# **UNIVERSITY OF CALCUTTA**

# CBCS SYLLABUS OF ZOOLOGY 2018

F O R

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; SI				
CC 3	Non Chordata – II (All Coelomate Phyla)	50	30	20
CC 4	Cell Biology	50	30	20
PART II; S	SEMI 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; S	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
<b>DSE B (1/2)</b>	Endocrinology/Reproductive Biology	50	30	20
PART III; SEM VI				
CC 13	Developmental Biology	50	30	20
CC 14	Evolutionary Biology	50	30	20
<b>DSE A (1/2)</b>	Animal Biotechnology/Animal Cell Biotechnology	50	30	20
<b>DSE B (1/2)</b>	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.

- 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

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# 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
<ul> <li>Protozoa</li> <li>General characteristics and Classification up to phylum (according to Levine <i>et. al.</i>, 1980)</li> <li>Locomotion in <i>Euglena</i>, <i>Paramoecium</i> and <i>Amoeba</i>; Conjugation in <i>Paramoecium</i>.</li> <li>Life cycle and pathogenicity of <i>Plasmodium vivax</i> and <i>Entamoeba histolytica</i></li> <li>Metazoa</li> <li>Evolution of symmetry and segmentation of Metazoa</li> </ul>		
Unit 3: Porifera		6
General characteristics and Classification up to classes (Ruppert and Barnes, 1994, 6 <sup>th</sup> Ed.); Canal system and spicules in sponges		
Unit 4: Cnidaria		10
General characteristics and Classification up to classes (Ruppert and Barnes, 1994, 6 <sup>th</sup> Ed.), Metagenesis in <i>Obelia</i> ; 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, 6 <sup>th</sup> Ed.) Life cycle and pathogenicity and control measures of <i>Fasciola hepatica</i> and <i>Taenia solium</i>		
Unit 7: Nematoda		7
General characteristics and Classification up to classes (Ru Life cycle, and pathogenicity and control measures of <i>bancrofti</i> Parasitic adaptations in helminthes	appert and Barnes, 1994, 6 <sup>th</sup> Ed.) Ascaris lumbricoides and Wuchereria	

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

#### Non-Chordates I: Protists to Pseudocoelomates

Full Marks 3060 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,	Taen	ia 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 504 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: <i>lac</i> operon and <i>trp</i> 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

Fı	ull Marks 30 6	0 Hours	2 Credits
List of	Practical		
1.	Demonstration of polytene and lampbrush chromosome from photograp	ph	
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 <i>Pila sp.</i> Torsion in Gastropoda. Feeding and respiration in <i>Pila</i> sp.	
Unit 6: Echinodermata	8
General characteristics and Classification up to classes (Ruppert and Barnes, 1994); Water- vascular system in <i>Asterias</i> . 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		
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 hypothe Respiratory Chain, Chemiosmotic hypothesis; Peroxisomes: Structure and Function	sis Mitochondrial	

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 M	Carks 30 60 Hours	2 Credits
List of	Practical	
1.	Preparation of temporary stained squash of onion/arum root tip to study varie	ous 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 huma	n 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 Ma	arks 30 60 Hours	2 Credits	
List of	Practical		
Identifie	cation with Reasons		
a) ]	Protochordata: Balanoglossus, Branchiostoma		
b) .	Agnatha: Petromyzon		
c) ]	F <b>ishes</b> : Scoliodon, Sphyrna, Pristis, Torpedo, Mystus, Heteropneus	stes, Labeo rohita, Exocoetus,	
	Hippocampus, Anabas, Flat fish		
d) .	Amphibia: Necturus, Bufo (Duttaphrynus) melanostictus, Rana (Hop	plobatrachus) tigerinus, Hyla,	
,	<i>Tylototriton</i> , Axolotl larva		
e) ]	e) Reptilia: Chelone, Trionyx, Hemidactylus, Varanus, Calotes, Chamaeleon, Draco, Vipera, Naja,		
	Hydrophis,		
f) ]	Mammalia: Bat (Insectivorous and Frugivorous), Funambulus (Indian	Palm squirrel)	
Dissecti	on of brain and pituitary - ex situ, digestive and Urino-genital system of	Tilapia	
Pecten f	rom Fowl head		
Power point presentation on study of habit, habitat or behaviour of any one animal by student - for internal			
assessm	ent 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 t	issue, 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 across the myelinated and non-myelinated nerve fibres; Types of synapse, Synaps and Neuromuscular junction	its propagation ic transmission	
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 reproducti and oestrous cycle	on – menstrual	
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 Steroidal and Non- steroidal hormones; Hypothalamus (neuroendocrine gland) - involved in neuroendocrine control of anterior pituitary; Placental hormones	on pathways for principal nuclei	

#### Animal Physiology: Controlling & Coordinating Systems, Lab;

#### ZOOA-CC3-6-P

Full N	Aarks 30	60 Hours	2 Credits
List o	f Practical		
1.	Recording of cardiac and simple muscle twitch with	h electrical stimulation	
2.	Preparation of temporary mounts: Squamous epithe	elium, Striated muscle fibr	es and nerve cells
3.	Study of permanent slides of Mammalian Skin, S	Spinal cord, Pancreas, Tes	stis, Ovary, Adrenal, Lung,
	pyloric stomach, cardiac stomach, Thyroid, small i	ntestine and large intestine	of mammal (white rat)
4.	Microtomy: Preparation of permanent slide of any	five mammalian (Goat/wh	ite 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: $\beta$ -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 $\alpha$ -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, Inhibito Transport System	rs and un-couplers of Electron	

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

Fundamentals of Biochemistry			
Full N	Iarks 30	60 Hours	2 Credits
List o	f 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	s following Lowry Method	

## **PART II: SEMESTER 4**

# **CORE COURSE 8.Comparative Anatomy of Vertebrates**

## ZOOA-CC4-8-TH

Full Marks 504 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 M	larks 30	60 Hours	2 Credits
List of	Practical		
1.	Study of placoid, cycloid and ctenoid scales throu	gh permanent slid	es/photographs
2.	2. Study of disarticulated skeleton of toad, Pigeon, Guineapig (limb bones, vertebrae, limb and girdle)		
3.	Comparative study of heart and brain, with the he	lp of model/pictur	e
4.	Identification of skulls: Pigeon, one herbivore (G	uineapig) 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 c of food, absorption of Carbohydrates, Lipids and Proteins in Human	hemical digestion	
Unit 2: Physiology of Respiration		10
Mechanism of Respiration, Respiratory volumes and capacities, transport of Ox dioxide in blood, Dissociation curves and the factors influencing it, respiratory monoxide poisoning	ygen and Carbon pigments; Carbon	
Unit 3: Physiology of Circulation		8
Structure and functions of haemoglobin; Blood clotting system; Haematopoiesis its regulation; Blood groups; ABO and Rh factor	; Basic steps and	
Unit 4: Physiology of Heart		8
Coronary Circulation, Structure and working of conducting myocardial fil conduction of cardiac impulses; Cardiac Cycle and cardiac output	bres, Origin and	
Unit 5: Thermoregulation & Osmoregulation		6
Thermal regulation in camel and polar bear, Osmoregulation in aquatic vertebra	tes	
Unit 6: Renal Physiology		8
Structure of Kidney and its functional unit, Mechanism of urine formation, Rebase balance	egulation of acid-	

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

Full M	larks 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 sys	stem			
Unit 2: Innate and Adaptive Immunity				
Anatomical barriers, Inflammation, Cell and molecules involved in innate immimunity (Cell mediated and humoral).	nunity, Adaptive			
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 M	larks 30				60 H	ours			2 Credit	ts	
List of	Practical										
1.	Demonstratio	n of lyn	npho	id organs (by pictu	ure).						
2.	Histological photographs	study	of	Bursa fabricius,	spleen,	thymus	and	lymph	nodes	through	slides/
3.	Demonstratio	n of EL	ISA								

## 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, Stators, The Biosphere.	udy of Physical	
Unit 2: Population		20
Unitary and Modular populations Unique and group attributes of population: Demo life tables, fecundity tables, survivorship curves, dispersal and dispersion. Geome and logistic growth, equation and patterns, r and K strategies Population regul dependent and independent factors, Population Interactions, Gause's Principle with field examples, Lotka-Volterra equation for competition.	graphic factors, tric, exponential ation - density- h laboratory and	
Unit 3: Community		11
Community characteristics: species diversity, abundance, dominance, richne stratification, Ecotone and edge effect; Ecological succession with one example.	ss, Vertical	

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 ( <i>in situ</i> and <i>ex situ</i> 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 M	arks 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, Measur	ement of area, temperature,
	salinity, determination of pH, and Dissolved Oxygen content (Winkler's	method), Chemical Oxygen
	Demand and free $CO_2$	

## **PART III: SEMESTER 5**

#### **CORE COURSE 12.Principle of Genetics**

## **ZOOA-CC5-12-TH**

Full Marks 504 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).	

<sup>3.</sup> Report on a visit to National Park/Biodiversity Park/Wild life sanctuary/ any place of ecological interest/ ecological uniqueness/ Zoological garden

Unit 3: Mutations	12
Types of gene mutations (Classification), Types of chromosomal aberrations (Classification with one	
suitable example from <i>Drosophila</i> and Human of each), variation in chromosome number; Non- disjunction of X chromosome in <i>Drosophila</i> : 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 <i>Drosophila</i> and in man; Dosage compensation in <i>Drosophila</i> & 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 <i>Drosophila</i> , LINE, SINE, Alu elements in humans	

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

Full m	arks 30	60 Hours	2 Credits	
List of Practical				
1.	Chi-square analyses for genetic ratio test			
2.	Identification of chromosomal aberration in Dro	sophila and man from photo	graph	
3.	Pedigree analysis of some inherited traits in anin	nals		

# 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); Tyj membranes; Fertilization in sea urchin and mammal; Planes and patterns of Blastula [frog and chick]; Fate map in chick embryo, fate mapping using vital technique; Gastrulation in frog and chick; Embryonic induction and orga (Spemann & Mangold's experiment)	pes of eggs, Egg cleavage; Types of dye and radioactive mizers in <i>Xenopus</i>	

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

Fu	ll Marks 30	60 Hours	2 Credits
Lis	st of Practical		
1.	Study of whole mounts of developmental stages of chick e	mbryo through perm	anent slides: 24, 48, and 96
	hours of incubation		
2.	Study of the developmental stages and life cycle of Drosop	ohila	
3.	Study of different sections of placenta (photomicropgraph/	slides)	
4.	Identification of Invertebrate larva through slides/ photogr	aphs of Phylum Anne	lida, 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 Dar	rwinism	
Unit 3		6
Geological time scale, Fossil: types and age determination by Carbon dating, Ev	olution 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 <i>Drosophila</i> . 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 M	Iarks 30 60 Hours		2 Credits	
List of Practical				
1.	Study of fossils from models/ pictures: Dickinsonia, Parado	xides (Trilobita).	, Asteroceras (Ammonoid),	
	Pentremites (Blastoid Echinoderm), Ichthyosaur, Archaeopt	eryx, Cynodont.		
2.	Study of homology and analogy from suitable specimens.			
3.	Phylogenetic trees, Construction & interpretation of Phylogenetic	genetic tree usin	g parsimony, Construction	
	of dendrogram following principles of phenetics & cladistic	s from a data tab	le.	

# **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 (mechanic vector); Host parasite relationship	al and biological	
Unit 2: Parasitic Protists		12
Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathoger Prophylaxis and Treatment of <i>Giardia intestinalis</i> , <i>Trypanosoma gambiense</i> , <i>Leishmania donovani</i>	nicity, Diagnosis,	
Unit 3: Parasitic Platyhelminthes		12
Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathoger Prophylaxis and Treatment of <i>Schistosoma haematobium</i> , <i>Taenia solium</i>	nicity, Diagnosis,	
Unit 4: Parasitic Nematodes		12
Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogen Prophylaxis and Treatment of <i>Ascaris lumbricoides</i> , <i>Ancylostoma duoden</i> <i>bancrofti</i> , Nematode plant interaction.	nicity, Diagnosis, ale, Wuchereria	
Unit 5: Parasitic Arthropods		10
Biology, importance and control of ticks: Soft tick ( <i>Ornithodoros</i> ), Hard tick ( <i>Ixodes</i> ), mites ( <i>Sarcoptes</i> ), Lice ( <i>Pediculus</i> ), Flea ( <i>Xenopsylla</i> ) and Bug ( <i>Cimex</i> ). Parasitoid.		
Unit 6: Parasite Vertebrates		2
Cookicutter Shark, Hood Mocking bird, Vampire bats their parasitic behaviour an	nd 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 intestina	ulis, Trypanosoma gambiens	e, Leishmania donovani,
	Plasmodium vivax, Plasmodium falciparum th	rough permanent slides/micro	photographs
2.	Study of adult and life stages of Schistos	oma haematobium, Taenia s	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 Ba	arnes, 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, nervous system	, endocrine and	
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-pla	int 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 important vectors	mosquitoes as	

## 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 padd	y and their damages		
7. Study of Mulberry silk moth as be	neficial 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		
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 ( <i>Diabetes mellitus</i> type I & Type II; Graves' Disease).		
Unit 4: Regulation of Hormone Action		12
Mechanism of action of steroidal, non-steroidal hormones with receptors (cAM Calcium and Glucose homeostasis in mammals. Bioassays of hormones using R Estrous cycle in rat and menstrual cycle in human.	P, IP3-DAG), IA & ELISA,	

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 M	larks 30	60 Hours	2 Credits
List of Practical			
1.	Dissect and display of Endocrine glands in laborator	y 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.		ny 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 regul synthesis and metabolism; Accessory glands functions	lation; Androgen	
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, Assiste Technology: Sex selection, sperm banks, frozen embryos, <i>in vitro</i> fertilization IVF Modern contraceptive technologies	ed Reproductive & IUI	

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

Full M	arks 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 a	ny 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, fallopi	an tube, uterus (proliferative

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

and secretory stages), cervix and vagina.

## 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, H HAC. Shuttle and Expression Vectors. Construction of Genomic libraries and cDNA libraries Transformation techniques: Cloning in bacteria and detection technique of clone	BAC, YAC, and	
Unit 3: Animal cell Culture		15
Basic techniques in animal cell culture and organ culture, Primary Culture and Ce media – Natural and Synthetic, Stem cells, Cryopreservation of cultures. Agarose and Polyacrylamide Gel Electrophoresis, Southern, Northern and W Polymerase chain reaction: Allele specific, RAPD & RT PCR.	ll lines, Culture	
Unit 4: Fermentation		10
Different types of Fermentation: Submerged & Solid state; batch, Fed batch & Cortank, Air Lift, Fixed Bed and Fluidized. Downstream Processing: Filtration, centrifugation, extraction, chromatography, splyophilization.	ntinuous; Stirred	

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 Mark	s 50 60 Hours	2 Credits
List of Pra	nctical	
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 agar using lambda DNA as standard).	ose gel electrophoresis (by
5.	Techniques: Western Blot, Southern Hybridization, DNA Fingerprinting	g, 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 <i>E.coli</i> and <i>Drosophila</i> 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		
Animal cell culture, Expressing cloned genes in mammalian cells, Molecul	ar 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	om <i>E. coli</i> and Plasmid DNA isolation (j	pUC 18/19	9) from <i>E. coli</i>	
2. To study following technic	ques through photographs - Southern E	Blotting, N	Northern Blotting, V	Western
Blotting, PCR, DNA finger	printing			

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 Learned Behaviour; FAP, Associative learning, classical and operant conditioning Imprinting.	; Instinct vs. , Habituation,	
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), Co Selfishness Sexual Behaviour: Sexual dimorphism, Mate choice in peacock, Intra-sexual se rivalry in red deer) Kinship theory: Relatedness & inclusive fitness; parental care in fishes (Nest Bui benefit), conflict within families: parent offspring conflict and sibling rivalry	operation and election (male lding & coast	
Unit 3: Chronobiology & Biological Rhythm		20
Types and characteristics of biological rhythms: Short- and Long- term rhythm rhythms; Tidal rhythms and Lunar rhythms, Circannual rhythms; Photic a zeitgebers; Role of melatonin. Biological clock and its adaptive significance. Circ in bird migration.	ms; Circadian nd non-photic annual rhythm	

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

Full M	arks 50 60 Hours	2 Credits			
List of	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 humin	d 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 stu	dy behavioural activities of			
	animals and prepare a short report.				
6.	Study of circadian functions in humans (daily eating, sleep and temper	ature 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; Type of scales in Classification and determination of age of fish; Gills and gas exchange Types and role in Respiration, buoyancy; Electric organ, Bioluminescence	es of Scales, Use e; Swim Bladder:	
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 Composite fish culture; Brood stock management; Induced breeding of fish; Mana hatcheries; Preparation and maintenance of fish aquarium; Preparation of compour Role of water quality in aquaculture; Fish diseases: Bacterial, viral and parasitic; processing of harvested fish, Fishery by-products	rre; Polyculture; agement of finfish and diets for fish; Preservation and	
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 M	larks 30	60 Hours	2 Cree	dits	
List of	Practical				
1.	Morphometric and meristic characters of fishes				
2.	Identification of Petromyzon, Myxine, Pr	ristis, Exocoetus, Hip	pocampus,	Gambusia, 1	Labeo,
	Heteropneustes, Anabas				
3.	Study of different types of scales (through perma	anent slides/ photograph	hs).		
4.	Study of crafts and gears used in Fisheries (Phot	toghaphs)			
5.	Water quality criteria for Aquaculture: Assessme	ent of pH, alkalinity, Sa	alinity.		
6.	Study of air breathing organs in Channa, He	eteropneustes, 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
<i>Apis</i> and Non- <i>Apis</i> Bee species and their identification. General Morphology of Social Organization of Bee Colony	f Apis Honey Bees	
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, Pol	len etc.	
Unit 5: Entrepreneurship in Apiculture		6
Bee Keeping Industry – Recent Efforts, Modern Methods in employing artificia pollination in horticultural gardens	al Beehives for cross	

## 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, employed	ment, 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