UNIVERSITY OF CALCUTTA

Notification No. CSR/ 12 /18

It is notified for information of all concerned that the Syllabi of different subjects in Undergraduate Honours / General / Major courses of studies (CBCS) under this University, as laid down in the accompanying pamphlet:

List of the subjects

Sl. No.	Subject	Sl. No.	Subject
1	Anthropology (Honours / General)	29	Mathematics (Honours / General)
2	Arabic (Honours / General)	30	Microbiology (Honours / General)
3	Persian (Honours / General)	31	Mol. Biology (General)
4	Bengali (Honours / General /LCC2 /AECC1)	32	Philosophy (Honours / General)
5	Bio-Chemistry (Honours / General)	33	Physical Education (General)
6	Botany (Honours / General)	34	Physics (Honours / General)
7	Chemistry (Honours / General)	35	Physiology (Honours / General)
8	Computer Science (Honours / General)	36	Political Science (Honours / General)
9	Defence Studies (General)	37	Psychology (Honours / General)
10	Economics (Honours / General)	38	Sanskrit (Honours / General)
11	Education (Honours / General)	39	Social Science (General)
12	Electronics (Honours / General)	40	Sociology (Honours / General)
13	English ((Honours / General/ LCC1/ LCC2/AECC1)	41	Statistics (Honours / General)
14	Environmental Science (Honours / General)	42	Urdu (Honours / General /LCC2 /AECC1)
15	Environmental Studies (AECC2)	43	Women Studies (General)
16	Film Studies (General)	44	Zoology (Honours / General)
17	Food Nutrition (Honours / General)	45	Industrial Fish and Fisheries – IFFV (Major)
18	French (General)	46	Sericulture – SRTV (Major)
19	Geography (Honours / General)	47	Computer Applications – CMAV (Major)
20	Geology (Honours / General)	48	Tourism and Travel Management – TTMV (Major)
21	Hindi (Honours / General /LCC2 /AECC1)	49	Advertising Sales Promotion and Sales Management –ASPV (Major)
22	History (Honours / General)	50	Communicative English –CMEV (Major)
23	Islamic History Culture (Honours / General)	51	Clinical Nutrition and Dietetics CNDV (Major)
24	Home Science Extension Education (General)	52	Bachelor of Business Administration (BBA) (Honours)
25	House Hold Art (General)	53	Bachelor of Fashion and Apparel Design – (B.F.A.D.) (Honours)
26	Human Development (Honours / General)	54	Bachelor of Fine Art (B.F.A.) (Honours)
27	Human Rights (General)	55	B. Music (Honours / General) and Music (General)
28	Journalism and Mass Communication (Honours / General)		

The above shall be effective from the academic session 2018-2019.

SENATE HOUSE
KOLKATA-700073
The 4th June, 2018

Paul 4/6/18
(Dr. Santanu Paul)
Deputy Registrar

UNIVERSITY OF CALCUTTA

CBCS SYLLABUS OF ZOOLOGY

2018

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THREE-YEAR HONOURS

DEGREE COURSE OF STUDIES

Outline Structure of CBCS Curriculum for Zoology (Hons), C.U.

PART I; SEM I				
Subject Code	**Name of Paper**	**Theory**	**Practical**	**Internal assessment**
CC 1	Non Chordata – I (Protists to Pseudocoelomates)	50	30	20
CC 2	Molecular Biology	50	30	20
PART I; SEM II				
CC 3	Non Chordata – II (All Coelomate Phyla)	50	30	20
CC 4	Cell Biology	50	30	20
PART II; SEM III				
CC 5	Chordata	50	30	20
CC 6	Animal Physiology: Controlling & Co-ordinating System	50	30	20
CC 7	Fundamentals of Biochemistry	50	30	20
SEC-A (1/2)	Apiculture / Sericulture	80	NA	20
PART II; SEM IV				
CC 8	Comparative Anatomy of Vertebrate	50	30	20
CC 9	Animal Physiology: Life sustaining system	50	30	20
CC 10	Immunology	50	30	20
SEC- B(1/2)	Aquarium Fisheries/ Medical Diagnosis	80	NA	20
PART III; SEM V				
CC 11	Ecology	50	30	20
CC 12	Principle of Genetics	50	30	20
DSE A(1/2)	Parasitology/Biology of Insect	50	30	20
DSE B (1/2)	Endocrinology/Reproductive Biology	50	30	20
PART III; SEM VI				
CC 13	Developmental Biology	50	30	20
CC 14	Evolutionary Biology	50	30	20
DSE A (1/2)	Animal Biotechnology/Animal Cell Biotechnology	50	30	20
DSE B (1/2)	Animal Behaviour & Chronology/Fish & Fisheries	50	30	20

Abbreviations:

CC: Core Course; DSE A/B: Discipline Specific Elective A/B; SEC A/B: Skill Enhancement Course.

SUBJECT/PAPER CODE FORMAT

1. **Subject Code: ZOO**
2. **Honours Code: A**
3. **Course Code: a) Core Course: CC**

   b) Discipline Specific Elective: DSE-A/DSE-B

   c) Skill Enhancement Course: SEC-A/SEC-B
4. **Semester Code: 1/2/3/4/5/6**
5. **Paper No. Code: 1/2/3…../14**
6. **Paper Component Code: a) Theory: TH, b) Practical: P**

INDEX

CBCS ZOOLOGY (HONOURS), Papers & Their Codes

PART I: SEMESTER 1

CORE COURSE 1. Non-Chordates I

ZOOA-CC1-1-TH

Full Marks 50	**4 Credits**	**50 Hours**
Non-Chordates I: Protists to Pseudocoelomates		
Unit 1: Basics of Animal Classification		4
Definitions: Classification, Systematics and Taxonomy; Taxonomic Hierarchy, Taxonomic types Codes of Zoological Nomenclature; Principle of priority; Synonymy and Homonymy; Concept of classification – three kingdom concept of Carl Woese, 1977 and five kingdom concept of Whittaker, 1969		
Unit 2: Protista and Metazoa		15
Protozoa General characteristics and Classification up to phylum (according to Levine *et. al.*, 1980) Locomotion in *Euglena*, *Paramoecium* and *Amoeba*; Conjugation in *Paramoecium*. Life cycle and pathogenicity of *Plasmodium vivax* and *Entamoeba histolytica* **Metazoa** Evolution of symmetry and segmentation of Metazoa		
Unit 3: Porifera		6
General characteristics and Classification up to classes (Ruppert and Barnes, 1994, 6th Ed.); Canal system and spicules in sponges		
Unit 4: Cnidaria		10
General characteristics and Classification up to classes (Ruppert and Barnes, 1994, 6th Ed.), Metagenesis in *Obelia*; Polymorphism in Cnidaria; Corals and coral reef diversity, Role of symbiotic algae in reef formation. Conservation of coral and coral reefs.		
Unit 5: Ctenophora		2
General characteristics		
Unit 6: Platyhelminthes		6
General characteristics and Classification up to classes (Ruppert and Barnes, 1994, 6th Ed.) Life cycle and pathogenicity and control measures of *Fasciola hepatica* and *Taenia solium*		
Unit 7: Nematoda		7
General characteristics and Classification up to classes (Ruppert and Barnes, 1994, 6th Ed.) Life cycle, and pathogenicity and control measures of *Ascaris lumbricoides* and *Wuchereria bancrofti* Parasitic adaptations in helminthes		

Non-Chordates I Lab; ZOOA-CC-1-1-P

Non-Chordates I: Protists to Pseudocoelomates

Full Marks 30	**60 Hours**	2 credits
List of Practical		
Study of whole mount of *Euglena*, *Amoeba* and *Paramoecium* Identification with reason & Systematic position of *Amoeba*, *Euglena*, *Entamoeba*, *Paramecium*, *Plasmodium*, *Balantidium*, *Vorticella* (from the prepared slides) Identification with reason & Systematic position of *Sycon*, *Poterion* (Neptune's Cup), *Obelia*, *Physalia*, *Aurelia*, *Gorgonia*, *Metridium*, *Pennatula*, *Madrepora*, *Fasciola hepatica*, *Taenia solium* and *Ascaris lumbricoides.* Staining/mounting of any protozoa/helminth from gut of *Periplaneta* sp.		

CORE COURSE 2: Molecular Biology

ZOOA-CC1-2-TH

Full Marks 50	4 Credits	50 Hours
Unit 1: Nucleic Acids		3
Salient features of DNA, Chargaff's Rule, Hypo and Hyperchromic shift. Watson and Crick Model of DNA. RNA types & Function.		
Unit 2: DNA Replication		9
Mechanism of DNA Replication in Prokaryotes, Prove that replication is Semi-conservative, bidirectional and discontinuous, RNA priming, Replication of telomeres.		
Unit 3: Transcription		9
Mechanism of Transcription in prokaryotes and eukaryotes, Transcription factors, Difference between prokaryotic and eukaryotic transcription.		
Unit 4: Translation		9
Genetic code, Degeneracy of the genetic code and Wobble Hypothesis. Mechanism of protein synthesis in prokaryotes.		
Unit 5: Post Transcriptional Modifications and Processing of Eukaryotic RNA		8
Capping and Poly A tail formation in mRNA; Split genes: concept of introns and exons, splicing mechanism, alternative splicing and RNA editing		

Unit 6: Gene Regulation	7
Regulation of Transcription in prokaryotes: *lac* operon and *trp* operon; Regulation of Transcription in eukaryotes: Activators, enhancers, silencer, repressors, miRNA mediated gene silencing. Epigenetic Regulation: DNA Methylation, Histone Methylation & Acetylation.	
Unit 7: DNA Repair Mechanisms	2
Types of DNA repair mechanisms, RecBCD model in prokaryotes, nucleotide and base excision repair, SOS repair	
Unit 8: Molecular Techniques	3
PCR, Western and Southern blot, Northern Blot	

Molecular Biology Lab; ZOOA-CC-1-2-P

Full Marks 30	**60 Hours**	2 Credits
List of Practical		
1. Demonstration of polytene and lampbrush chromosome from photograph 2. Isolation and quantification of genomic DNA from goat liver. 3. Agarose gel electrophoresis for DNA. 4. Histological staining of DNA and RNA in prepared slides		

PART I: SEMESTER 2

CORE COURSE 3: Non-Chordates II – Coelomates

ZOOA-CC2-3-TH

Full Marks 50	4 Credits	50 Hours
Unit 1: Introduction		2
Evolution of coelom		
Unit 2: Annelida		10
General characteristics and Classification up to classes (Ruppert and Barnes, 1994) Excretion in Annelida through nephridia; Metamerism in Annelida.		
Unit 3: Arthropoda		16
General characteristics and Classification up to classes (Ruppert and Barnes, 1994); Insect Eye (Cockroach only). Respiration in Prawn and Cockroach; Metamorphosis in Lepidopteran Insects; Social life in Termite		
Unit 4: Onychophora		2
General characteristics and Evolutionary significance		

Unit 5: Mollusca	10
General characteristics and Classification up to classes (Ruppert and Barnes, 1994); Nervous system in *Pila sp*. Torsion in Gastropoda. Feeding and respiration in *Pila* sp.	
Unit 6: Echinodermata	8
General characteristics and Classification up to classes (Ruppert and Barnes, 1994); Water-vascular system in *Asterias*. Echinoderm larva and affinities with chordates	
Unit 7: Hemichordata	2
General characteristics of phylum Hemichordata. Relationship with non-chordates and chordates	

Non-Chordates II Lab, ZOOA-CC-2-3-P

Full Marks 30	**2 Credits**
List of Practical	

1. Study of following specimens:
   - **a.** Annelids - *Aphrodite, Nereis, Chaetopterus,* Earthworm, *Hirudinaria*
   - **b.** Arthropods - *Limulus, Palaemon, Balanus, Eupagurus, Scolopendra, Peripatus,* Silkworm – life history stages, Termite – members of a colony and Honey bee – members of the colony
   - **c.** Molluscs - *Dentalium, Patella, Chiton, Pila, Achatina, Pinctada, Sepia, Octopus, Nautilus*
   - **d.** Echinoderms - *Asterias, Ophiura, Clypeaster, Echinus, Cucumaria* and *Antedon*
2. Anatomy study: Nervours system, Reproductive system (Male & female), Mouth parts & Salivary apparatus in *Periplaneta* sp.

PART I: SEMESTER 2

CORE COURSE 4: Cell Biology

ZOOA-CC2-4-TH

Full Marks 50	**4 Credits**	**50 Hours**
Unit 1: Plasma Membrane		7
Ultra-structure and composition of Plasma membrane: Fluid mosaic model, Transport across membrane - Active and Passive transport, Facilitated transport, Cell junctions: Tight junctions, Gap junctions, Desmosomes		
Unit 2: Cytoplasmic organelles I		5
Structure and Functions: Endoplasmic Reticulum, Golgi Apparatus, Lysosomes; Protein sorting and mechanisms of vesicular transport		
Unit 3: Cytoplasmic organelles II		7
Mitochondria: Structure, Semi-autonomous nature, Endosymbiotic hypothesis Mitochondrial Respiratory Chain, Chemiosmotic hypothesis; Peroxisomes: Structure and Functions		

Centrosome (Kinetochore and centromeric DNA): Structure and Functions	
Unit 4: Cytoskeleton	5
Type, structure and functions of cytoskeleton; Accessory proteins of microfilament & microtubule	
Unit 5: Nucleus	8
Nuclear envelope, Nuclear pore complex, Nucleolus; Chromatin: Euchromatin and Heterochromatin and packaging (nucleosome),	
Unit 6: Cell Cycle	10
Cell cycle and its regulation, Cancer (Concept of oncogenes and tumor suppressor genes with special reference to p53, Retinoblastoma and Ras. Process of Proto-oncogene activation	
Unit 7: Cell Signalling	8
Cell signalling transduction pathways; Types of signalling molecules and receptors (Classification and Example only): RTK & JAK/STAT. Apoptosis	

Cell Biology Lab; ZOOA-CC-2-4-P

Full Marks 30	**60 Hours**	2 Credits
List of Practical		

1. Preparation of temporary stained squash of onion/arum root tip to study various stages of mitosis
2. Study of various stages of meiosis from grasshopper testis
3. Preparation of permanent slide to show the presence of Barr body in human female blood cells/cheek cells.
4. Preparation of permanent slide to demonstrate:
    a. DNA by Feulgen reaction
    b. Cell viability study by Trypan Blue staining

PART II: SEMESTER 3.

CORE COURSE 5 : Chordata

ZOOA-CC3-5-TH

Full Marks 50	4 Credits	50 Hours
Unit 1: Introduction to Chordates		2
General characteristics and outline classification of Phylum Chordata (Young, 1981)		
Unit 2: Protochordata		7
General characteristics and classification of sub-phylum Urochordata and Cephalochordata up to Classes (Young, 1981). Metamorphosis in *Ascidia*. Chordate Features, structure of pharynx and feeding in *Branchiostoma*		

Unit 3: Agnatha	2
General characteristics and classification of cyclostomes up to order (Young, 1981)	
Unit 4: Pisces	7
General characteristics and classification up to living sub classes (Young, 1981); Accessory respiratory organ, Migration in fishes; Parental care in fishes; Swim bladder in fishes.	
Unit 5: Amphibia	7
General characteristics and classification up to living Orders (Young, 1981); Metamorphosis, Paedomorphosis, Parental care in Amphibia	
Unit 6: Reptilia	8
General characteristics and classification up to living Orders (Young, 1981); Poison apparatus and Biting mechanism in Snake. Poisonous & Non-Poisonous snake.	
Unit 7: Aves	8
General characteristics and classification up to living Sub-Classes (Young, 1981); Exoskeleton and migration in Birds; Principles and aerodynamics of flight	
Unit 8: Mammals	9
General characters and classification up to living sub classes (Young, 1981); Exoskeleton derivatives of mammals; Adaptive radiation in mammals with reference to locomotory appendages; Echolocation in Micro chiropterans	

Chordata Lab; ZOOA-CC-3-5-P

Full Marks 30	**60 Hours**	2 Credits
List of Practical		

Identification with Reasons

a) **Protochordata**: *Balanoglossus*, *Branchiostoma*
b) **Agnatha**: *Petromyzon*
c) **Fishes**: *Scoliodon, Sphyrna, Pristis, Torpedo, Mystus, Heteropneustes, Labeo rohita, Exocoetus, Hippocampus, Anabas,* Flat fish
d) **Amphibia**: *Necturus, Bufo (Duttaphrynus) melanostictus, Rana (Hoplobatrachus) tigerinus, Hyla, Tylototriton,* Axolotl larva
e) **Reptilia**: Chelone, Trionyx, Hemidactylus, Varanus, *Calotes*, *Chamaeleon, Draco, Vipera, Naja, Hydrophis,*
f) **Mammalia**: Bat (Insectivorous and Frugivorous), *Funambulus* (Indian Palm squirrel)

Dissection of brain and pituitary – *ex situ*, digestive and Urino-genital system of *Tilapia*

Pecten from Fowl head

Power point presentation on study of habit, habitat or behaviour of any one animal by student – for internal assessment only

PART II: SEMESTER 3.

CORE COURSE 6: Animal Physiology: Controlling and Co-ordinating System

ZOOA-CC3-6-TH

Full Marks 50	4 Credits	50 Hours
Unit 1: Tissues		4
Structure, location, classification and functions of epithelial tissue, connective tissue, muscular tissue and nervous tissue		
Unit 2: Bone and Cartilage		4
Structure and types of bones and cartilages, Ossification		
Unit 3: Nervous System		10
Structure of neuron, resting membrane potential, Origin of action potential and its propagation across the myelinated and non-myelinated nerve fibres; Types of synapse, Synaptic transmission and Neuromuscular junction		
Unit 4: Muscular system		10
Histology of different types of muscle; Ultra-structure of skeletal muscle; Molecular and chemical basis of muscle contraction; Characteristics of muscle fibre		
Unit 5: Reproductive System		6
Histology of mammalian testis and ovary; physiology of mammalian reproduction – menstrual and oestrous cycle		
Unit 6: Endocrine System		16
Histology and function of thyroid, pancreas and adrenal. Function of pituitary Classification of hormones; Mechanism of Hormone action; Signal transduction pathways for Steroidal and Non- steroidal hormones; Hypothalamus (neuroendocrine gland) - principal nuclei involved in neuroendocrine control of anterior pituitary; Placental hormones		

Animal Physiology: Controlling & Coordinating Systems, Lab;

ZOOA-CC3-6-P

Full Marks 30	**60 Hours**	2 Credits
List of Practical		
1. Recording of cardiac and simple muscle twitch with electrical stimulation 2. Preparation of temporary mounts: Squamous epithelium, Striated muscle fibres and nerve cells 3. Study of permanent slides of Mammalian Skin, Spinal cord, Pancreas, Testis, Ovary, Adrenal, Lung, pyloric stomach, cardiac stomach, Thyroid, small intestine and large intestine of mammal (white rat) 4. Microtomy: Preparation of permanent slide of any five mammalian (Goat/white rat) tissues		

PART II: SEMESTER 3

CORE COURSE 7: Fundamentals of Biochemistry

ZOOA-CC3-7-TH

Full Marks 50	4 Credits	50 Hours
Unit 1: Carbohydrates		8
Structure and Biological importance: Monosaccharides, Disaccharides, Polysaccharides; Derivatives of Monosaccharides; Carbohydrate metabolism: Glycolysis, Citric acid cycle, Pentose phosphate pathway, Gluconeogenesis		
Unit 2: Lipids		7
Structure and Significance: Physiologically important saturated and unsaturated fatty acids, Tri-acylglycerols, Phospholipids, Sphingolipid, Glycolipids, Steroids, Eicosanoids and terpinoids. Lipid metabolism: β-oxidation of fatty acids - a. Palmitic acid {saturated (C 16:0)}, b. Linoleic acid {unsaturated (C 18:2)}; Fatty acid biosynthesis		
Unit 3: Proteins		10
Amino acids: Structure, Classification, General and Electro chemical properties of α-amino acids; Physiological importance of essential and non-essential amino acids, Proteins Bonds stabilizing protein structure; Levels of organization; Protein metabolism: Transamination, Deamination, Urea cycle, Fate of C-skeleton of Glucogenic and Ketogenic amino acids		
Unit 4: Nucleic Acids		10
Structure of Purines, Pyrimidines, Nucleosides and Nucleotides; Nucleic Acid Metabolism: Catabolism of adenosine, Guanosine, cytosine and thymine.		
Unit 5: Enzymes		13
Nomenclature and classification; Cofactors; Specificity of enzyme action; Isozymes; Mechanism of enzyme action; Enzyme kinetics; Derivation of Michaelis-Menten equation, Lineweaver-Burk plot; Factors affecting rate of enzyme-catalyzed reactions; Enzyme inhibition.		
Unit 5: Oxidative Phosphorylation		**2**
Redox systems; Mitochondrial respiratory chain, Inhibitors and un-couplers of Electron Transport System		

Fundamentals of Biochemistry Lab; ZOOA-CC-7-3-P

Fundamentals of Biochemistry		
Full Marks 30	**60 Hours**	**2 Credits**
List of Practical		
1. Qualitative tests for carbohydrates, proteins and lipids 2. Qualitative estimation of Urea & Uric acid 3. Paper chromatography of amino acids. 4. Quantitative estimation of water soluble proteins following Lowry Method		

PART II: SEMESTER 4

CORE COURSE 8.Comparative Anatomy of Vertebrates

ZOOA-CC4-8-TH

Full Marks 50	4 Credits	50 Hours
Unit 1: Integumentary System		10
Structure, function and derivatives of integument in amphibian, birds and mammals		
Unit 2: Digestive System		6
Comparative anatomy of stomach; dentition in mammals		
Unit 3: Respiratory System		6
Respiratory organs in fish, birds and mammals		
Unit 4: Circulatory System		7
General plan of circulation, Comparative account of heart and aortic arches		
Unit 5: Urinogenital System		5
Succession of kidney in different vertebrate groups; evolution of urino-genital ducts		
Unit 6: Nervous system and sense organs		**8**
Comparative account of brain in vertebrates; cranial nerves; olfactory and auditory receptors in vertebrates		
Unit 7: Skeletal system		**8**
Overview of axial and appendicular skeleton – limbs, girdles of pigeon; jaw suspension in mammals		

Comparative Anatomy of Vertebrates Lab; ZOOA-CC4-8-P

Full Marks 30	60 Hours	2 Credits
List of Practical		
1. Study of placoid, cycloid and ctenoid scales through permanent slides/photographs 2. Study of disarticulated skeleton of toad, Pigeon, Guineapig (limb bones, vertebrae, limb and girdle) 3. Comparative study of heart and brain, with the help of model/picture 4. Identification of skulls: Pigeon, one herbivore (Guineapig) and one carnivore (Dog) animal		

PART II: SEMESTER 4

CORE COURSE 9: Animal Physiology: Life Sustaining Systems

ZOOA-CC4-9-TH

Full Marks 50	4 Credits	50 Hours
Unit 1: Physiology of Digestion		10
Structural organisation and function of gastro-intestinal tract; Mechanical and chemical digestion of food, absorption of Carbohydrates, Lipids and Proteins in Human		
Unit 2: Physiology of Respiration		10
Mechanism of Respiration, Respiratory volumes and capacities, transport of Oxygen and Carbon dioxide in blood, Dissociation curves and the factors influencing it, respiratory pigments; Carbon monoxide poisoning		
Unit 3: Physiology of Circulation		8
Structure and functions of haemoglobin; Blood clotting system; Haematopoiesis; Basic steps and its regulation; Blood groups; ABO and Rh factor		
Unit 4: Physiology of Heart		**8**
Coronary Circulation, Structure and working of conducting myocardial fibres, Origin and conduction of cardiac impulses; Cardiac Cycle and cardiac output		
Unit 5: Thermoregulation & Osmoregulation		6
Thermal regulation in camel and polar bear, Osmoregulation in aquatic vertebrates		
Unit 6: Renal Physiology		8
Structure of Kidney and its functional unit, Mechanism of urine formation, Regulation of acid-base balance		

Animal Physiology: Life Sustaining Systems Lab; ZOOA-CC4-9-P

Full Marks 30	60 Hours	2 Credits
List of Practical		
1. Determination of ABO Blood group 2. Estimation of haemoglobin using Sahli's haemoglobin meter 3. Identification of blood cells from human blood 4. Preparation of haemin crystals and haemochromogen crystals 5. Identification of blood cells from cockroach haemolymph 6. Demonstration of blood pressure by digital meter		

PART II: SEMESTER 4

CORE COURSE 10: Immunology

ZOOA-CC4-10-TH

Full Marks 50	4 Credits	50 Hours
Unit 1: Overview of Immune System		3
Introduction – concept of health and disease; Cells and organs of the Immune system		
Unit 2: Innate and Adaptive Immunity		9
Anatomical barriers, Inflammation, Cell and molecules involved in innate immunity, Adaptive immunity (Cell mediated and humoral).		
Unit 3: Antigens		6
Antigenicity and immunogenicity, Immunogens, Adjuvants and haptens, Factors influencing immunogenicity, B and T-Cell epitopes		
Unit 4: Immunoglobulins		10
Structure and functions of different classes of immunoglobulins, Antigen-antibody interactions, Immunoassays (ELISA and RIA), Monoclonal antibody production		
Unit 5: Major Histocompatibility Complex		6
Structure and functions of MHC molecules. Structure of T cell Receptor and its signalling, T cell development & selection		
Unit 6: Cytokines		3
Types, properties and functions of cytokines.		

Unit 7: Complement System	5
Components and pathways of complement activation.	
Unit 8: Hypersensitivity	4
Gell and Coombs' classification and brief description of various types of hypersensitivities.	
Unit 9: Vaccines	4
Various types of vaccines. Active & passive immunization (Artificial and natural).	

Immunology Lab; ZOOA-CC4-10-P

Full Marks 30	**60 Hours**	2 Credits
List of Practical		
1. Demonstration of lymphoid organs (by picture). 2. Histological study of Bursa fabricius, spleen, thymus and lymph nodes through slides/ photographs 3. Demonstration of ELISA		

PART III: SEMESTER 5

CORE COURSE 11.Ecology

ZOOA-CC5-11-TH

Full Marks 50	4 Credits	50 Hours
Unit 1: Introduction to Ecology		4
Autecology and synecology, Levels of organization, Laws of limiting factors, Study of Physical factors, The Biosphere.		
Unit 2: Population		20
Unitary and Modular populations Unique and group attributes of population: Demographic factors, life tables, fecundity tables, survivorship curves, dispersal and dispersion. Geometric, exponential and logistic growth, equation and patterns, r and K strategies Population regulation - density-dependent and independent factors, Population Interactions, Gause's Principle with laboratory and field examples, Lotka-Volterra equation for competition.		
Unit 3: Community		11
Community characteristics: species diversity, abundance, dominance, richness, Vertical stratification, Ecotone and edge effect; Ecological succession with one example.		

Unit 4: Ecosystem	8
Types of ecosystem with an example in detail, Food chain: Detritus and grazing food chains, Linear and Y-shaped food chains, Food web, Energy flow, Ecological pyramids and Ecological efficiencies; Nitrogen cycle.	
Unit 5: Applied Ecology	7
Types & level of biodiversity Mega-diversity countries, Biodiversity Hot spot, Flagship species, Keystone species, Wildlife Conservation (*in situ* and *ex situ* conservation), concept of protected areas. Red data book, Indian wild life act & Schedule. Concept of corridor, advantages and problem of corridor. Threats to survival and conservation strategies for Tiger, Olive ridley, White Rumped Vulture.	

Ecology Lab, ZOOA-CC5-11-P

Full Marks 30	**60 Hours**	2 Credits
List of Practical		
1. Determination of population density in a natural/hypothetical community by quadrate method and calculation of Shannon-Weiner diversity index for the same community 2. Study of an aquatic ecosystem: Phytoplankton and zooplankton, Measurement of area, temperature, salinity, determination of pH, and Dissolved Oxygen content (Winkler's method), Chemical Oxygen Demand and free CO_2 **3.** Report on a visit to National Park/Biodiversity Park/Wild life sanctuary/ any place of ecological interest/ ecological uniqueness/ Zoological garden		

PART III: SEMESTER 5

CORE COURSE 12.Principle of Genetics

ZOOA-CC5-12-TH

Full Marks 50	4 Credits	Class
Unit 1: Mendelian Genetics and its Extension		12
Principles of inheritance, Incomplete dominance and co-dominance, Epistasis, Multiple alleles, Isoallele (White eye mutations), Pseudoallele (Lozenge Locus) & Cis-trans test for allelism, Lethal alleles, Pleiotropy, Penetrance & Expressivity		
Unit 2: Linkage, Crossing Over and Linkage Mapping		8
Linkage and Crossing, Complete & Incomplete Linkage, Measuring Recombination frequency and linkage map construction using three factor crosses, Interference and coincidence Sex linkage in *Drosophila* (White eye locus) & Human (Haemophilia).		

Unit 3: Mutations	12
Types of gene mutations (Classification), Types of chromosomal aberrations (Classification with one suitable example from *Drosophila* and Human of each), variation in chromosome number; Non-disjunction of X chromosome in *Drosophila*; Non-disjunction of Human Chromosome 21. Molecular basis of mutations in relation to UV light and chemical mutagens. Mutation detection in *Drosophila* by attached X method. Biochemical mutation detection in *Neurospora*.	
Unit 4: Sex Determination	8
Mechanisms of sex determination in *Drosophila* and in man; Dosage compensation in *Drosophila* & Human	
Unit 5: Extra-chromosomal Inheritance	2
Kappa particle in *Paramoecium*, Shell spiralling in snail	
Unit 6: Genetic Fine Structure	2
Complementation test in Bacteriophage (Benzer's experiment on rII locus)	
Unit 7: Transposable Genetic Elements	6
IS element in bacteria, Ac-Ds elements in maize and P elements in *Drosophila*, LINE, SINE, Alu elements in humans	

Principles of Genetics Lab, ZooA-CC5-12-P

Full marks 30	**60 Hours**	2 Credits
List of Practical		
1. Chi-square analyses for genetic ratio test 2. Identification of chromosomal aberration in *Drosophila* and man from photograph 3. Pedigree analysis of some inherited traits in animals		

PART III: SEMESTER 6

CORE COURSE 13: Developmental Biology

ZOOA-CC6-13-TH

Full Marks 50	4 Credits	50 Hours
Unit 1: Early Embryonic Development		20
Gametogenesis: Spermatogenesis, Oogenesis (sea urchin & mammal); Types of eggs, Egg membranes; Fertilization in sea urchin and mammal; Planes and patterns of cleavage; Types of Blastula [frog and chick]; Fate map in chick embryo, fate mapping using vital dye and radioactive technique; Gastrulation in frog and chick; Embryonic induction and organizers in *Xenopus* (Spemann & Mangold's experiment)		

Unit 2: Late Embryonic Development	10
Extra-embryonic membranes in Chick; Implantation of embryo in humans, Placenta (Structure, types and functions of placenta)	
Unit 3: Post Embryonic Development	8
Development of brain and Eye in Chick. Molecular Induction in Brain and Eye development.	
Unit 4: Implications of Developmental Biology	12
In vitro fertilization (IVF), Stem cell: Concept of potency, types, markers and applications of stem cell therapy in bone marrow transplantation and cartilage regeneration	

Developmental Biology Lab; ZOOA-ZooA-CC6-13-P

Full Marks 30	**60 Hours**	2 Credits
List of Practical		
1. Study of whole mounts of developmental stages of chick embryo through permanent slides: 24, 48, and 96 hours of incubation 2. Study of the developmental stages and life cycle of *Drosophila* 3. Study of different sections of placenta (photomicropgraph/ slides) 4. Identification of Invertebrate larva through slides/ photographs of Phylum Annelida, Arthropoda, Mollusca and Echinodermata		

PART III: SEMESTER 6

CORE COURSE 14.Evolutionary Biology

ZOOA-CC6-14-TH

Full Marks 50	4 Credits	50 Hours
Unit 1		**5**
Origin of Life (Chemical basis), RNA world hypothesis		
Unit 2		5
Historical review of Evolutionary concepts: Lamarkism, Darwinism and Neo Darwinism		
Unit 3		6
Geological time scale, Fossil: types and age determination by Carbon dating, Evolution of horse		
Unit 4		6
Natural Selection: Modes with Examples;		

Unit 5	10
Species concept, Isolating mechanisms, modes of speciation; Speciation by chromosome rearrangement in *Drosophila*. Adaptive radiation/macroevolution (exemplified by Galapagos finches).	
Unit 6	2
Origin and Evolution of Man, Unique Hominid characteristics contrasted with primate characteristic	
Unit 7	10
Population genetics: Hardy-Weinberg Law; factors disrupting H-W equilibrium (Genetic Drift, Migration and Mutation and Selection in changing allele frequencies (only derivations required). Simple problems related to estimation of allelic and gene frequencies.	
Unit 8	**3**
Extinction, back ground and mass extinctions, detailed example of K-T extinction	
Unit 9	**5**
Phylogenetic trees, construction and interpretation of Phylogenetic tree using parsimony, convergent and divergent evolution.	

Evolutionary Biology Lab, ZooA-CC6-14-P

Full Marks 30	**60 Hours**	2 Credits
List of Practical		
1. Study of fossils from models/ pictures: Dickinsonia, Paradoxides (Trilobita), Asteroceras (Ammonoid), Pentremites (Blastoid Echinoderm), Ichthyosaur, Archaeopteryx, Cynodont. 2. Study of homology and analogy from suitable specimens. 3. Phylogenetic trees, Construction & interpretation of Phylogenetic tree using parsimony, Construction of dendrogram following principles of phenetics & cladistics from a data table.		

Discipline Specific Elective

[Students will choice either of ZOOA-DSE(A)-5-1-TH or ZOOA-DSE(A)-5-2-TH]

PART III: SEMESTER 5

DSE1. Parasitology

ZOOA-DSE(A)-5-1-TH

Full Marks 50	**4 Credits**	**50 hours**
Unit 1: Introduction to Parasitology		2
Brief introduction of Parasitism, Parasite, Parasitoid and Vectors (mechanical and biological vector); Host parasite relationship		
Unit 2: Parasitic Protists		12
Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Giardia intestinalis*, *Trypanosoma gambiense*, *Leishmania donovani*		
Unit 3: Parasitic Platyhelminthes		12
Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Schistosoma haematobium*, *Taenia solium*		
Unit 4: Parasitic Nematodes		12
Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Ascaris lumbricoides*, *Ancylostoma duodenale*, *Wuchereria bancrofti*, Nematode plant interaction.		
Unit 5: Parasitic Arthropods		10
Biology, importance and control of ticks: Soft tick (*Ornithodoros)*, Hard tick (*Ixodes*), mites (*Sarcoptes*), Lice (*Pediculus*), Flea (*Xenopsylla*) and Bug (*Cimex*). Parasitoid.		
Unit 6: Parasite Vertebrates		**2**
Cookicutter Shark, Hood Mocking bird, Vampire bats their parasitic behaviour and effect on host.		

Parasitology Lab, ZOOA-DSE(A)-5-1-P

Full Marks 30	**60 Hours**	2 Credits
List of Practical		

1. Study of life stages of *Giardia intestinalis*, *Trypanosoma gambiense*, *Leishmania donovani*, *Plasmodium vivax*, *Plasmodium falciparum* through permanent slides/micro photographs
2. Study of adult and life stages of *Schistosoma haematobium*, *Taenia solium* through permanent slides/micro photographs
3. Study of adult and life stages of *Ancylostoma duodenale* through permanent slides/micro photographs.

4. Study of monogenea from the gills of fresh/marine fish [Gills can be procured from fish market as by product of the industry]
5. Study of nematode/cestode parasites from the intestines of Poultry bird [Intestine can be procured from poultry/market as a by-product] & Goat.

Submission of a brief report on parasitic vertebrates

PART III: SEMESTER 5

DSE2. Biology of Insects

ZOOA-DSE(A)-5-2-TH

Full Marks 50	4 Credits	50 Hours
Unit 1: Insect Taxonomy		4
Basis of insect classification; Classification of insects up to orders (Ruppert and Barnes, 1994)		
Unit 2: General Morphology of Insects		6
External Features; Head – Eyes, Types of antennae, Mouth parts with respect to feeding habits Thorax: Wings and wing articulation, Types of Legs adapted to diverse habitat Abdominal appendages and genitalia		
Unit 3: Physiology of Insects		20
Structure and physiology of Insect body systems - Digestive, respiratory, endocrine and nervous system Photoreceptors: Types, Structure and Function Metamorphosis: Types and Neuroendocrine control of metamorphosis		
Unit 4: Insect Society		7
Social insects with special reference to termites Trophallaxis in social insects such as ants, termites and bees		
Unit 5: Insect Plant Interaction		4
Theory of co-evolution, role of allelochemicals in host plant mediation Host-plant selection by phytophagous insects, Major insect pests in paddy		
Unit 6: Insects as Vectors		**9**
Insects as mechanical and biological vectors, Brief discussion on houseflies and mosquitoes as important vectors		

Biology of Insect Lab, ZOOA-DSE(A)-5-2-P

Full Marks 30	**60 Hours**	2 Credits
List of Practical		
1. Study of life cycle of Mosquito 2. Study of different kinds of antennae, legs and mouth parts of insects 3. Mounting of insect wings any insects 4. Methodology of collection, preservation and identification of insects. *5.* Morphological studies of various castes of *Apis*, Ant-*Camponotus*, Termite-*Odontotermes* 6. Study of major insect pests of paddy and their damages 7. Study of Mulberry silk moth as beneficial insect		

Students will choice either of ZOOA-DSE(B)-5-1-TH or ZOOA-DSE(B)-5-2-TH

PART III: SEMESTER 5

DSE1. Endocrinology

ZOOA-DSE(B)-5-1-TH

Full Marks 50	4 Credits	50 Hours
Unit 1: Introduction to Endocrinology		**6**
General idea of Endocrine systems, Classification, Characteristic and Transport of Hormones, Neuro-secretions and Neuro-hormones: Examples and Functions		
Unit 2: Hypothalamo-Hypophyseal Axis		12
Structure and functions of hypothalamus and Hypothalamic nuclei, Regulation of neuroendocrine glands, Feedback mechanisms, Hypothalamo-Hypophyseal-Gonadal Axis. Structure of pituitary gland, Hormones and their functions, Hypothalamo-hypophyseal portal system		
Unit 3: Peripheral Endocrine Glands		12
Structure, Hormones and Functions of Thyroid gland, Parathyroid, Adrenal, Pancreas, Ovary and Testis. Disorders of endocrine glands (*Diabetes mellitus* type I & Type II; Graves' Disease).		
Unit 4: Regulation of Hormone Action		12
Mechanism of action of steroidal, non-steroidal hormones with receptors (cAMP, IP3-DAG), Calcium and Glucose homeostasis in mammals. Bioassays of hormones using RIA & ELISA, Estrous cycle in rat and menstrual cycle in human.		

Unit 5. Non Mammalian Vertebrate Hormone	**8**
Functions of Prolactin in Fishes, Amphibia & Birds Function of Melanotropin in Teleost fishes, Amphibians and Reptiles.	

Endocrinology Lab, ZOOA-DSE(B)-5-1-P

Full Marks 30	**60 Hours**	**2 Credits**

List of Practical

1. Dissect and display of Endocrine glands in laboratory bred rat.
2. Study of the permanent slides of all the endocrine glands
3. Tissue fixation, embedding in paraffin, microtomy and slide preparation of any endocrine gland.
4. H-E staining of Histological slides.

PART III: SEMESTER 5

DSE2. Reproductive Biology

ZOOA-DSE(B)-5-2-TH

Full Marks 50	**4 Credits**	**50 Hours**
Unit 1: Reproductive Endocrinology		**10**
Mechanism of action of steroid and glycoprotein hormones. Hypothalamo – Hypophyseal – gonadal axis, regulation of gonadotrophin secretion in human (male and female); Reproductive system: Development and differentiation of gonads, genital ducts and external genitalia		
Unit 2: Functional anatomy of male reproduction		14
Histoarchitechture of testis in human; Spermatogenesis and its hormonal regulation; Androgen synthesis and metabolism; Accessory glands functions		
Unit 3: Functional anatomy of female reproduction		18
Histoarchitechture of ovary in human; Oogenesis and its hormonal regulation; Steroidogenesis and secretion of ovarian hormones; Reproductive cycles (human) and their regulation, Fertilization; Hormonal control of implantation; Hormonal regulation of gestation, pregnancy diagnosis, feto-maternal relationship; Mechanism of parturition and its hormonal regulation; Lactation and its regulation		
Unit 4: Reproductive Health		8
Infertility in male and female: causes, diagnosis and management, Assisted Reproductive Technology: Sex selection, sperm banks, frozen embryos, *in vitro* fertilization IVF & IUI Modern contraceptive technologies		

Reproductive Biology Lab, ZOOA-DSE(B)-5-2-P

Full Marks 50	**60 Hours**	2 Credits
List of Practical		
1. Study of animal house: set up and maintenance of animal house, breeding techniques, care of normal and experimental animals (only demonstration through chart). 2. Tissue fixation, embedding in paraffin, microtomy and slide preparation of any endocrine gland. 3. H-E staining of histological slides. 4. Examination of histological sections from photomicrographs/ permanent slides of rat/human: testis, epididymis and accessory glands of male reproductive systems; ovary, fallopian tube, uterus (proliferative and secretory stages), cervix and vagina.		

Students will choice either of ZOOA-DSE(A)-6-1-TH or ZOOA-DSE(A)-6-2-TH

PART III: SEMESTER 6

DSE1. Animal Cell Biotechnology

ZOOA-DSE(A)-6-1-TH

Full Marks 50	4 Credits	50 Hours
Unit 1: Introduction		2
Concept and Scope of Biotechnology		
Unit 2: Techniques in Gene manipulation		15
Recombinant DNA technology, Restriction endonucleases. Cloning Vectors & their features: Plasmids, Phage vectors, Cosmids, Phagemids, BAC, YAC, and HAC. Shuttle and Expression Vectors. Construction of Genomic libraries and cDNA libraries Transformation techniques: Cloning in bacteria and detection technique of clone		
Unit 3: Animal cell Culture		15
Basic techniques in animal cell culture and organ culture, Primary Culture and Cell lines, Culture media – Natural and Synthetic, Stem cells, Cryopreservation of cultures. Agarose and Polyacrylamide Gel Electrophoresis, Southern, Northern and Western blotting, Polymerase chain reaction: Allele specific, RAPD & RT PCR.		
Unit 4: Fermentation		10
Different types of Fermentation: Submerged & Solid state; batch, Fed batch & Continuous; Stirred tank, Air Lift, Fixed Bed and Fluidized. Downstream Processing: Filtration, centrifugation, extraction, chromatography, spray drying and lyophilization.		

Unit 5: Application in Health	8
Hybridoma technology, Production of recombinant Proteins: Insulin and growth hormones.	

Animal Cell Biotechnology Lab, ZOOA-DSE(A)-6-1-P

Full Marks 50	**60 Hours**	2 Credits
List of Practical		

1. Packing and sterilization of glass and plastic wares for cell culture.
2. Preparation of culture media.
3. Preparation of genomic DNA from E. coli/animals/ human.
4. Plasmid DNA isolation (pUC 18/19) and DNA quantitation using agarose gel electrophoresis (by using lambda DNA as standard).
5. Techniques: Western Blot, Southern Hybridization, DNA Fingerprinting, PCR, DNA Microarrays (By Photograph).

PART III: SEMESTER 6

DSE2. Animal Biotechnology

ZOOA-DSE(A)-6-2-TH

Full Marks 50	4 Credits	Class
Unit 1: Introduction		5
Organization of *E.coli* and *Drosophila* genome.		
Unit 2: Molecular Techniques in Gene manipulation		23
Recombinant DNA technology, Restriction endonucleases. Cloning Vectors & their features: Plasmids, Phage vectors, Cosmids, Phagemids, BAC, YAC, and HAC. Shuttle and Expression Vectors. Construction of Genomic libraries and cDNA libraries Transformation techniques: Cloning in bacteria and detection technique of clone Agarose and Polyacrylamide Gel Electrophoresis, Southern, Northern and Western blotting, Polymerase chain reaction: Allele specific, RAPD & RT PCR, DNA Fingerprinting		
Unit 3: Genetically Modified Organisms		12
Production of cloned and transgenic animals: Nuclear Transplantation, Retroviral Method, DNA microinjection. Applications of transgenic animals: Production of pharmaceuticals, production of donor organs, knock-out mice.		
Unit 4: Culture Techniques and Applications		10
Animal cell culture, Expressing cloned genes in mammalian cells, Molecular diagnosis of		

genetic diseases (Cystic fibrosis, Sickle cell anaemia, Thalassemia). Dolly &Polly cloning Genetically modified economically important animal Gene Therapy	

Animal Biotechnology Lab, ZOOA-DSE(A)-6-2-P

Full Marks 30	**60 Hours**	2 Credits
List of Practical		

1. Genomic DNA isolation from *E. coli* and Plasmid DNA isolation (pUC 18/19) from *E. coli*
2. To study following techniques through photographs - Southern Blotting, Northern Blotting, Western Blotting, PCR, DNA fingerprinting
3. Project report on animal cloning & Application & ethical Issues.

Students will choice either of ZOOA-DSE(B)-6-1-TH or ZOOA-DSE(B)-6-2-TH

PART III: SEMESTER 6

DSE1. Animal Behaviour and Chronobiology

ZOOA-DSE(B)-6-1-TH

Full Marks 50	4 Credits	50 Hours
Unit 1: Patterns of Behaviour		10
Stereotyped Behaviours (Orientation, Reflex); Individual Behavioural patterns; Instinct vs. Learned Behaviour; FAP, Associative learning, classical and operant conditioning, Habituation, Imprinting.		
Unit 2: Social and Sexual Behaviour		20
Social organisation in termites; Communication (dance & pheromones in Bees) Social behaviour: Altruism (Hamilton's rule and concept of haplodiploidy), Cooperation and Selfishness Sexual Behaviour: Sexual dimorphism, Mate choice in peacock, Intra-sexual selection (male rivalry in red deer) Kinship theory: Relatedness & inclusive fitness; parental care in fishes (Nest Building & coast benefit), conflict within families: parent offspring conflict and sibling rivalry		
Unit 3: Chronobiology & Biological Rhythm		20
Types and characteristics of biological rhythms: Short- and Long- term rhythms; Circadian rhythms; Tidal rhythms and Lunar rhythms, Circannual rhythms; Photic and non-photic zeitgebers; Role of melatonin. Biological clock and its adaptive significance. Circannual rhythm in bird migration.		

Animal Behaviour and Chronobiology Lab, ZOOA-DSE(B)-6-1-P

Full Marks 50	**60 Hours**	2 Credits
List of Practical		

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

PART III: SEMESTER 6

DSE2. Fish and Fisheries

ZOOA-DSE(B)-6-2-TH

Full Marks 50	4 Credits	50 Hours
Unit 1: Introduction and Classification		**4**
Feeding habit, habitat and manner of reproduction. Classification of fish (upto Subclasses) (Romar, 1959)		
Unit 2: Morphology and Physiology		14
Types of fins and their modifications; Locomotion in fish; Hydrodynamics; Types of Scales, Use of scales in Classification and determination of age of fish; Gills and gas exchange; Swim Bladder: Types and role in Respiration, buoyancy; Electric organ, Bioluminescence		
Unit 3: Fisheries		10
Inland Fisheries; Marine Fisheries; Fishing crafts and Gears; Depletion of fisheries resources; Application of remote sensing and GIS in fisheries; Fisheries law and regulations		
Unit 4: Aquaculture		16
Extensive, semi-intensive and intensive culture of fish; Pen and cage culture; Polyculture; Composite fish culture; Brood stock management; Induced breeding of fish; Management of finfish hatcheries; Preparation and maintenance of fish aquarium; Preparation of compound diets for fish; Role of water quality in aquaculture; Fish diseases: Bacterial, viral and parasitic; Preservation and processing of harvested fish, Fishery by-products		
Unit 5: Fish in research		6
Transgenic fish Zebra fish as a model organism in research		

Fish and Fisheries Lab, ZOOA-DSE(B)-6-2-P

Full Marks 30	**60 Hours**	2 Credits

List of Practical

1. Morphometric and meristic characters of fishes
2. Identification of *Petromyzon, Myxine, Pristis, Exocoetus, Hippocampus, Gambusia, Labeo, Heteropneustes, Anabas*
3. Study of different types of scales (through permanent slides/ photographs).
4. Study of crafts and gears used in Fisheries (Photoghaphs)
5. Water quality criteria for Aquaculture: Assessment of pH, alkalinity, Salinity.
6. Study of air breathing organs in *Channa, Heteropneustes, Anabas* and *Clarias*
7. Project Report on a visit to any fish farm/ pisciculture unit/Zebrafish rearing Lab.

Skill Enhancement courses (SEC)

[A student will choice either ZOOA-SEC(A)-3-1 or ZOOA-SEC(A)3-2]

PART II: SEMESTER 3

SEC-1 Apiculture

ZOOA-SEC(A)-3-1-TH

Full Marks 80	2 Credits	30 Hours
Unit 1: Biology of Bees		**2**
Apis and Non-*Apis* Bee species and their identification. General Morphology of *Apis* Honey Bees Social Organization of Bee Colony		
Unit 2: Rearing of Bees		14
Artificial Bee rearing (Apiary), Beehives – Newton and Langstroth box Bee Pasturage Selection of Bee Species for Apiculture Modern Bee Keeping Equipment Methods of Extraction of Honey (Indigenous and Modern)		
Unit 3: Diseases and Enemies		6
Bee Diseases and Enemies Control and Preventive measures		
Unit 4: Bee Economy		2
Products of Apiculture Industry and its Uses – Honey, Bees Wax, Propolis, Pollen etc.		
Unit 5: Entrepreneurship in Apiculture		6
Bee Keeping Industry – Recent Efforts, Modern Methods in employing artificial Beehives for cross pollination in horticultural gardens		

PART II: SEMESTER 3

SEC-2.Sericulture

ZOOA-SEC(A)-3-2-TH

Full Marks 80	2 Credits	30 Hours
Unit 1: Introduction		**6**
Sericulture: Definition, history and present status; Silk route Types of silkworms, Distribution and Races Exotic and indigenous races Mulberry and non-mulberry Sericulture		
Unit 2: Biology of Silkworm		4
Life cycle of *Bombyx mori* Structure of silk gland and secretion of silk		
Unit 3: Rearing of Silkworms		10
Selection of mulberry variety and establishment of mulberry garden Rearing house and rearing appliances. Disinfectants: Formalin, bleaching powder, RKO Silkworm rearing technology: Early age and Late age rearing Types of mountages Spinning, harvesting and storage of cocoons		
Unit 4: Pests and Diseases		7
Pests of silkworm: Uzi fly, dermestid beetles and vertebrates Pathogenesis of silkworm diseases: Protozoan, viral, fungal and bacterial Control and prevention of pests and diseases		
Unit 5: Entrepreneurship in Sericulture		3
Prospectus of Sericulture in India: Sericulture industry in different states, employment, potential in mulberry and non-mulberry sericulture Visit to various sericulture centres.		

[A student has to choice either ZOOA-SEC(B)-4-1 or ZOOA-SEC(B)4-2]

PART II: SEMESTER 4

SEC-1.Aquarium Fish Keeping

ZOOA-SEC(B)-4-1-TH

Full Marks 80	2 Credits	30 Hours
Unit 1: Introduction to Aquarium Fish Keeping		**2**
The potential scope of Aquarium Fish Industry as a Cottage Industry, Exotic and Endemic species of Aquarium Fishes		
Unit 2: Biology of Aquarium Fishes		10
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		8
Use of live fish feed organisms. Preparation and composition of formulated fish feeds, Aquarium fish as larval predator		
Unit 4: Fish Transportation		5
Live fish transport - Fish handling, packing and forwarding techniques.		
Unit 5: Maintenance of Aquarium		5
General Aquarium maintenance – budget for setting up an Aquarium Fish Farm as a Cottage Industry		

PART II: SEMESTER 4

SEC-2.Medical Diagnostic Technique

ZOOA-SEC(B)-4-2-TH

Full Marks 80	2 Credits	30 Hours
Unit 1: Diagnostics Methods Used for Analysis of Blood		**8**
Blood composition, Differential Leucocyte Count (DLC) using Leishman's stain, Platelet count using haemocytometer, Erythrocyte Sedimentary Rate (ESR), Packed Cell Volume (PCV)		
Unit 2: Diagnostic Methods Used for Urine Analysis		**4**
Urine Analysis: Physical characteristics; Abnormal constituents, Urine culture		
Unit 3: Non-infectious Diseases		**6**
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 4: Infectious Diseases	**3**
Causes, types, symptoms, diagnosis and prevention of Tuberculosis and Hepatitis, Malarial parasite (Microscope based and ELISA based)	
Unit 5: Clinical Biochemistry	**1**
Lipid profiling, Liver function test. PSA test	
Unit 6: Clinical Microbiology	**1**
Antibiotic Sensitivity Test	
Unit 7: Tumours	**2**
Types (Benign/Malignant), Detection and metastasis; Medical imaging: X-Ray of Bone fracture, PET, MRI and CT Scan (using photographs).	
Unit 8: Visit to Pathological Laboratory and Submission of Project	**6**

UNIVERSITY OF CALCUTTA

CBCS SYLLABUS FOR ZOOLOGY

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THREE-YEAR GENERAL
DEGREE COURSE OF STUDIES

ZOOLOGY

2018

Outline Structure of CBCS Curriculum For Zoology (General), C.U.

PART I; SEM I				
Subject Code	**Name of Paper**	**Theory**	**Practical**	**Internal assessment**
CC1/GE1	**Animal Diversity**	**50**	**30**	**20**
PART I; SEM II				
CC2/GE2	**Comparative Anatomy & Developmental Biology**	**50**	**30**	**20**
PART II; SEM III				
CC 3/GE3	**Physiology and Biochemistry**	**50**	**30**	**20**
SEC-A (1)	**Apiculture**	**80**	**NA**	**20**
PART II; SEM IV				
CC 4/GE4	**Genetics and Evolutionary Biology**	**50**	**30**	**20**
SEC- B(1)	**Aquarium Fish Keeping**	**80**	**NA**	**20**
PART III; SEM V				
DSE A(1)	**Applied Zoology**	**50**	**30**	**20**
DSE B (1)	**Aquatic biology**	**50**	**30**	**20**
SEC-A (1)	**Sericulture**	**80**	**NA**	**20**
PART III; SEM VI				
DSE A (1)	**Biology of Insect**	**50**	**30**	**20**
DSE B (2)	**Ecology & Wild life Biology**	**50**	**30**	**20**
SEC-B (1)	**Medical diagnosis**	**80**	**NA**	**20**

Abbreviations:

CC: Core Course; DSE A/B: Discipline Specific Elective A/B; SEC A/B: Skill Enhancement Course.

SUBJECT/PAPER CODE FORMAT

4. **Subject Code: ZOO**
5. **Honours Code: G**
6. **Course Code: a) Core Course:CC**
   b) Discipline Specific Elective: DSE-A/DSE-B
   c) Skill Enhancement Course: SEC-A/SEC-B

4. **Semester Code: 1/2/3/4/5/6**
5. **Paper No. Code: 1/2/3…../14**
6. **Paper Component Code: a) Theory:TH, b) Practical: P**

INDEX

CBCS ZOOLOGY (GENERAL), Papers & Their Codes

PART I: SEMESTER 1.

CORE COURSE 1.Animal Diversity

ZOOG-CC1-1-TH

Full Marks 50	4 Credits	50 Hours
Unit 1: Kingdom Protista		2
General characters and classification up to classes (Levine et. al., 1980); Locomotory Organelles and locomotion in *Amoeba* and *Paramecium*		
Unit 2: Phylum Porifera		2
General characters and classification up to classes (Ruppert and Barnes, 1994, 6th Ed.); Canal System in *Sycon*		
Unit 3: Phylum Cnidaria		2
General characters and classification up to classes (Ruppert and Barnes, 1994, 6th Ed.); Metagenesis in *Obelia*		
Unit 4: Phylum Platyhelminthes		2
General characters and classification up to classes (Ruppert and Barnes, 1994, 6th Ed.); Life history of *Taenia solium*		
Unit 5: Phylum Nemathelminthes		2
General characters and classification up to classes (Ruppert and Barnes, 1994, 6th Ed.); Life history of *Ascaris lumbricoides* and its adaptation		
Unit 6: Phylum Annelida		4
General characters and classification up to classes (Rupert and Barnes, 1994, 6th Ed.); Metamerism in Annelida		
Unit 7: Phylum Arthropoda		4
General characters and classification up to classes (Ruppert and Barnes, 1994, 6th Ed.); Eye in Cockroach, Metamorphosis in Lepidoptera		
Unit 8: Phylum Mollusca		2
General characters and classification up to classes (Ruppert and Barnes, 1994, 6th Ed.); Respiration in *Pila*		
Unit 9: Phylum Echinodermata		4
General characters and classification up to classes (Ruppert and Barnes, 1994, 6th Ed.); Water-vascular system in Asteroidea		
Unit 10: Protochordates		2
General Characters ; Pharynx and feeding mechanism in *Amphioxus*		
Unit 11: Agnatha		2
General features of Agnatha and classification of cyclostomes up to classes (Young, 1981)		

Unit 12: Pisces	4
General features and Classification up to orders (Young, 1981); Osmoregulation in Fishes	
Unit 13: Amphibia	4
General features and Classification up to orders (Young, 1981); Parental care	
Unit 14: Reptiles	4
General features and Classification up to orders (Young, 1981); Poisonous and non-poisonous snakes, Biting mechanism	
Unit 15: Aves	4
General features and Classification up to orders (Young, 1981); Flight adaptations in birds	
Unit 17: Mammals	4
Classification up to orders (Young, 1981); Hair, Horn & Antler, Nail & claw	

Animal Diversity, ZOOG-CC1-1-P

Full Marks: 30	60 Hours	2 Credits

List of Practicals

1. Identification with reasons of the following specimens:

   Amoeba, Euglena, Paramecium, Sycon, Obelia, Aurelia, Metridium, Taenia solium, Ascaris lumbricoides (Male and female), *Aphrodite, Nereis, Hirudinaria, Palaemon, Cancer, Limulus, Apis, Chiton, Dentalium, Unio, Sepia, Octopus, Echinus, Cucumaria* and *Antedon, Balanoglossus, Branchiostoma, Petromyzon, Torpedo, Labeo rohita, Exocoetus, Salamandra, Hyla, Chelone, Hemidactylus, Chamaeleon, Draco, Vipera, Naja*, Bat, *Funambulus*
2. Key for Identification of poisonous and non-poisonous snakes
3. Study of anatomy of digestive system, salivary gland, mouth parts of *Periplaneta*, Study of reproductive system of female cockroach

   An "animal album" containing photographs, cut outs, with appropriate write up about the above mentioned taxa. Different taxa/ topics may be given to different sets of students for this purpose

PART I: SEMESTER 2.

CORE COURSE 2.Comparative Anatomy & Developmental Biology

ZOOG-CC2-2-TH

Full Marks 50	4 Credits	50 Hours
Unit 1: Integumentary System		4
Derivatives of integument with respect to glands in Birds & Mammals		
Unit 2: Digestive System		4
Stomach and Dentition		
Unit 3: Respiratory System		6

Brief account of Gills, lungs, air sacs and swim bladder	
Unit 4: Circulatory System	6
Evolution of heart and aortic arches	
Unit 5: Urino-genital System	6
Succession of kidney, Evolution of urino-genital ducts	
Unit 6: Early Embryonic Development	14
Gametogenesis: Spermatogenesis and oogenesis with respect to mammals. Fertilization: Sea-Urchin; Early development of frog; structure of mature egg and its membranes, patterns of cleavage, fate map, up to formation of gastrula; types of morphogenetic movements; Fate of germ layers	
Unit 7: Late Embryonic Development	10
Placenta types and function; Metamorphic events in frog life cycle and its hormonal regulation	

Comparative Anatomy & Developmental Biology Lab, ZOOG-CC2-2-P

Full marks 30 60 hours	**2 Credits**
List of Practical:	
1. Osteology: Limb bones, girdle and vertebra of Pigeon & Guineapig, Mammalian skulls: One herbivorous; Guinea pig and one carnivorous; Dog. 2. Larval stages: Veliger, Nauplius, Trochophore, Mysis. 3. Study of the different types of placenta- histological sections through photomicrographs. 4. Developmental stages of chick embryo: 24 Hrs., 48 Hrs, 72 Hrs., 96 Hrs.	

PART II: SEMESTER 3.

CORE COURSE 3. PHYSIOLOGY AND BIOCHEMISTRY

ZOOG-CC3-3-TH

Full Marks 50	4 Credits	50 Hours
Unit 1: Nerve and muscle		**8**
Structure of a neuron, resting membrane potential, Origin of Action potential and its propagation in myelinated and non-myelinated nerve fibres, Ultra-structure of skeletal muscle, Molecular and chemical basis of muscle contraction		
Unit 2: Digestion		6
Physiology of digestion in the alimentary canal; Absorption of carbohydrates, proteins, lipids		
Unit 3: Respiration		6
Pulmonary ventilation, Transport of Oxygen and carbon		
Unit 4: Cardio-vascular system		6

Composition of blood, Structure of Heart, Origin and conduction of the cardiac impulse, cardiac cycle	
Unit 5: Excretion	6
Structure of nephron, Mechanism of Urine formation; Counter-current Mechanism	
Unit 6:Reproduction and Endocrine Glands	10
Physiology of male reproduction: Histology of testis, hormonal control of spermatogenesis; Physiology of female, reproduction: Histology of ovary, hormonal control of menstrual cycle. Structure and function of pituitary, thyroid, pancreas and adrenal.	
Unit 7: Carbohydrate Metabolism	4
Glycolysis, Kreb's cycle, Glycogenesis, Electron Transport Chain.	
Unit 8: Lipid metabolism	
Beta oxidation of Palmitic acid {saturated (C 16:0)} and Linoleic acid {unsaturated (C 18:2)}	
Unit 9: Protein Metabolism	4
Transamination, Deamination, Urea cycle	
Unit 10. Enzyme	2
Enzyme Classification, factors affecting enzyme action, Inhibition.	

PHYSIOLOGY AND BIOCHEMISTRY Lab; ZOOG-CC3-3-P

Full Marks 30	**60 Hours**	2 Credits
List of Practical		
1. Study of permanent histological sections of mammalian pituitary, thyroid, pancreas, adrenal gland. 2. Study of permanent histological sections of mammalian duodenum, liver, lung, kidney. 3. Qualitative test for carbohydrate samples.		

PART II: SEMESTER 4.

CORE-COURSE 4.Genetics & Evolutionary Biology

ZOOG-CC4-4-TH

Full Marks 50	4 Credits	50 Hours
Unit 1:Mendelian Genetics and its Extension		10
Principles of Inheritance, Chromosome theory of inheritance, Incomplete dominance and co-dominance, Multiple alleles, lethal alleles, sex linked inheritance in *Drosophila* (White eye locus) & Human (Thalassemia).		
Unit 2: Linkage, Crossing Over		8
Linkage and crossing over, Complete & Incomplete Linkage, Recombination frequency as a measure of linkage intensity. Holiday Model		
Unit 3: Mutation		

Chromosomal mutation, Deletion, duplication, inversion, translocation, aneuploidy, gene mutation, induced mutation, types & example	8
Unit 4: Sex determination	8
Genic Balance theory and dosage compensation in *Drosophila*.	
Unit 5: Origin of Life	2
Chemical Origin of life	
Unit 6: Evolutionary Theories	6
Lamarckism, Darwinism, Neo-Darwinism.	
Unit 7: Process of Evolutionary changes	4
Isolating mechanism, Natural Selection.	
Unit 8: Speciation	4
Sympatric, Allopatric, Parapatric	

Genetics and Evolutionary Biology Lab ZOOG-CC4-4-P

Full marks 30	**2 Credits**
List of Practical:	
Verification of Mendelian Ratio using Chi square test. Identification of Human Aneuploidy using photo graph of karyotype. Phylogeny of horse with diagram of limb and skull. Study and identification of Darwin Finches from photographs. Visit to natural history museum and submission of report.	

Discipline specific courses

Elective Course (Any One from DSE-A)

Semester-5

DSE-A

Applied Zoology.ZOOG-DSE-A-5-1-TH

Full Marks 50	Credits 4	50 Hours
Unit I: Host & Parasite Relationship		2
Type of Host, Types of Parasites, Other types of Relations.		
Unit 2: Epidemiology of Diseases		5

Transmission, Prevention and Control of Tuberculosis and Typhoid.	
Unit 3: Parasitic Protozoa	7
Life History and pathogenicity of *Entamoeba histolytica*, *Plasmodium vivax* and *Trypanosoma gambiense.*	
Unit 4: Parasitic Helminthes	8
Life History and pathogenicity of *Alcylostoma duodenale, Wuchereria bancrofti*.	
Unit 5: Insect of Economic Importance	8
Biology, Control and Damage caused by *Heliocoverpa armigera, Pyrilla perpusilla, Sytophilus oryzae* and *Tribolium casteneum*.	
Unit 6: Insect of Medical Importance	2
Medical Importance and control of *Anopheles*	
Unit 8: Animal Husbandry	6
Preservation and artificial insemination in cattle; Induction of early puberty and synchronization of estrus in cattle	
Unit 9: Poultry Farming	6
Principles of poultry breeding, Management of breeding stock and broilers, Processing and preservation of eggs	
Unit 10: Fish Technology	6
Genetic improvements in aquaculture industry; Induced breeding and transportation of fish seed	

Applied Zoology. ZOOG-DSE-A-5-1-P

Full marks 30	**60 Hours**	2 Credits
List of Practical:		

1. Study of *Plasmodium vivax, Entamoeba histolytica, Trypanosoma gambiense, Ancylostoma duodenale* and *Wuchereria bancrofti* and their life stages through permanent slides/photomicrographs or specimens.
2. Study of arthropod vectors associated with human diseases: *Pediculus, Culex, Anopheles, Aedes*
3. Study of insect damage to different plant parts/stored grains through damaged products/photographs.
4. Identifying feature and economic importance of *Helicoperva; Heliothis armigera,Papilio demoleus, Pyrilla perpusilla*, *Callosobruchus chinensis, Sitophilus oryzae* and *Tribolium castaneum*
5. Visit to poultry farm or animal breeding centre. Submission of visit report
6. Maintenance of freshwater aquarium(demonstration only)

Discipline specific courses

Elective Course (Any One from DSE-A)

Semester-5

DSE-A

AQUATIC-BIOLOGY. ZOOG-DSE-A-5-2-TH

Full Marks 50	**Credits 4**	**Class 60**
Unit 1: Aquatic Bionics		15
Brief introduction of the aquatic biomes: Freshwater ecosystem; lakes, wetlands, streams and rivers, estuaries, intertidal zones, oceanic pelagic zone, marine benthic zone and coral reefs.		
Unit 2: Freshwater Biology lakes		15
Origin and classification, Lake as an Ecosystem, Lake morphometry, Physico-chemical Characteristics: Light, Temperature, Thermal stratification, Dissolved Solids, Carbonate, Bicarbonates, Phosphates and Nitrates, Turbidity; dissolved gases; Oxygen, Carbon dioxide. Nutrient Cycles in Lakes-Nitrogen, Sulphur and Phosphorous. **Streams:** Different stages of stream development, Physico-chemical environment, Adaptation of hill-stream fishes.		
Unit 3: Marine Biology		15
Salinity and density of Sea water, Continental shelf, Adaptations of deep sea organisms, Coral reefs, Sea weeds.		
Unit 4: Management of Aquatic Resources		15
Causes of pollution: Agricultural, Industrial, Sewage, Thermal and Oil spills, Eutrophication, Management and conservation ;legislations, Sewage treatment Water quality assessment - BOD and COD		

AQUATIC BIOLOGY. ZOOG-DSE-A-5-2-P

Full Marks 30	60 Hours	2 Credits

1. Determine the area of a lake using graphimetric and gravimetric method.
2. Identify the important macrophytes, phytoplanktons and zooplanktons present in a lake ecosystem.
3. Determine the amount of dissolved Oxygen, and free Carbon dioxide, in water collected from a nearby lake / water body.
4. Visit to any aquatic Ecosystem and preparation and submission of report.

Discipline specific courses

Elective Course (Any One from DSE-B)

Semester-6

DSE-B

Biology of Insect. ZOOG-DSE-B-6-1-TH

Full Marks 50	Credits 4	50 Hours
Unit I: Introduction to Insects		6
General Features of Insects, Morphological features, Head, Eyes, Types of antennae, Mouth parts with respect to feeding habits		
Unit II: Concept of Vectors		6
Brief introduction of Carrier and Vectors; mechanical and biological vector, Reservoirs, Host-vector relationship, Adaptations as vectors, Host Specificity		
Unit III: Insects as Vectors		8
Classification of insects up to orders, detailed features of orders with insects as vectors - Diptera, Siphonaptera, Siphunculata, Hemiptera		
Unit IV: Dipteran as Disease Vectors		14
Dipterans, as important insect vectors - Mosquitoes, Sand fly, Houseflies; Study of mosquito-borne diseases - Dengue, Viral encephalitis, Filariasis; Control of mosquitoes.		
Unit V: Siphonaptera as Disease Vectors		6
Fleas as important insect vectors; Host-specificity, Study of Flea-borne diseases - Plague, Typhus fever; Control of fleas		
Unit VI: Siphunculata as Disease Vectors		4
Human louse; Head, Body and Pubic louse as important insect vectors; Study of louse-borne diseases -Typhus fever, Relapsing fever, Trench fever; Control of human louse		
Unit VII: Hempitera as Disease Vectors		6
Bugs as insect vectors; Blood-sucking bugs; Chagas disease, Bed bugs as mechanical vectors,Control and prevention measures		

Biology of Insect. ZOOG-DSE-B-6-1-P

Full marks 25	**60 Hours**	2 Credits
List of Practical		
1. Study of different kinds of mouth parts of insects 2. Study of following insect vectors through permanent slides/photographs: *Aedes, Culex, Anopheles, Pediculus humanuscapitis, Pediculus humanuscorporis, Phlebotomus argentipes, Musca domestica,* 3. Submission of a project report on any one of the insect vectors and disease transmitted by the insect.		

Ecology& Wild life Biology;ZOOG-DSE-B-6-2-TH

Full Marks 50	Credits 4	Class 60
Unit 1: Introduction to Ecology		4
Ecosystem, Autecology and synecology, Levels of organization, Laws of limiting factors, Study of Physical factors, The Biosphere.		
Unit 2: Population		20
Attributes of population: Life tables, fecundity tables, survivorship curves, dispersal and dispersion. Geometric, exponential and logistic growth, equation and patterns, Population regulation: density-dependent and independent factors,		
Unit 3: Community		11
Community characteristics: species diversity, abundance, dominance, richness, Vertical stratification, Ecotone and edge effect.		
Unit 4: Ecosystem		10
Types of ecosystem with an example in detail, 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		
Unit 5: Wild Life		5
Wildlife Conservation (in-situ and ex-situ conservation)**:** Necessity for wildlife conservation; National parks & sanctuaries, Tiger conservation - Tiger reserves in India; Management challenges in Tiger reserve		

Ecology& Wild life Biology;ZOOG-DSE-B-6-2-P

Full marks 30	**60 Hours**	2 Credits
List of Practical		
1. Identification of flora, mammalian fauna, avian fauna 2. Demonstration of basic equipment needed in wildlife studies use, care and maintenance (Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System, Various types of Cameras and lenses) 3. Familiarization and study of animal evidences in the field; Identification of animals through pug marks, hoof marks, scats, pellet groups, nest, antlers, etc. 4. Study of an aquatic ecosystem: Phytoplankton and zooplankton, Measurement of area, temperature, salinity, determination of pH, and Dissolved Oxygen content (Winkler's method), Chemical Oxygen Demand and free CO_2		

Skill Enhancement Elective Courses (SEC)

SEMESTER –3

SEC-A

APICULTURE; ZOOG-SEC-A-3-1-TH

Full Marks 80	Credits 2	30 Hours
Unit 1: Biology of Bees		2
Classification and Biology of Honey Bees Social Organization of Bee Colony		
Unit 2: Rearing of Bees		14
Artificial Bee rearing; Apiary, Beehives - Newton and Langstroth, Bee Pasturage; Selection of Bee Species for Apiculture; Bee Keeping Equipment; Methods of Extraction of Honey; Indigenous and Modern		
Unit 3: Diseases and Enemies		6
Bee Diseases and Enemies Control and Preventive measures		
Unit 4: Bee Economy		2
Products of Apiculture Industry and its Uses ;Honey, Bees Wax, Propolis, Pollen etc		
Unit 5: Entrepreneurship in Apiculture		6
Bee Keeping Industry - Recent Efforts, Modern Methods in employing artificial Beehives for cross		

Skill Enhancement Elective Courses (SEC)

SEMESTER – 4

AQUARIUM FISH KEEPING; ZOOG-SEC-B-4-2-TH

Full Marks 80	Credits 2	30 Hours
Unit l: Introduction to Aquarium Fish Keeping		2
The potential scope of Aquarium Fish Industry as a Cottage Industry, Exotic and Endemic species of Aquarium Fishes		
Unit 2: Biology of Aquarium Fishes		10
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		8
Use of live fish feed organisms. Preparation and composition of formulated fish feeds		
Unit 4: Fish Transportation		5
Live fish transport - Fish handling, packing and forwarding techniques.		
Unit 5: Maintenance of Aquarium		5
General Aquarium maintenance - budget for setting up an Aquarium Fish Farm as a Cottage		

Skill Enhancement Elective Courses (SEC)

SEMESTER –5

SEC-A

Sericulture; ZOOG-SEC-A-5-3-TH

Full Marks 80	Credits 2	30 Hours
Unit 1: Introduction		6
Sericulture: Definition, history and present status; Silk route; Types of silkworms, Distribution and Races Exotic and indigenous races Mulberry and non-mulberry Sericulture		
Unit 2: Biology of Silkworm		4
Life cycle of *Bombyx mori;* Structure of silk gland and secretion of silk		
Unit 3: Rearing of Silkworms		10
Selection of mulberry variety and establishment of mulberry garden Rearing house and rearing appliances Disinfectants: Formalin, bleaching powder, RKO Silkworm rearing technology: Early age and Late age rearing Types of mountages; Spinning and harvesting and storage of cocoons.		
Unit 4: Pests and Diseases		7
Pests of silkworm: Uzi fly, dermestid beetles and vertebrates Pathogenesis of silkworm diseases: Protozoan, viral, fungal and bacterial Control and prevention of pests and diseases		
Unit 5: Entrepreneurship in Sericulture		3
Prospectus of Sericulture in India: Sericulture industry in different states, employment, potential in mulberry and non-mulberry sericulture. Visit to various sericulture centres.		

Skill Enhancement Elective Courses (SEC)

SEMESTER –6

SEC-B

Medical diagnosis; ZOOG-SEC-B-6-4-TH

Full Marks 80	Credits 2	Class 30
Unit 1: Diagnostics Methods Used for Analysis of Blood		8
Blood composition, Preparation of blood smear and Differential Leucocyte Count (D.L.C) using Leishman's stain, Platelet count using haemocytometer, Erythrocyte Sedimentation Rate (E.S.R)		
Unit 2: Diagnostic Methods Used for Urine Analysis		4
Urine Analysis: Physical characteristics; Abnormal constituents, Urine culture		
Unit 3: Non-infectious Diseases		6
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 4: Infectious Diseases		3
Causes, types, symptoms, diagnosis and prevention of Tuberculosis and Hepatitis, Malarial parasite		

(Microscope based and ELISA based)	
Unit 5: Clinical Biochemistry	1
Lipid profiling, Liver function test. PSA test	
Unit 6: Clinical Microbiology	1
Antibiotic Sensitivity Test	
Unit 8: Tumours	2
Types (Benign/Malignant), Detection and metastasis; Medical imaging: X-Ray of Bone fracture,	
Unit 9: Visit to Pathological Laboratory and Submission of Project	5

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