



UNIVERSITY OF GOUR BANGA

Scheme of ZOOLOGY (General) Syllabus (UG) in CBCS System

Semester wise Course Structure under CBCS For B.Sc. Zoology (General) Programme

ACADEMIC SEMESTERS	Courses				Credits	Marks
	Discipline Core (DC)	Discipline Specific Elective (DSE)	Ability Enhancement Compulsory (AEC)	Skill Enhancement (SEC)		
SEM-I	DC1 (A1) DC2 (B1) DC3 (C1) (6x3=18)	--	ENVS (2)	--	20	200
SEM-II	DC4 (A2) DC5 (B2) DC6 (C2) (6x3=18)	--	Communicative Bengali/Communicative English/MIL* (2)	--	20	200
SEM-III	DC7 (A3) DC8 (B3) DC9 (C3) (6x3=18)	--	--	SEC-1 (2)	20	200
SEM-IV	DC10 (A4) DC11(B4) DC12 (C4) (6x3=18)	--	--	SEC-2 (2)	20	200
SEM-V	--	DSE1 (A1) DSE2 (B1) DSE3 (C1) (6x3=18)	--	SEC-3 (2)	20	200
SEM-VI	--	DSE4 (A2) DSE5 (B2) DSE6(C2) (6x3=18)	--	SEC-4 (2)	20	200
Total	--	--	--	--	120	1200

Notes:

1. Each course is of 50 marks for examination.
2. DC/DSE: Each course is of 6 credits for course work per week

(Theory - 4 credits + Practical- 2 credit)

1 Credit = 1 hour duration of teaching (lecture/tutorial) or 2 hour duration of practical period.

3. **SE:** Covering any two Discipline Cores (DC) out of A, B & C with two courses each, 2x2= 4 SEs
4. **DSE:** Two DSEs for each DC, *i.e.*, 3x2= 6 DSEs. A student has to opt one course out of two courses provided for each DSE in SEM V & SEM VI.
5. Students have to opt 3 different disciplines as Core disciplines at the time of admission. Disciplines once selected in SEM -1 should be continued up to SEM -VI without any alternation or change.

*MIL: Modern Indian Language

Marks & Question Type Distribution for General Program

Courses	Credit of each course	Full marks of each course	Distribution of marks of each course			
			Internal Assessment (IA)	End Semester Examination (ESE)		
				Theoretical		Practical
				Descriptive	MCQ	
DC,LC, DSE and GE	06	50 (practical based course)	10	25	nil	15
02 SE	02	50	10	40	nil	nil
AEC-1 (ENVS)	02	50	10 (Project)	nil	40	nil
AEC-2 (Communicative Bengali/English)	02	50	10	nil	40	nil

Course Structure in CBCS for Zoology (General)

Subject	Semester	Paper code	Description of the subject content	Credit	Marks
Core Subject	SEM-1	(A1) -ZOOL-G- DC1-T	Animal Diversity and Ecology (Theory)	04	25
	SEM-1	(A1) -ZOOL-G- DC1-P	Animal Diversity and Ecology (Practical)	02	15
	SEM-1	(B1)-(Second choice) DC2-T	From pool of subjects (Theory)	04	25
	SEM-1	(B1) -(Second choice) –DC2-P	From pool of subjects (Practical)	02	15
	SEM-1	(C1) - (Third Choice)-G- DC3-T	From pool of subjects (Theory)	04	25
	SEM-1	(C1)- (Third Choice)-G-DC3-P	From pool of subjects (Practical)	02	15
	SEM-II	(A2) -ZOOL –G-DC4-T	Comparative Anatomy and Developmental Biology of Vertebrates (Theory)	04	25
	SEM-II	(A2) - ZOOL-G- DC4-P	Comparative Anatomy and Developmental Biology of Vertebrates (Practical)	02	15
	SEM-II	(B2)-(Second choice)-G-DC5-T	From pool of subjects (Theory)	04	25
	SEM-II	(B2) - (Second choice)-G-DC5-P	From pool of subjects (Practical)	02	15
	SEM-II	(C2) - (Third Choice)-G-DC6-T	From pool of subjects (Theory)	04	25
	SEM-II	(C2) - (Third Choice)-G-DC6-P	From pool of subjects (Practical)	02	15
	SEM-III	(A3)-ZOOL-G- DC7-T	Physiology and Biochemistry (Theory)	04	25
	SEM-III	(A3) - ZOOL–G-DC7-P	Physiology and Biochemistry (Practical)	02	15
	SEM-III	(B3) - (Second choice)-G-DC8-T	From pool of subjects (Theory)	04	25
	SEM-III	(B3) - (Second choice)-G-DC8-P	From pool of subjects (Practical)	02	15
	SEM-III	(C3) - (Third Choice)-G-DC9-T	From pool of subjects (Theory)	04	25
	SEM-III	(C3) - (Third Choice)-G-DC9-P	From pool of subjects (Practical)	02	15
	SEM-IV	(A4) - ZOOL-G- DC 10 -T	Genetics and Evolutionary Biology (Theory)	04	25
	SEM-IV	(A4) -ZOOL –G-DC 10 -P	Genetics and Evolutionary Biology (Practical)	02	15
SEM-IV	(B4) - (Second choice)-G-DC11-T	From pool of subjects (Theory)	04	25	
SEM-IV	(B4) -(Second choice)-G-DC11-P	From pool of subjects (Practical)	02	15	
SEM-IV	(C4)- (Third Choice)-G-DC12 -T	From pool of subjects (Theory)	04	25	
SEM-IV	(C4) - (Third Choice)-G-DC-12-P	From pool of subjects (Practical)	02	15	
Discipline Specific elective	SEM-V	(A1) - ZOOL-G- DSE1- A/B/C-T	Cell Biology and Animal biotechnology (or) Immunology (or) Reproductive biology (Theory)	04	25
	SEM-V	(A1) -ZOOL-G-DSE1-A/B/C-P	Cell Biology and Animal biotechnology (or) Immunology (or) Reproductive biology (Practical)	02	15
	SEM-V	(B1) -(Second choice)-G-DSE2-T	From pool of subjects (Theory)	04	25
	SEM-V	(B1) -(Second choice)-G-DSE2-P	From pool of subjects (Practical)	02	15
	SEM-V	(C1) -(Third choice)- G-DSE3-T	From pool of subjects (Theory)	04	25
	SEM-V	(C1) -(Third choice)-G-DSE3-P	From pool of subjects (Practical)	02	15
	SEM-VI	(A2) -ZOOL-G-DSE4 A/B/C-T	Aquatic biology (or) Applied Zoology (or) Insects, Vectors and Diseases (Theory)	04	25
	SEM-VI	(A2) -ZOOL-G- DSE-4A/B/C -P	Aquatic biology (or) Applied Zoology (or) Insects Vectors and Diseases (Practical)	02	15
	SEM-VI	(B2) - (Second choice)-G-DSE 5-T	From pool of subjects (Theory)	04	25
	SEM-VI	(B2) -(Second choice)- DSE5-P	From pool of subjects (Practical)	02	15
	SEM-VI	(C2) - (Third choice)- DSE6-T	From pool of subjects (Theory)	04	25
	SEM-VI	(C2) -(Third choice)-DSE6-P	From pool of subjects (Practical)	02	15
Ability enhancement course	SEM-I	ENVS-AEC 1	Environmental studies	02	50
	SEM-II	(Selected subject)-AEC 2	Communicative Bengali/Communicative English/MIL	02	50
Skill enhancement Course	SEM-III	ZOOL-G- SEC 1	Apiculture (Theory)	02	50
	SEM-IV	ZOOL-G- SEC2	Sericulture (Theory)	02	50
	SEM-V	ZOOL-G- SEC3	Aquarium Fish Keeping (Theory)	02	50
	SEM-VI	ZOOL-G- SEC4	Medical Diagnostics (Theory)	02	50

Note: Internal assessment (IA) for each of the theoretical papers carries 10 marks

Discipline Core Courses (DC): Zoology for General Studies

(A1)DC 1: Animal Diversity and Ecology (=50 marks)

(Theory: 25 marks, Practical: 15 marks, Internal Assessment: 10 marks)

Theory (=25 marks)[(A1)-ZOOLOG-G-DC 1-T]:

Group A: Biology of Non-Chordates(=10 marks)

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

Unit 2: Protista and Metazoa - Protozoa-general characteristics and classification up to phylum, locomotion in *Euglena*, *Paramecium* and *Amoeba*, conjugation in *Paramecium*.

Unit 3: Porifera - General characteristics and classification up to classes, canal system in sponges.

Unit 4: Cnidaria - General characteristics and classification up to classes, metagenesis in *Obelia*; corals and coral reef diversity, functions & conservation.

Unit 5: Ctenophora - General characteristics and classification up to class.

Unit 6: Platyhelminthes - General characteristics and classification up to classes; life cycle and pathogenicity and control measures of *Fasciola hepatica*, parasitic adaptation of *Fasciola* sp.

Unit 7: Aschelminthes - General characteristics and classification up to classes, life cycle, and pathogenicity and control measures of *Ascaris lumbricoides*; Parasitic adaptation of *Ascaris* sp.

Unit 8: Annelida - General characteristics and classification up to classes, Excretion in Annelida.

Unit 9: Arthropoda - General characteristics and classification up to classes, Respiration in arthropoda (gills in prawn and trachea in cockroach).

Unit 10: Onychophora- General characteristics, body structure and evolutionary significance.

Unit 11: Mollusca: General characteristics and classification up to classes, Nervous system and torsion in gastropod; feeding and respiration in *Pila* sp.

Unit 12: Echinodermata: General characteristics and classification up to classes; water-vascular system in Asterozoa.

Unit 13: Hemichordata: General characteristics of phylum Hemichordata; relationship with non-chordates and chordates.

Group B: Biology of Chordates (=10 marks)

Unit 1: Introduction to Chordates- General characteristics and outline classification of phylum Chordata.

Unit 2: Protochordata (invertebrate chordate) - General characteristics and classification of sub-phylum Urochordata and Cephalochordata up to classes; retrogressive metamorphosis in *Ascidia*; chordate features and feeding in *Branchiostoma*.

Unit 3: Agnatha- General characteristics and classification of Cyclostomes up to order.

Unit 4: Pisces: General characteristics and classification of Chondrichthyes and Osteichthyes up to subclasses, accessory respiratory organ in fishes.

Unit 5: Amphibia: General characteristics and classification up to living Orders, parental care in Amphibia.

Unit 6: Reptilia - General characteristics and classification up to living Orders, poison apparatus and biting mechanism in snake.

Unit 7: Aves - General characteristics and classification up to Sub-Classes, exoskeleton and migration in birds.

Unit 8: Mammals - General characteristics and classification up to living infraclasses, affinities of Prototheria.

Group C: Ecology (=5 marks)

Unit 1: Introduction to Ecology: Autecology and Synecology, Levels of organization.

Unit 2: Population and Community: Geometric, exponential and logistic growth, equation, Gause's Principle with laboratory and field examples. Community characteristics: species diversity, abundance, dominance, richness. Ecological succession with example of Hydrosere.

Unit 3: Ecosystem: Food chain: Detritus and grazing food chains, Food web, Energy flow through the ecosystem, Ecological pyramids.

Unit 4: Applied Ecology: Wildlife Conservation (in-situ and ex-situ conservation).

Management strategies for tiger conservation; Wild life protection act (1972)

Practical (=15 marks) [(A1)-ZOOLOGICAL-GROUP 1-P]:

Group A: Experimentation (=10marks)

- **Biology of Non-Chordates**
 - i. **Characterization** of whole mount of *Paramecium* sp.
 - ii. **Identification of -**
 - a. *Amoeba, Euglena, Opalina, Paramecium*, (from the prepared slides)
 - b. *Sycon, Neptune's Cup, Obelia, Physalia, Aurelia, Tubipora, Corallium, Alcyonium, Gorgonia, Metridium, Pennatula, Fungia, Meandrina, Madrepora* from museum specimen.
 - c. Adult *Fasciola hepatica, Taenia solium* and *Ascaris lumbricoides*
 - d. **Annelids** : *Aphrodite, Nereis, Heteronereis, Chaetopterus, Pheretima, Hirudinaria*
 - e. **Arthropods**: *Limulus, Palaemon, Daphnia, Balanus, Buthus, Eupagurus, Scolopendra, Julus, Bombyx*.
 - f. **Molluscs** : *Chiton, Doris, Unio, Sepia, Octopus, Nautilus, Loligo, Mytilus*.
 - g. **Echinodermate**: *Pentaceros/Asterias, Ophiura, Echinus, Cucumaria* and *Antedon*
 - iii. **Staining/mounting** of any protozoa/helminth from gut of cockroach.
- **Biology of Chordates**
 - i. **Identification:**
 - a. **Protochordata**: *Balanoglossus, Herdmania, Branchiostoma; Agnatha- Petromyzon, Myxine*.
 - b. **Fishes**: *Scoliodon, Sphyrna, Mystus, Heteropneustes, Labeo, Exocoetus, Echeineis, Anguilla, Hippocampus, Anabas* Flat fish;
 - c. **Amphibia**: *Necturus, Bufo, Hyla, Axolotl, Tylototriton*.
 - d. **Reptilia**: *Chelone, Hemidactylus, Varanus, Uromastix, Chamaeleon, Vipera, Naja*;
Key for identification of poisonous and non-poisonous snakes.
 - e. **Mammalia**: bat (insectivorous and frugivorous), funambulid; pecten from fowl head

- ii. **Dissection** of Urino-genital system of *Tilapia* and Pituitary of *Labeo* (**subject to UGC guideline**).
- **Ecology**
 - i. **Study** of an aquatic ecosystem: determination of pH, and Dissolved Oxygen content (Winkler's method) and CO₂ in water.
 - ii. **Report** on a one-day visit to Sanctuary/Zoo/Sericulture station/Fishery/apiculture station/pond ecosystem/agro-ecosystem.

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

Internal Assessment (=10 marks) [(A1)-ZOOLOGICAL-G-DC 1-IA]

(A2)-DC 4 Comparative Anatomy and Developmental Biology of Vertebrates (=50 marks)

(Theory: 25 marks, Practical: 15 marks, Internal Assessment: 10 marks)

Theory (=25 marks) [(A2)-ZOOLOGICAL-G-DC 4-T]:

Group A: Comparative Anatomy (= 12.5 marks)

Unit 1: Integumentary system- Structure, function and derivatives of integument in amphibian, birds and mammals,. Glands and digital tips.

Unit 2: Digestive System- Comparative anatomy of stomach; Dentition in mammals

Unit 3: Respiratory System- Respiratory organs in fishes, amphibians, birds and mammals, Brief account of gills, lungs, air sacs and swim bladders.

Unit 4: Circulatory System- General plan of circulation, comparative account of heart and aortic arches.

Unit 5: Urinogenital System- Succession of kidney, Evolution of urinogenital ducts.

Unit 6: Nervous System- Comparative account of brain, cranial nerves in mammals.

Unit 7: Skeletal System- Evolution of visceral arches.

Group B: Developmental Biology of Vertebrates (=12.5 marks)

Unit1: Early Embryonic Development- Gametogenesis: spermatogenesis, oogenesis; types of eggs, egg membranes; fertilization in Sea urchin: changes in gametes, Blocks to polysperm, planes and patterns of cleavage; Types of blastula, Early development of chick up to gastrulation.

Unit 2: Late Embryonic Development- Fate of germ layers, Extra-embryonic membranes in birds, placenta (structure, types and functions of placenta).

Unit 3: Post Embryonic Development- Development of brain and eye in vertebrates.

Unit 4: Control of Development- Fundamental processes in development (brief idea)

– Gene activation, Determination, Induction, Differentiation, Morphogenesis, intercellular communication, Cell movements and cell death.

Practical (=15 marks) [(A2)-ZOOLOGICAL-G-DC 4-P]:

Group A: Experimentation (= 10 marks)

- **Comparative Anatomy**
 - i. Study of placoid, cycloid and ctenoid scales through permanent slides/photographs.
 - ii. Study of disarticulated skeleton of toad, pigeon, fowl, guineapig and rabbit.
 - iii. **Demonstration** of carapace and plastron of turtle.
 - iv. Identification of mammalian skulls: *Bufo*, *Rana*, *Columba*, *Cavia* and Dog.
- **Developmental Biology of Vertebrates**
 - i. **Identification** of whole mounts of developmental stages of chick through permanent slides: Primitive streak (13 and 18 hours), 24, 48, 72, and 96 hours of incubation.
 - ii. **Study** of different sections of placenta (from photo-micrograph/ slides)
 - iii. **Study** of live gametes from white rat.
 - iv. **Study** of the different types of placenta- histological sections through permanent slides or photo-micrographs.
 - v. **Examination of gametes** - Frog/rat - sperm and ova through permanent slides or photomicrographs.
 - vi. **Study on life-cycle:** Project report on *Drosophila* culture/chick embryo development.

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

Internal Assessment (=10 marks) [(A2)-ZOOLOGICAL-G-DC 4-IA]

(A3)DC7 Physiology and Biochemistry (=50 marks)

(Theory: 25 marks, Practical: 15 marks, Internal Assessment: 10 marks)

Theory (=25 marks) [(A3)-ZOOLOG-DC 7-T]:

Group A: Physiology (= 12.5 marks)

Unit 1: Digestion and Absorption of Food- Digestion and absorption of carbohydrates, fats and proteins.

Unit 2: Functioning of Excitable Tissue (Nerve and Muscle): Structure of neuron, Propagation of nerve impulse (myelinated and non-myelinated nerve fibre); structure of skeletal muscle, Mechanism of muscle contraction, Neuromuscular junction, Synaptic transmission.

Unit 3: Respiratory Physiology: Ventilation, external and internal respiration, transport of oxygen and carbon dioxide in blood.

Unit 4: Renal Physiology: Functional anatomy of kidney, Mechanism of urine formation.

Unit 5: Cardiovascular Physiology: Structure of heart, Coordination of heart beat.

Unit 6: Endocrine and Reproductive Physiology: Structure of endocrine glands (pituitary, thyroid, pancreas, adrenal, ovaries and testes) and role of hormones secreted by these glands, menstrual cycle.

Unit 7: Introduction to Endocrinology: General idea of endocrine systems, Classification, characteristic and transport of hormones,

Unit 8: Regulation of Hormone Action: Mechanism of action of steroidal, Non-steroidal hormones with receptors.

Group B: Biochemistry (= 12.5 marks)

Unit 1: Carbohydrates- Structure of: monosaccharides, disaccharides, polysaccharides, carbohydrate metabolism: glycolysis, citric acid cycle, glycogenesis and glycogenolysis

Unit 2: Lipids - Structure and significance: physiologically important saturated and unsaturated fatty acids, tri-acylglycerols, phospholipids, sphingolipid, glycolipids, steroids lipid metabolism: β -oxidation of fatty acids.

Unit 3: Proteins - Classification, Secondary structure, Protein metabolism: Transamination, Deamination, Urea cycle.

Unit 4: Nucleic Acids - DNA is the genetic material, Structure of purines and pyrimidines, nucleosides, nucleotides, nucleic acids; types of DNA and RNA.

Unit 5: Enzymes - Nomenclature and classification; Mechanism of enzyme action.

Practical (=15 marks) [(A3)-ZOOLOGICAL-G-DC 7-P]:

Group A: Experimentation (= 10marks)

• **Physiology**

- i. **Preparation** of temporary mounts: Blood film.
- ii. **Preparation** of hemin and hemochromogen crystals
- iii. **Estimation** of haemoglobin using Sahli's haemoglobinometer.
- iv. **Examination of permanent histological** sections of mammalian duodenum, lung, kidney, thyroid, pancreas, adrenal, testis, ovarian and pituitary
- v. **Study of permanent slides** of spinal cord, duodenum, liver, lung, kidney, bone, cartilage

• **Biochemistry**

- i. **Qualitative tests** of functional groups in carbohydrates, proteins
- ii. **Estimation of total protein** in given solutions by Lowry's method.
- iii. **Study of activity of salivary amylase** under optimum conditions

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

Internal Assessment (=10 marks) [(A3)-ZOOLOGICAL-G-DC 7-IA]

(A4) DC 10 Genetics and Evolutionary Biology (=50 marks)

(Theory: 25 marks, Practical: 15 marks, Internal Assessment: 10 marks)

Theory (=25 marks) [(A4)-ZOOLOGICAL-G-DC 10-T]

Group A: Principles of Genetics (= 12. 5 marks)

Unit 1: Mendelian Genetics and its Extension- Principles of Mendelian inheritance, Incomplete dominance and co-dominance, Multiple alleles, Sex-linked characters, Sex- influenced and Sex-limited inheritance.

Unit 2 : Linkage, Crossing Over and Chromosomal Mapping- Linkage and crossing over, molecular basis of crossing over, Steps in Chromosome mapping, Measuring recombination frequency.

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

Unit 4: Sex Determination- Mechanisms of sex determination in *Drosophila* and human

Group B: Evolutionary Biology (= 12..5 marks)

Unit 1: Life's Beginnings- Origin of life, Chemogeny

Unit 2: Theory and concept of evolution - Historical review of evolutionary concepts, Lamarkism, Darwinism and Neo-Darwinism, Geological time scale, evolution of Horse.

Unit 3: Sources of variations - Types of variations and their role in evolution

Unit 4: Population genetics - Hardy-Weinberg law, Natural selection; Genetic drift mechanism (Founder's effect, Bottleneck phenomenon);

Unit 5: Species concept - Biological species concept (advantages and limitations), isolating mechanisms, modes of speciation (Allopatric, Sympatric)

Unit 6: Macro-evolution – Idea about Macro-evolutionary Principles and stages in macro-evolution (example: Darwin's Finches)

Unit 7: Zoogeography - Zoogeographical realms, distribution of birds and mammals in different realms.

Practical (=15 marks) [(A4)-ZOOL-G-DC 10-P]:

Group A: Experimentation (= 10 marks):

- **Principles of Genetics**
 - i. **Study of Mendelian Inheritance** and gene interactions (Non Mendelian Inheritance) using suitable examples. Verify the results using Chi-square test.
 - ii. **Construction of linkage map** using the data provided

iii. **Study of Human Karyotypes** (normal and abnormal).

iv. **Blood group typing.**

- **Evolutionary Biology**

i. **Study of fossil** evidences from plaster cast models and pictures

ii. **Study of homology** and analogy from suitable specimens/ pictures

iii. **Study from charts:** (i) Phylogeny of horse with diagrams/ cut outs of limbs and teeth of horse ancestors, (ii) Darwin's Finches with diagrams/ cut outs of beaks of different species.

iv. **Identification of Zoogeographical fauna.**

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

Internal Assessment (=10 marks) [(A4)-ZOOL-G-DC 10-IA]

Discipline Specific Electives (DSE): Zoology (General)

(Only two papers to be opted)

(A1) DSE 1A : Cell Biology and Animal Biotechnology(=50 marks)

(Theory: 25 marks, Practical: 15 marks, Internal Assessment: 10 marks)

Theory (=25 marks) [(A1)-ZOOLOG-G-DSE 1A -T]:

Group A: Cell Biology (=12.5 marks)

Unit 1: Cell types- Prokaryotic and eukaryotic cell

Unit 2: Plasma membrane- Structure (Fluid mosaic model) and function of plasma membrane.

Unit3: Cell organelles- Structure and function of Mitochondria, Nucleus, Golgi complex, ER, Ribosomes.

Group B: Biotechnology (=12.5 marks)

Unit 1: Introduction: Concept and scope of biotechnology

Unit 2: Techniques in Gene manipulation : Recombinant DNA technology, isolation of genes, concept of restriction and modification: Restriction endonucleases, cloning vectors: Plasmids, phage vectors, cosmids, YAC, and expression vectors, construction of genomic libraries and cDNA libraries; process of gene cloning by using cloning vector (plasmid).

Unit 3: Animal cell Culture: Basic techniques in animal cell culture and organ culture, primary Culture and Cell lines, Culture media- Natural and Synthetic, Stem cells, Cryopreservation of cultures, Southern, Northern and Western blotting, polymerase chain reaction, DNA fingerprinting

Practical (=15 marks) [(A1)-ZOOLOG-G-DSE 1A -P]:

Group A: Experimentation (= 10 marks)

- i.* Genomic DNA isolation from *E.coli*.
- ii.* Plasmid DNA isolation (pUC 18/19) from *E.coli*.
- iii.* Restriction digestion of plasmid DNA.
- iv.* To study following techniques through photographs: (i) Southern Blotting,(ii) Northern Blotting, (iii)Western Blotting, (iv) DNA Sequencing (Sanger's Method)

- PCR, (v) DNA fingerprinting.
- v. Seminar on tools and techniques of Biotechnology.
- vi. Study/ Identification of different stages of mitosis and meiosis.

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

Internal Assessment (=10 marks) [(A1)-ZOOLOGY-G-DSE 1A -IA]

(OR)

DSE 1B: Immunology(=50 marks)

(Theory: 25 marks, Practical: 15 marks, Internal Assessment: 10 marks)

Theory (=25 marks) [(A1)-ZOOLOGY-G-DSE 1B -T]:

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

Unit 2: Innate and Adaptive Immunity- Cell and molecules involved in innate immunity, adaptive immunity (cell mediated and humoral),

Unit 3: Antigens- Antigenicity and immunogenicity, immunogens, B and T-Cell subtypes

Unit: 4: Immunoglobulins- Structure and functions of different classes of immunoglobulins.

Unit 5: Major Histocompatibility Complex- Structure and functions of MHC molecules,

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

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

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

Unit 9: Vaccines- Various types of vaccines, active & passive immunization (artificial and natural)

Practical (=15 marks) [(A1)-ZOOLOGY-G-DSE 1B -P]:

Group A: Experimentation (=10 marks)

- i. **Demonstration** of lymphoid organs of rat/ mice (**Subject to UGC guidelines**).
- ii. **Identification of slides** of spleen, thymus and lymph nodes /through photographs
- i. **Preparation of stained blood film** to study various types of blood cells.

- ii. Ouchterlony's double immuno-diffusion method.
- iii. ABO blood group determination.
- iv. Cell counting and viability test from splenocytes of farm bred animals/cell lines.
- v. Demonstration of ELISA techniques
- vi. Immunoelectrophoresis

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

Internal Assessment (=10 marks) [(A1)-ZOOLOGICAL-DISEASE 1B -IA]

(OR)

DSE 1C: Reproductive Biology(=50 marks)

(Theory: 25 marks, Practical: 15 marks, Internal Assessment: 10 marks)

Theory (=25 marks) [(A1)-ZOOLOGICAL-DISEASE 1C -T]:

Unit 1: Reproductive Endocrinology: Gonadal hormones and mechanism of hormone action, steroids, regulation of gonadotrophin secretion in male and female; Reproductive System: Development and differentiation of gonads,

Unit 2: Functional anatomy of male reproduction: Outline and histological study of male reproductive system in human; Testis: Cellular functions, germ cell, stem cell renewal; Spermatogenesis: process of hormonal regulation;

Unit 3: Functional anatomy of female reproduction: Outline and histological study of female reproductive system in human; Ovary: folliculogenesis, ovulation, corpus luteum formation and regression; secretion of ovarian hormones; Reproductive cycles (human) and their hormonal regulation.

Unit 4: Fertilization and Reproductive Health: Process of fertilization in Sea-urchin, Infertility in male and female: causes, diagnosis and management; Brief idea of assisted Reproductive Technology: sex selection, sperm banks, frozen embryos, in vitro fertilization, ET, EFT, IUT, ZIFT, GIFT, ICSI, PROST; Modern contraceptive technologies; Demographic terminology used in family planning.

Practical (=15 marks) [(A1)-ZOOLOGICAL-DISEASE 1C -P]:

Group A: Experimentation (=10 marks)

- i. **Study of animal house:** set up and maintenance of animal house, breeding techniques, care of normal and experimental animals.

- ii. **Examination of live gamet** of white rat.
- iii. **Surgical techniques:** principles of surgery in endocrinology. Ovaryectomy, hysterectomy, castration and vasectomy in rats.
- iv. **Examination of histological sections** from photomicrographs/ permanent slides of mammalian ovary, testis, and accessory glands of male reproductive systems;
- v. **Sections** of ovary, fallopian tube, uterus (proliferative and secretory stages), cervix and vagina.
- vi. **Human vaginal exfoliate cytology.**
- vii. **Sperm count and sperm motility in rat**

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

Internal Assessment (=10 marks) [(A1)-ZOOL-G-DSE 1C -IA]

(A2) DSE 4A: Aquatic Biology(=50 marks)

(Theory: 25 marks, Practical: 15 marks, Internal Assessment: 10 marks)

Theory (= 25 marks) [(A2)-ZOOL-G-DSE 4A -T]:

Unit 1: Aquatic Biomes- Brief introduction of the aquatic biomes: Freshwater ecosystem (lakes, wetlands, streams and rivers), estuaries, intertidal zones, and coral reefs.

Unit 2: Freshwater Biology- (i) Lakes: Origin and classification, Lake as an Ecosystem, Lake morphometry, Physico-chemical Characteristics: Light, Thermal stratification, Dissolved Solids, Carbonate, Bicarbonates, Phosphates and Nitrates, Turbidity; dissolved gases (Oxygen, Carbon dioxide). (ii) Streams: Different stages of stream development, Physico-chemical environment,

Unit 3: Marine Biology- Salinity and density of Sea water, Continental shelf, Adaptations of deep sea organisms,

Unit 4: Management of Aquatic Resources- Causes of pollution: Agricultural, Industrial, Sewage, Thermal and Oil spills, Eutrophication, Management and conservation (legislations), Sewage treatment Water quality assessment- BOD and COD.

Practical (=15 marks) [(A2)-ZOOLOG-G-DSE 4A -P]:

Group A: Experimentation (=10 marks)

- i. **Determine the area of a lake** using graphimetric and gravimetric method.
- ii. **Identify** the important macrophytes, phytoplanktons and zooplanktons present in a lake ecosystem.
- iii. **Determine the amount** of Turbidity/transparency, Dissolved Oxygen, and Carbon dioxide, in water collected from a nearby lake / water body.
- iv. **Observation on the Instruments used in limnology** (Secchi disc, Van Dorn Bottle, Conductivity meter, Turbidity meter, PONAR grab sampler) and their significance.
- v. **A Project Report on** a visit to a Sewage treatment plant/Marine bio-reserve/ Fisheries Institutes/ any aquatic habitat/ aquaculture farm.

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

Internal Assessment (=10 marks) [(A2)-ZOOLOG-G-DSE 4A -IA]

(OR)

DSE 4B: Applied Zoology (=50 marks)

(Theory: 25 marks, Practical: 15 marks, Internal Assessment: 10 marks)

Theory (=25 marks) [(A2)-ZOOLOG-G-DSE 4B -T]:

Group A: Scope of Applied Zoology (= 12.5 marks)

Unit 1: Introduction to Host-parasite Relationship- Host, Definitive host, Intermediate host, Parasitism, Symbiosis, Commensalism,

Unit 2: Epidemiology of Diseases- Transmission, Prevention and control of diseases: Tuberculosis, typhoid.

Unit 3: Parasitic Protozoa- Life history and pathogenicity of *Entamoeba histolytica*, *Plasmodium vivax* and *Trypanosoma gambiense*.

Unit 4: Parasitic Helminthes- Life history and pathogenicity of *Ancylostoma duodenale* and *Wuchereria bancrofti*.

Unit 5: Animal Husbandry- Preservation and artificial insemination in cattle.

Unit 6: Poultry Farming- Principles of poultry breeding, Management of breeding stock and broilers, Processing and preservation of eggs.

Group B : Commercial Zoology (= 12.5 marks)

Unit 1: Insect biology: (i) Insects as Vectors: Insects as mechanical and biological vectors, brief discussion on houseflies and mosquitoes as important vectors.(ii) Insects of Economic Importance: Biology, Control and damage caused by *Helicoverpa armigera*, *Sitophilus oryzae* and *Tribolium castaneum*,(iii)Insects of Medical Importance: Medical importance and control of *Pediculus humanus corporis*, *Anopheles*, *Culex*, *Aedes*,

Unit 2: Fisheries and aquaculture: Inland Fisheries; Marine Fisheries; Fishing crafts and Gears. Extensive, semi-intensive and intensive culture of fish; Pen and cage culture; Polyculture; Composite fish culture; Induced breeding of fish; Management of finfish hatcheries; Role of water quality in aquaculture; Fish diseases: EUS, Dropsy, Finrot, Gillrot, (Causative agents, symptoms and control)

Practical (=15 Marks) [(A2)-ZOOLOG-G-DSE 4B -P]

Group A: Experimentation (=10 marks)

- **Scope of Applied Zoology**
 - i. **Identification of arthropod vectors** associated with human diseases: *Pediculus*, *Culex*, *Anopheles*, *Aedes* and *Xenopsylla*.
 - ii. **Study of insect damage** to different plant parts/stored grains through damaged products/photographs.
 - iii. **Identifying feature and economic importance** of *Helicoverpa (Heliiothis) armigera*, *Sitophilus oryzae* and *Tribolium castaneum*
- **Commercial Zoology**
 - i. **Morphometric and meristic characters of fishes.**
 - ii. **Study** of *Petromyzon*, *Myxine*, *Exocoetus*, *Hippocampus*, *Labeo*, *Heteropneustes*, *Anabas*,
 - iii. **Identification of different types of fish scales** (through permanent slides/ photographs).

- iv. **Study of different crafts and gears** used in Fisheries (Pictures/models).
 - v. **Assessment** of pH, DO, CO₂, (by titration/refractometer).
 - vi. **Dissect and display/ photograph** of air breathing organs in *Channa*,. Drawing with characters.
 - vii. **Study** of different kinds of and mouth parts of insects.
 - viii. **Mounting** of insect wings, Methodology of collection, preservation and identification of insects.
 - ix. **Morphological studies** of various castes of *Apis* and *Odontotermes* with photographs
 - x. **Identification** of major insect pests of paddy and their damages with photographs.
- **Identification:** Identification of *Plasmodium vivax*, *Entamoeba histolytica*, *Trypanosoma gambiense*, *Ancylostoma duodenale* and *Wuchereria bancrofti* and their life stages through permanent slides/photomicrographs or specimens

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

Internal Assessment (=10 marks) [(A2)-ZOOLOGY-G-DSE 4B -IA]

(OR)

DSE 4C: Insects, Vectors and Diseases (=50 marks)

(Theory: 25 marks, Practical: 15 marks, Internal Assessment: 10 marks)

Theory (=25 marks) [(A2)-ZOOLOGY-G-DSE 4C -T]:

Unit I: Introduction to Insects- General Features of Insects, Morphological features, Head – Eyes, Types of antennae, Mouth parts, Feeding habits.

Unit 2: Insect Taxonomy- Basis of insect classification; classification of insects up to class.

Unit 3: Physiology of Insects- Structure and physiology of insect body systems - integumentary, digestive, excretory, circulatory, respiratory, reproductive, and types of metamorphosis

Unit 4: Concept of Vectors- Brief introduction of Carrier and Vectors (mechanical and biological vector), Reservoirs, Host-vector relationship, Vectorial capacity, Adaptations as vectors, Host Specificity

Unit 5: Dipteran as Disease Vectors- Dipterans as important insect vectors – Mosquitoes, Study of mosquito-borne diseases – Malaria, Dengue, Chikungunya, Viral encephalitis, Filariasis; Control of mosquitoes

Unit 6: Siphonaptera as Disease Vectors- Fleas as important insect vectors; Host-specificity, Study of Flea-borne diseases – Plague, Typhus fever; Control of fleas

Practical (=15 marks) [(A2)-ZOOLOGY-G-DSE 4C -P]:

Group A: Experimentation (= 10 marks):

- i. Study of *Plasmodium vivax*, *Entamoeba histolytica*, *Trypanosoma gambiense*, *Ancylostoma duodenale* and *Wuchereria bancrofti* and their life stages through permanent slides/photomicrographs or specimens.
- ii. Study of arthropod vectors associated with human diseases: *Pediculus*, *Culex*, *Anopheles*, *Aedes* and *Xenopsylla*.
- iii. Study of insect damage to different plant parts/stored grains through damaged product/ photographs

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

Internal Assessment (=10 marks) [(A2)-ZOOLOGY-G-DSE 4C -IA]

Skill Enhancement Courses: Zoology (General)

SEC 1: Apiculture (=50 marks)

(Theory: 40 marks, Internal Assessment: 10 marks)

Theory (=40 marks) [ZOOL-G-SEC 1-T]

Unit 1: Biology of Bees- History, classification and biology of honey bees; social organization of bee colony.

Unit 2: Rearing of Bees- Artificial bee rearing (apiary), beehives – Langstroth; bee pasturage, selection of bee species for Apiculture, bee keeping equipment, methods of extraction of honey (indigenous and modern).

Unit 3: Diseases and Enemies- Bee diseases and enemies, control and preventive measures

Unit 4: Bee Economy- Products of Apiculture industry and its uses (honey, bees wax, propolis), pollen, etc.

Internal Assessment (=10 marks) [ZOOL-G-SEC 1 -IA]

SEC 2: Sericulture

(Theory: 40 marks, Internal Assessment: 10 marks)

Theory (=40 Marks) [ZOOL-G-SEC 2-T]:

Unit 1: Introduction- Sericulture: Definition, and present status; types of silkworms, distribution and races; exotic and indigenous races; mulberry sericulture.

Unit 2: Biology of Silkworm- Life cycle of *Bombyx mori*; structure of silk gland and secretion of silk

Unit 3: Rearing of Silkworms- Selection of mulberry variety and establishment of mulberry garden, rearing house and rearing appliances, silkworm rearing technology: types of mountages; spinning, harvesting and storage of cocoons

Unit 4: Pests and Diseases- Pests of silkworm: Uzi fly, pathogenesis of silkworm diseases: Protozoan, fungal and bacterial Control and prevention of pests and diseases.

Internal Assessment (=10 marks) [ZOOL-G-SEC2-IA]

SEC 3: Aquarium Fish Keeping

(Theory: 40 marks, Internal Assessment: 10 marks)

Theory (=40 marks) [ZOOL-G-SEC3-T]:

Unit 1: Introduction to Aquarium Fish Keeping: Exotic and Endemic species of Aquarium Fishes

Unit 2: Scope of Aquarium Fish Keeping: The potential scope of aquarium fish industry as a cottage industry,

Unit 3: Biology of Aquarium Fishes: Common characters and sexual dimorphism of freshwater and marine aquarium fishes such as Guppy, Gold fish, Angel fish.

Unit 4: Food and feeding of Aquarium fishes: Live fish feed organisms, preparation and composition of formulated fish feeds, aquarium fish as larval predator.

Unit 5: Fish Transportation: Live fish transport - fish handling, packing and forwarding techniques.

Internal Assessment (=10 marks) [ZOOL-G-SEC3-IA]

SEC 4: Medical Diagnostics

(Theory: 40 marks, Internal Assessment: 10 marks)

Theory (=40 marks) [ZOOL-G-SEC4-T]:

Unit 1: Introduction to Medical Diagnostics and its Importance

Unit 2: Diagnostics Methods Used for Analysis of Blood-Blood composition, Preparation of blood smear and Differential Leucocyte Count (D.L.C) using Leishman's stain,

Unit 3: Diagnostic Methods Used for Urine Analysis- Urine Analysis: Physical characteristics; Abnormal constituents

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

Unit 6: Tumours- Types (Benign/Malignant), Medical imaging: MRI (using photographs).

Internal Assessment (=10 marks) [ZOOL-G-SEC4-IA]:

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 I accordance to UGC guideline.