidogyne incognita*, *Heterodera rostochiensis*-Life-Cycle, symptoms and control.

Unit 5: Parasitic Arthropods: Biology, importance and control of Ticks, Mites, Lice, Flea and Bug.

Group B: Immunology(=12.5 marks)

Unit 1: Overview of Immune System- Cells and organs of the immune system

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.

Unit 4: Immunoglobulins-Structure and functions of different classes of immunoglobulins, antigen- antibody interactions, immunoassays (ELISA and RIA), generation of antibody diversity, clonal selection and immunological memory

Unit 5: Major Histocompatibility Complex-MHC genes and genes products; endogenous and exogenous pathway of antigen processing presentation; structure of T cell receptor and its signalling, T cell development & selection

Unit 6: Complement System: Components and pathways of complement activation and its biological effect.

Unit 7: Hypersensitivity: Gell and Coombs' classification and brief description of various types of hypersensitivities.

Unit 8: Immunity and cell activation: Humoral immunity; Cell activation and production of antibody.

Practical (Full marks = 15) [ZOOL-H-DC13-P]

Group A : Laboratory Experimentation (= 10 marks)

1. Study of life stages of *Giardia intestinalis, Trypanosoma gambiense* and *Leishmania donovani* through permanent slides/micro photographs.
2. Study of adult and life stages of *Schistosoma haematobium* and *Taenia saginata* through permanent slides/micro photographs.
3. Study of adult and life stages of *Ancylostoma duodenale, Brugia malayi* and *Trichinella spiralis* through permanent slides/micro photographs.
4. Study of *Pediculus humanus*, *Xenopsylla cheopis* and *Cimex lectularius* through permanent slides/ photographs.
5. Study of nematode/cestode parasites from the intestines of Poultry bird (Intestine can be procured from poultry/market as a by-product).
6. Submission of a brief report on parasitic vertebrates.
7. Study of rectal parasites of *Periplaneta* sp. / *Bufo* sp.
8. Demonstration of lymphoid organs.
9. Histological study of spleen, thymus and lymph nodes through slides/ photographs
10. Preparation of stained blood film to study various types of blood cells.
11. Antigen antibody reaction by immune-diffusion.
12. Demonstration of ELISA.
13. Determination of human blood group.

Group B : Laboratory note book and Viva voce (2+3= 5 marks)

Periodic updating of laboratory note book and viva-voce covering mostly the experimental works allotted during final examination.

Internal Assessment (Full marks = 10)* [ZOOL-H-DC13-IA]

(*To be done by the Concerned College)

ZOOL DC14: Molecular Biology

[Allotted Marks- 50 (Theory: 25+ Practical: 15+ Internal Assessment: 10)]

Theory (Full marks = 25) [ZOOL-H-DC14-T]

Unit 1: Nucleic Acids-Salient features of DNA and RNA; DNA/RNA as genetic material, Watson and Crick Model of DNA, Structure of t-RNA

Unit 2: DNA Replication-Semi-conservative DNA Replication, DNA Replication in Prokaryotes, Replication of telomeres.

Unit 3: Transcription-Mechanism of Transcription in prokaryotes and eukaryotes, Difference between prokaryotic and eukaryotic transcription, Post transcriptional processing of eukaryotic RNA, split genes, processing of rRNA and tRNA.

Unit 4: Translation-Genetic code, Degeneracy of the genetic code and Wobble Hypothesis; Mechanism of protein synthesis in prokaryotes, Inhibitors of protein synthesis; Difference between prokaryotic and eukaryotic translation.

Unit 5: Gene Regulation-Regulation of Transcription in prokaryotes: *lac* operon and *trp* operon; Basic idea about epigenetics in gene regulation.

Unit 6: Gene Mutation-Molecular basis of gene mutation in relation to spontaneous mutation and physical and chemical mutagens.

Unit 7: DNA Repair Mechanisms-Photo-reactivation nucleotide and base excision repair, SOS response.

Unit 8: Cancer Biology- Concepts of proto oncogenes and oncogenes, Activation of proto oncogenes to oncogenes , Properties of cancer cells, Study of Retrovirus and oncogene (Ras) mediated cancer. Tumor suppressor genes with special reference to p^{53} and retinoblastoma. Apoptosis and necrosis.

Unit 9: Molecular Techniques-PCR, Western and Southern blot, Northern Blot, DNA sequencing, DNA finger printing.

Practical (Full marks = 15) [ZOOL-H-DC14-P]

Group: A : Laboratory Experimentation(= 10marks)

1. Demonstration of polytene and lampbrush chromosome from photograph / Chironomus larvae.

2. Isolation and quantification of genomic DNA using spectrophotometer (A_{260} measurement).
3. Agarose gel electrophoresis for DNA.
4. Preparation of models of Nitrogenous bases, nucleosides, nucleotides and polynucleotide chain.
5. C-banding of chromosome.

Group: B : Laboratory note book and Viva voce (2+3= 5 marks)

Periodic updating of laboratory note book and viva-voce covering mostly the experimental work allotted during examination.

Internal Assessment (Full marks = 10)* [ZOOL-H-DC14-IA]

(*To be done by the Concerned College)

Discipline Specific Electives(DSE) in Zoology (H)

ZOOL DSE: 1 Animal Biotechnology (OR) Microbiology

ZOOL DSE: 1A Animal Biotechnology

[Allotted Marks- 50 (Theory: 25+ Practical: 15+ Internal Assessment: 10)]

Theory (Full marks 25) [ZOOL-H-DSE-IA-T]

Unit 1: Introduction: Organization of prokaryotic and eukaryotic genome, Concept of genomics.

Unit 2: Molecular Techniques in Gene manipulation: (i) Cloning vectors: Plasmids, Cosmids, Phagemids, Lambda Bacteriophage, M13, BAC, YAC, HAC and cloning of genes by using these vectors. Expression vectors. Restriction endonucleases, (ii) Construction of genomic and cDNA libraries and screening by colony and plaque hybridization,(iii) Southern, Northern and Western blotting, (iv) DNA sequencing: Maxam Gilbert and Sanger method, (v) Polymerase Chain Reaction, DNA Finger Printing and DNA microarray.

Unit 3: Genetically Modified Organisms: (i) Production of cloned and transgenic animals: Nuclear Transplantation, Retroviral mediated gene delivery method, DNA microinjection, (ii) Applications of transgenic animals: Production of pharmaceuticals, production of donor organs, knockout mice.

Unit 4: Cell Culture Techniques and Applications: (i) Animal cell culture, Expressing cloned genes in mammalian cells, Molecular diagnosis of genetic diseases (Thalassemia, Sickle cell anemia)

Unit 5: **Immuno Biotechnology** :(i)Hybridoma technology, monoclonal anibody and its applications, (ii) Various types of vaccines; active and passive immunization.

Practical (Full marks 15) [ZOOL-H-DSE-IA-P]

Group: A: Laboratory experimentation (= 10 marks)

1. Genomic DNA isolation from *E.coli.*
2. Plasmid DNA isolation (pUC 18/19) from *E.Coli.*
3. Construction of circular and linear restriction map from the data provided.

4. Calculation of transformation efficiency from the data provided.
5. To study the following techniques by photographs and documentation- (a)Southern Blotting , (b) Northern Blotting, (c) Western Blotting, (d) DNA Sequencing (Sanger's Method), (e) PCR, (f) DNA fingerprinting
6. Seminar on tools and techniques of biotechnology (Topics to be decided by the concern college teachers).

Group: B: Laboratory note book and Viva voce (2+3= 5marks)

Periodic updating of laboratory note book and viva-voce covering mostly the experimental work allotted during examination.

Internal Assessment (Full marks = 10)* [ZOOL-H-DSE-1A-IA]

(*To be done by the Concerned College)

(OR)

ZOOL DSE: 1B Microbiology

[Allotted Marks- 50 (Theory: 25+ Practical: 15+ Internal Assessment: 10)]

Theory (Full Marks 25) [ZOOL-H-DSE-1B-T]

Unit 1: Introduction to Microbiology-Historical perspective of Microbiology, prokaryotic pathogens, eukaryotic pathogens.

Unit 2: Bacterial taxonomy-Principles and modern approaches of bacterial taxonomy. Basic idea about Hackel and Whittaker's kingdom concept and domain concept of Carl Woese.

Unit 3: Morphology of Bacteria and Virus-Cell wall (Structure of peptidoglycan), Cell envelope (Cell membrane, Differences between gram-positive and gram-negative species, External capsule and glycocalyx, Plasmids and episomes. Nuclear material, Bacterial Chromosome (Fundamental differences with eukaryotic chromosome); Structural organization of viruses, Prions and viroids.

Unit 4: Normal flora-Distribution of normal flora in the body: Skin, eye, mouth, intestinal tract, Urino-genital tract; Beneficial functions of normal flora; Harmful effects of normal flora.

Unit 5: Pathogenicity of Microorganisms- Bacterial pathogenesis: Entry to the host, Adherence to host cells, Invasiveness; Bacterial toxins: Exotoxins, Endotoxins, Antigenic switching; Viral Pathogenesis: Cellular level (Cell death, Transformation, Cell fusion, Cytopathic effect), Initial infections, Routes of entry and dissemination to secondary sites, Typical secondary sites of localization, Virus shedding and mode of transmission; Factors involved in termination of acute infection.

Unit 6: Infection of pathogens to human populations-Communicable, Non-communicable, Endemic, Epidemic, Pandemic and Sporadic classes.

Unit 7: Diagnostic Microbiology and Bacteria culture-Koch's postulates, Sensitivity and specificity of test results, Principles and applications: Simple staining, Gram-staining, Acid-fast staining, Collection of specimens, Growth requirements and Growth factors, Oxygen requirement. Culture Media: Simple media, Complex media, Selective media and Enriched media.

Unit 8: Genetic recombination in bacteria-Transformation, Conjugation- F+, F-, `Hfr& F' strain, Transduction, Generalised& specialized types.

Unit 9: Microbial Diseases-Name of pathogen, clinical symptoms, pathogenesis & preventive measures of Bacterial (Typhoid, Staphylococcal Food Poisoning) and Viral (Dengue, AIDS, Polio) infection to humans.

Practical (Full marks 15) [ZOOL-H-DSE-1B-P]

Group A: Laboratory experimentation (= 10marks)

1. Gram's staining and spore staining of bacteria.
2. Preparation of liquid media (broth) and solid media for routine cultivation of bacteria; preparation of slant and stab.
3. Pure culture techniques: replica plate, pour plate and streak plate.

4. Biochemical test for characterization of bacteria: catalase, nitrate-reduction, methyl red and Voges-Poskauer test oxidase, indole and citrate tests.
5. Sugar fermentation test for glucose, sucrose, lactose and mannitol.
6. Microbiological examination of milk (methylene blue reductase Test).

Group B: Laboratory note book and Viva voce (2+3= 5marks)

Periodic updating of laboratory note book and viva-voce covering mostly the experimental works allotted during examination.

Internal Assessment (Full marks = 10)* [ZOOL-H-DSE-1B-IA]
(*To be done by the Concerned College)

ZOOL DSE: 2 Biostatistics (OR) Bioinformatics

(Allotted Marks- 50 (Theory: 25+ Practical: 15+ Internal Assessment: 10)

Paper ZOOL DSE: 2A Biostatistics

Theory (Full marks 25) [ZOOL-H-DSE-2A-T]

1. Basic idea on variables, frequency distribution and sampling.
2. Measures of central tendency: mean, median, mode.
3. Measures of distributions: variance, standard deviation and standard error—problems and application.
4. Test of significance: t-test, ANOVA, Chi-square test.
5. Correlation and regression analysis.
6. Probability distribution and significance.

Practical (Full parks 15) [ZOOL-H-DSE-2A-P]

Group A: Experimentation (= 10marks)

1. Frequency distribution, bar diagram, histogram, Pie diagram, Cumulative frequency curve, Principal Component analysis, Correlation matrix
2. Chi-square test, t-test, ANOVA, Correlation analysis from data provided.

Group: B: Laboratory note book and Viva voce (2+3= 5marks)

Periodic updating of laboratory note book and viva-voce covering mostly the experimental work allotted during examination.

Internal Assessment (Full marks = 10)* [ZOOL-H-DSE-2A-IA]

(*To be done by the Concerned College)

(OR)

ZOOL DSE: 2 B Bioinformatics

[Allotted Marks- 50 Theory: 25+ Practical: 15+ Internal Assessment: 10)]

Theory (Full Marks 25) [ZOOL-H-DSE-2B-T]

Unit 1: The computer-History and development of computer, generation of computer

Unit 2: Classification of computer-Analog computers, digital computers, mainframe computers, structure of digital computers, arithmetic unit, Central unit, Memory unit, input unit and output unit.

Unit 3: Computer coding-Number system, decimal number system, binary number system, binary to decimal conversion, binary arithmetic, Octal number system, Hexadecimal number system

Unit 4: Internet and related programme-WWW, HTML,HTTP,telnet, FTP, Computer domain

Unit 5: Proteomics-Protein sequence information, composition and properties, Physiochemical properties based on sequence, sequence comparison

Unit 6: Sequencing-Pairwise sequence alignment, gaps, gap-penaltiesscoring matrices, PAM250, BLOSUM62,local and global sequence alignment, multiple sequence alignment, useful programs, ClustalW,BLASTp.

Unit 7: Phylogeny-Phylogenetic analysis of evolutionary consequences, elements of phylogeny, methods of phylogenetic analysis,Phylogenetic tree of life, Comparison of genetic sequence of organisms, idea of phylogenetic analytical tools- Phylip.

Practical (=15 marks) [ZOOL-H-DSE-2B-P]

Group: A: Laboratory xperimentation (= 10marks)

1. Idea on Nucleotide sequences data bases: EMBL, DDBJ, gene bank, protein sequence data base –Swiss Prot, PIR
2. NCBI, EBI, RasMol, Clustal X (basic idea only).
3. Construction of phylogenetic tree with bioinformatics tools (Clustal X and Phylip).
4. Sequence alignment and analysis using software

Group: B: Laboratory note book and Viva voce (2+3= 5marks)

Periodic updating of laboratory note book and viva-voce covering mostly the experimental work allotted during examination.

Internal Assessment (Full marks = 10)* [ZOOL-H-DSE-2B-IA]

(*To be done by the Concerned College)

Paper ZOOL DSE: 3 Animal Behaviour and Chronobiology (OR) Toxicology, Environmental Biology and Public Health

Paper ZOOL DSE: 3A Animal Behaviour and Chronobiology

[Allotted Marks- 50 (Theory 25+ Practical 15+ Internal Assessment 10)]

Theory (Full marks 25) [ZOOL-H-DSE-3A-T]

Unit 1: Introduction to Animal Behaviour-Origin and history of ethology, brief profiles of Karl Von Frish, Ivan Pavlov, Konrad Lorenz, Niko Tinbergen, proximate and ultimate causes of behaviour, methods and recording of a behavior.

Unit 2: Patterns of Behaviour-Stereotyped behaviours (orientation, reflexes); individual behavioural patterns; instinct vs. learning behaviour; associative learning, classical and operant conditioning, habituation, imprinting.

Unit 3: Social and Sexual Behaviour- (i) Social Behaviour: Concept of society; communication and the senses, (ii)Altruism: Insects' society with honey bee as example; foraging and communication system in honey bees, (iii) Sexual Behaviour: Asymmetry of sex, sexual dimorphism, mate choice, intra-sexual selection (male rivalry), inter-sexual selection (female choice), sexual conflict in parental care, (iv)Parental care in Fish and Amphibia

Unit 4: Migratory behaviour, Migration in fish and bird

Unit 5: Introduction to Chronobiology-Biological clock, adaptive significance of biological clocks

Unit 6: Biological Rhythm-Circadian rhythm and lunar periodicity, photoperiodic and regulation of seasonal reproduction, role of melatonin.

Practical (Full Marks 15) [ZOOL-H-DSE-3A-P]

Group A: Laboratory experimentation (=10 marks)

1. **Study of the 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 the phototaxis** behaviour in insect larvae.
4. **Visit** to Forest/ Wild life sanctuary/Biodiversity park/Zoological park/Wetland/ to study behavioural activities of animals and prepare a short report.
5. **Study of behavioural activity** of domestic animals and preparation of a short report.
6. **Study of geotaxis** behaviour in earthworm
7. **Study and actogram construction** of locomotor activity of suitable animal models.
8. **Study of circadian functions** in humans (daily eating, sleep and temperature patterns)
9. **Study of learning behaviour** of white rat and aggressive behavior of fish.

Group: B: Laboratory note book and Viva voce (2+3=5 marks)

Periodic updating of laboratory note book and viva-voce covering mostly the experimental works allotted during final examination.

Internal Assessment (Full marks = 10)* [ZOOL-H-DSE-3A-IA]

(*To be done by the Concerned College)

(OR)

ZOOL DSE: 3B Toxicology, Environmental Biology and Public Health

[Allotted Marks- 50 (Theory: 25+ Practical: 15+ Internal Assessment: 10)]

Theory (Full marks 25) [ZOOL-H-DSE-3B-T]

Unit 1: **Outline of Toxicology**-(i) Introduction to general toxicology, history of toxicology, classification of toxicology, (ii)Route of exposure and characterization of toxicants,(iii) Animal and plant toxin and their effect on human health, (iv) Drug discovery, development and registration: Regulatory affairs, WTO, patent regime accreditation and harmonization process,(v) methods of toxin testing , dose-response characterization, (vi)Threshold limitation: Hormesis, Lower dose extrapolation.

Unit 2: Toxicological hazards - Sources of environmental hazards, hazard identification and accounting, fate of toxic and persistent substances in the environment, dose response evaluation, exposure assessment.

Unit 3: Climate Change - Greenhouse gases and global warming, acid rain, ozone layer destruction, effect of climate change on public health.

Unit 4: Pollution- Air, water, 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, nuclear waste handling and disposal, waste from thermal power plants.

Unit 5: Diseases - Causes, symptoms and control of tuberculosis, asthma, cholera, Minamata disease, typhoid.

Unit 6: Toxicants and public health-Toxicants and public health Hazards: classification of pesticides, mode of action, xenobiotics – a brief idea, Biomagnification and bioremediation, Detoxification process,Mode of absorption of toxins, health risk management.

Practical (Full Marks 15) [ZOOL-H-DSE-3B-P]

Group: A: Laboratory Experimentation(=10 marks)

1. **Identification** of mammalian fauna, avian fauna, herpeto-fauna (preserved specimen /photograph).

2. **Demonstration of basic equipments** 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. Ten tree method, Circular, Square & rectangular plots, methods for ground cover assessment, Tree canopy cover assessment, Shrub cover assessment.
5. **Trail/transect monitoring** for abundance and diversity estimation of mammals and bird(direct and indirect evidences).
6. **Detection adulteration** in a) Ghee b) Sugars c) Tea leaves and d) Turmeric.
7. **Determination of absorbed oil** content in fried foods.
8. **Estimation of lactose** in milk.
9. Ascorbic acid estimation in food by titrimetry.
10. **Estimation of calcium** in foods by titrimetry.
11. **Estimation of free air particles** by grease method.
12. Determination of LD_{50} and LC_{50} for selected pesticide formulation.
13. **Instrumentation used for forensic toxicology** (demonstration only).

Group B: Laboratory note book and Viva voce (2+3=5 marks)

Periodic updating of laboratory note book and viva-voce covering mostly the experimental work allotted during examination

Internal Assessment (Full marks = 10)* [ZOOL-H-DSE-3B-IA]

(*To be done by the Concerned College)

DSE 4: Biology of insects (OR) Project paper

DSE 4 : Biology of insects

[Allotted Marks- 50 (Theory 25+ Practical: 15+ Internal Assessment: 10)]

Theory (Full Marks 25) [ZOOL-H-DSE-4-T]

Unit 1: Introduction: (i) General features of insects,(ii) Distribution and success of insects on the earth.

Unit 2: Insect Taxonomy:(i) Basis of insect classification; classification of insects up to orders (Brusca and Brusca, 2016).

Unit 3: General Morphology of Insects:(i) External Features; head – eyes, types of antennae, mouth parts. feeding habits, (ii) Thorax: Wings and wing articulation, types of legs adapted to diverse habitat abdominal appendages and genitalia.

Unit 4: Physiology of Insects:(i) Structure and physiology of Insect body systems - integumentary, digestive, excretory, circulatory, respiratory, endocrine, reproductive, and nervous system, (ii) Photoreceptors: Types, structure and function,(iii) Metamorphosis: Types and neuroendocrine control of metamorphosis.

Unit 5: Insect Society: (i) Social insects with special reference to termites, (ii) Trophallaxis in social insects such as ants, termites and bees.

Unit 6: Insect Plant Interaction: Theory of co-evolution, role of allelochemicals in host plant mediation Host-plant selection by phytophagous insects, major insect pests in paddy.

Unit 7: Insects as Vectors: Insects as mechanical and biological vectors, brief discussion on houseflies and mosquitoes as important vectors.

Practical (Full marks 15) [ZOOL-H-DSE-4-P]

Group A: Experimentation (= 10 marks)

1. **Study and documentation** of life cycle of mosquito.
2. **Study** of different kinds of antennae, legs and mouth parts of insects.
3. **Mounting** of insect wings, spiracles and genitalia of medically important insects.
4. **Collection, preservation and identification** of insects from mango Orchards/rice fields.
5. **Morphological studies** of various castes of *Apis*, *Camponotus*, *Odontotermes*.
6. **Study of life cycle** of major insect pests of mango and their damages.
7. **Study of life cycle** of Mulberry silk moth as beneficial insect.

Group B: Laboratory note book and Viva voce (2+3=5 marks)

Periodic updating of laboratory note book and viva-voce covering mostly the experimental work allotted during examination.

Internal Assessment (Full marks = 10)* [ZOOL-H-DSE-4-IA]

(*To be done by the Concerned College)

(OR)

DSE 4 B Project paper[ZOOL-H-DSE-4-DP]

[50 Marks (Submission of the Project: 25, Presentation by power point during final examination: 12, Viva-voce: 08, Paper Presentation in seminar and/or publication in journal: 05)]

Project Problem: The project problem to be assigned to the student by the Teacher/faculty member of the college concerned. The project problem encompasses either laboratory/filed experimentation covering the entire semester months.

Project writing: The project consists of: title page, table of contents, acknowledgement, list of abbreviations, list of figures and/or list of tables (if necessary), introduction, materials methods, main body of result, discussion, conclusion, references / bibliography, appendices (if necessary). The text length (introduction, main Body of result discussion and conclusion) shall be of about 5500 words.

Project representation: Results obtained in the project work should be presented in **a** seminar not below the state level and/or published in at least **one** research journal.

[Three hard copies of the project in binding form to be submitted during the time of final examination]

Skill Enhancement Course (SEC) in Zoology(H)

ZOOL SEC 1: Sericulture (or) Apiculture

[Allotted marks-50 (Theory: 40 + Internal Assessment:10]

Sericulture (= 40 marks) [ZOOL-H-SEC-1A-T]

Unit 1: Introduction-(i) Sericulture: Definition, history and present status; Silk route, (ii) Types of silkworms, distribution and races, (iii) Exotic and indigenous races, (iv) Mulberry and non-mulberry sericulture

Unit 2: Biology of Silkworm- (i) Life cycle of *Bombyx mori*, Structure of silk gland and secretion of silk

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

Unit 4: Pests and Diseases- (i) Pests of silkworm: Uzi fly, Dermestid beetles and vertebrates,(ii) Pathogenesis of silkworm diseases: Protozoan, viral, fungal and bacterial, (iii) Control and prevention of pests and diseases

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

Internal Assessment (Full marks = 10)* [ZOOL-H-SEC-1A-IA]

(*To be done by the Concerned College)

(Or)

Apiculture (= 40 marks) [ZOOL-H-SEC-1B-T]

Unit 1: Biology of Bees-(i) History, Classification and Biology of Honey Bees,(ii) Social Organization of Bee Colony

Unit 2: Rearing of Bees-(i) Artificial Bee rearing (Apiary), Beehives – Newton and Langstroth,(ii)Bee Pasturage, (ii) Selection of Bee Species for Apiculture, (ii)

Bee Keeping Equipment,(iii) Methods of Extraction of Honey (Indigenous and Modern).

Unit 3: Diseases and Enemies-(i) Bee Diseases and Enemies,(ii) Control and Preventive measures.

Unit 4: Bee Economy- Products of Apiculture Industry and its Uses (Honey, Bees Wax, Propolis), Pollen etc.

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

Internal Assessment (Full marks = 10)* [ZOOL-H-SEC-1B-IA]

(*To be done by the Concerned College)

ZOOL SEC 2: Aquarium fish keeping (or) Medical Diagnostic Techniques (Full marks: 50)

[Allotted marks-50 (Theory: 40 + Internal Assessment:10]

Aquarium Fish Keeping (=40 Marks) [ZOOL-H-SEC-2A-T]

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.

Internal Assessment (Full marks = 10)* [ZOOL-H-SEC-2A-IA]

(*To be done by the Concerned College)

(Or)

Medical Diagnostic Techniques (= 40 marks) [ZOOL-H-SEC-2B-T]

Unit 1: Medical Diagnostics: Introduction and importance

Unit 2: Diagnostics Methods Used for Analysis of Blood: Blood composition, preparation of blood smear and differential leucocytes count (D.L.C) using Leishman's stain, platelet count using haemocytometer, erythrocyte sedimentary rate (E.S.R), packed cell volume (P.C.V.).

Unit 3: Diagnostic Methods Used for Urine Analysis- Physical characteristics; abnormal constituents of urine.

Unit 4: Non-infectious Diseases- Causes, types, symptoms, complications, diagnosis and prevention of diabetes (Type I and Type II), hypertension (primary and secondary), testing of blood glucose using glucometer/Kit.

Unit 5: Infectious Diseases-Causes, types, symptoms, diagnosis and prevention of tuberculosis and hepatitis, malarial parasite (microscope based and ELISA based).

Unit 6: Clinical Biochemistry- LFT, lipid profiling.

Unit 7: Clinical Microbiology-Antibiotic sensitivity test.

Unit 8: Tumours-Types (benign/malignant), characteristics and metastasis; medical imaging: X-ray of bone fracture, PET, MRI and CT scan (using photographs).

Internal Assessment (Full marks = 10)* [ZOOL-H-SEC-2B-IA]

(*To be done by the Concerned College)

General Instruction for Practical Classes: Animals/organisms collected from traps for practical classes to be released back into their own habitat as far as possible; only pictures/sketches and descriptions should be retained and accordingly be submitted. Nests/eggs of animals/organisms should not be disturbed/ collected unless abandoned. Guideline of UGC should be strictly adhered to during the collection and experimentation on animals/organisms. In no case should wildlife be harmed – only non-invasive recording and data collection is permitted. Experimentation on animals/organism should be done as per UGC guideline.