UNIVERSITY OF CALCUTTA

Notification No. CSR/ 12 /1S

It is notified for information of all concerned that the Syndicate in its meeting held on 28.05.2018 (vide Item No.14) approved 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	**Subject**	Sl.	Subject
	Anthropology (Honours / General)	29	Mathematics (Honours / General)
2	Arabic (Honours / General)	30	Microbiology (Honours / General)
3	Persian (Honours / General)	31	Mol. B iolopy (General)
4	Bengali (Honours / General /LCC2 /AECC 1)	32	Philosophy (Honours / General)
3	Bio-Chemistry (honours / Genera!)	33	Physical Education (General)
6	Botany (Honours / General)	34	Physics (Honours / General)
7	Chemistry (Honours / General)	35	Physiolo•py (Honours / General)
8	Computer Science (Honours / General)	36	Political Science (1-Honours / General)
9	Defence Studies (General)	37	Psychology (Honours / General)
" 10	**Economics** (Honours / General)	38	Sanskrit (honours / General)
i I	Education (Honours / General)	39	Social Science (General)
12	Electronics Honours / General	40	Sociology (1-lonours / General
13	English ((Honours / General/ LCC1/ LCC2/AECCI)	41	Statistics (Honours / General)
14	Environmental ScienceJHonours / General)	42	Urdu (Honours / General /LCC2 fAECC1)
\ 3	Environmental Studies (AECC2)	43a	Women Studies General)
16	Film Studies (General)	4	Zoology (Honours / General)
17	Food Nutrition (Honours / General)	45	Industrial Fish and Fisheries — lFFV (Major)
18	French (€ieneral)	46	Sericulture — SRTV (Major)
19	GeograRhy (Honours / General)	47	Computcr Applications — CMAV **(Major)**
20	Geology (Honours / General)	4S	Tourism and Travel Management — TTMV
.21	Hindi (Honours / General /LCC2 /AECCI)	49	Advertising Sales Promotion :tnd Sales Management —ASPV (Major}
22	History (Honours / General)	50	Conirrrunicative English —CMEV (Major)
23	Islamic History Culture (Honours / General)	5 I	Clinical Nutrition and Dietetics CNDV (Major)
24	Home Science Extension Education {General)	52	Bache lor of Business Administration (BBA) (f4 onours)
25	House Hold Art (General)	53	Bachelor of Fashion and Apparel Design — (B.F.A.D.) (Honours)
26	Human Development (Honours f General)	54	Bachclor 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

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		Sutirtha Sarkar
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		Shukla Mukherjee Sutirtha Sarkar
Unit 3: Porifera		6
General characteristics and Classification up to classes (Ruppert and Barnes, 1994, 6th Ed.); Canal system and spicules in sponges		Saswati Biswas
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.		Anirban Sinha
Unit 5: Ctenophora		2
General characteristics		Shukla Mukherjee
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*		Anirban Sinha
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		Saswati Biswas

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* **(Shampa Sarkar & Anirban Sinha)** Identification with reason & Systematic position of *Amoeba*, *Euglena*, *Entamoeba*, *Paramecium*, *Plasmodium*, *Balantidium*, *Vorticella* (from the prepared slides) **(Shampa Sarkar & Anirban Sinha)** 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.* **(Shukla Mukherjee)** Staining/mounting of any protozoa/helminth from gut of *Periplaneta* sp. **(Shukla Mukherjee)**		

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.		Shampa Sarkar
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.		Subrata Kr. Basu
Unit 3: Transcription		9
Mechanism of Transcription in prokaryotes and eukaryotes, Transcription factors, Difference between prokaryotic and eukaryotic transcription.		Subrata Kr. Basu
Unit 4: Translation		9
Genetic code, Degeneracy of the genetic code and Wobble Hypothesis. Mechanism of protein synthesis in prokaryotes.		Shampa Sarkar
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		Anirban Sinha

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.	Mohua Guha
Unit 7: DNA Repair Mechanisms	2
Types of DNA repair mechanisms, RecBCD model in prokaryotes, nucleotide and base excision repair, SOS repair	Anirban Sinha
Unit 8: Molecular Techniques	3
PCR, Western and Southern blot, Northern Blot	Mohua Guha

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 **(Subrata Kr. Basu)** 2. Isolation and quantification of genomic DNA from goat liver. **(Mohua Guha)** 3. Agarose gel electrophoresis for DNA. **(Mohua Guha)** 4. Histological staining of DNA and RNA in prepared slides **(Subrata Kr. Basu)**		

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		Shampa Sarkar
Unit 2: Annelida		10
General characteristics and Classification up to classes (Ruppert and Barnes, 1994) Excretion in Annelida through nephridia; Metamerism in Annelida.		Saswati Biswas
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		Sutirtha Sarkar
Unit 4: Onychophora		2
General characteristics and Evolutionary significance		Shukla Mukherjee

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.	Anirban Sinha
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	Subrata Kr. Basu
Unit 7: Hemichordata	2
General characteristics of phylum Hemichordata. Relationship with non-chordates and chordates	Mohua Guha

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

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

1. Study of following specimens: **(Shukla Mukherjee & Shampa Sarkar)**
   - ***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. **(Shukla Mukherjee & Shampa Sarkar)**

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		Subrata Kr. Basu
Unit 2: Cytoplasmic organelles I		5
Structure and Functions: Endoplasmic Reticulum, Golgi Apparatus, Lysosomes; Protein sorting and mechanisms of vesicular transport		Sutirtha Sarkar
Unit 3: Cytoplasmic organelles II		7
Mitochondria: Structure, Semi-autonomous nature, Endosymbiotic hypothesis Mitochondrial Respiratory Chain, Chemiosmotic hypothesis; Peroxisomes: Structure and Functions		Saswati Biswas

Centrosome (Kinetochore and centromeric DNA): Structure and Functions	
Unit 4: Cytoskeleton	5
Type, structure and functions of cytoskeleton; Accessory proteins of microfilament & microtubule	Saswati Biswas
Unit 5: Nucleus	8
Nuclear envelope, Nuclear pore complex, Nucleolus; Chromatin: Euchromatin and Heterochromatin and packaging (nucleosome),	Shampa Sarkar
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	Anirban Sinha
Unit 7: Cell Signalling	8
Cell signalling transduction pathways; Types of signalling molecules and receptors (Classification and Example only): RTK & JAK/STAT. Apoptosis	Mohua Guha

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

(Subrata Kr. Basu & Mohua Guha)

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)		Mohua Guha
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*		Shampa Sarkar

Unit 3: Agnatha	2
General characteristics and classification of cyclostomes up to order (Young, 1981)	Mohua Guha
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.	Shampa Sarkar
Unit 5: Amphibia	7
General characteristics and classification up to living Orders (Young, 1981); Metamorphosis, Paedomorphosis, Parental care in Amphibia	Subrata Kr. Basu
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.	Saswati Biswas
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	Anirban Sinha
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	Sutirtha Sarkar

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

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

Identification with Reasons **(Subrata Kr. Basu & Sutirtha Sarkar)**

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 **(Subrata Kr. Basu & Sutirtha Sarkar)**

Power point presentation on study of habit, habitat or behaviour of any one animal by student – for internal assessment only **(Subrata Kr. Basu & Sutirtha Sarkar)**

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		Shukla Mukherjee
Unit 2: Bone and Cartilage		4
Structure and types of bones and cartilages, Ossification		Anirban Sinha
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		Subrata Kr. Basu
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		Sutirtha Sarkar
Unit 5: Reproductive System		6
Histology of mammalian testis and ovary; physiology of mammalian reproduction – menstrual and oestrous cycle		Shampa Sarkar
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		Mohua Guha & Saswati Biswas

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		

(Shampa Sarkar & Anirban Sinha)

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		Anirban Sinha
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		Mohua Guha & Sutirtha Sarkar
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		Mohua Guha & Saswati Biswas
Unit 4: Nucleic Acids		10
Structure of Purines, Pyrimidines, Nucleosides and Nucleotides; Nucleic Acid Metabolism: Catabolism of adenosine, Guanosine, cytosine and thymine.		Shampa Sarkar
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.		Shukla Mukherjee
Unit 5: Oxidative Phosphorylation		**2**
Redox systems; Mitochondrial respiratory chain, Inhibitors and un-couplers of Electron Transport System		Subrata Kr. Basu

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 **(Shukla Mukherjee)** 2. Qualitative estimation of Urea & Uric acid **(Shukla Mukherjee)** 3. Paper chromatography of amino acids. **(Subrata Kr. Basu)** 4. Quantitative estimation of water soluble proteins following Lowry Method **(Shukla Mukherjee)**		

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		Anirban Sinha
Unit 2: Digestive System		6
Comparative anatomy of stomach; dentition in mammals		Shukla Mukherjee
Unit 3: Respiratory System		6
Respiratory organs in fish, birds and mammals		Shampa Sarkar
Unit 4: Circulatory System		7
General plan of circulation, Comparative account of heart and aortic arches		Mohua Guha
Unit 5: Urinogenital System		5
Succession of kidney in different vertebrate groups; evolution of urino-genital ducts		Saswati Biswas
Unit 6: Nervous system and sense organs		**8**
Comparative account of brain in vertebrates; cranial nerves; olfactory and auditory receptors in vertebrates		Subrata Kr. Basu
Unit 7: Skeletal system		**8**
Overview of axial and appendicular skeleton – limbs, girdles of pigeon; jaw suspension in mammals		Sutirtha Sarkar

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

(Subrata Kr. Basu & Anirban Sinha)

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		Shukla Mukherjee
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		Sutirtha Sarkar
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		Subrata Kr. Basu
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		Sutirtha Sarkar
Unit 5: Thermoregulation & Osmoregulation		6
Thermal regulation in camel and polar bear, Osmoregulation in aquatic vertebrates		Shampa Sarkar
Unit 6: Renal Physiology		8
Structure of Kidney and its functional unit, Mechanism of urine formation, Regulation of acid-base balance		Saswati Biswas

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		

(Shukla Mukherjee, Mohua Guha & Shampa Sarkar)

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		Mohua Guha
Unit 2: Innate and Adaptive Immunity		9
Anatomical barriers, Inflammation, Cell and molecules involved in innate immunity, Adaptive immunity (Cell mediated and humoral).		Saswati Biswas
Unit 3: Antigens		6
Antigenicity and immunogenicity, Immunogens, Adjuvants and haptens, Factors influencing immunogenicity, B and T-Cell epitopes		Shampa Sarkar
Unit 4: Immunoglobulins		10
Structure and functions of different classes of immunoglobulins, Antigen-antibody interactions, Immunoassays (ELISA and RIA), Monoclonal antibody production		Mohua Guha
Unit 5: Major Histocompatibility Complex		6
Structure and functions of MHC molecules. Structure of T cell Receptor and its signalling, T cell development & selection		Anirban Sinha
Unit 6: Cytokines		3
Types, properties and functions of cytokines.		Anirban Sinha

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

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		

(Saswati Biswas & Sutirtha Sarkar)

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		

(Shampa Sarkar)

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*		Subrata Kr. Basu
Unit 2: Phylum Porifera		2
General characters and classification up to classes (Ruppert and Barnes, 1994, 6th Ed.); Canal System in *Sycon*		Mohua Guha
Unit 3: Phylum Cnidaria		2
General characters and classification up to classes (Ruppert and Barnes, 1994, 6th Ed.); Metagenesis in *Obelia*		Mohua Guha
Unit 4: Phylum Platyhelminthes		2
General characters and classification up to classes (Ruppert and Barnes, 1994, 6th Ed.); Life history of *Taenia solium*		Sutirtha Sarkar
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		Saswati Biswas
Unit 6: Phylum Annelida		4
General characters and classification up to classes (Rupert and Barnes, 1994, 6th Ed.); Metamerism in Annelida		Saswati Biswas
Unit 7: Phylum Arthropoda		4
General characters and classification up to classes (Ruppert and Barnes, 1994, 6th Ed.); Eye in Cockroach, Metamorphosis in Lepidoptera		Sutirtha Sarkar
Unit 8: Phylum Mollusca		2
General characters and classification up to classes (Ruppert and Barnes, 1994, 6th Ed.); Respiration in *Pila*		Sutirtha Sarkar
Unit 9: Phylum Echinodermata		4
General characters and classification up to classes (Ruppert and Barnes, 1994, 6th Ed.); Water-vascular system in Asteroidea		Subrata Kr. Basu
Unit 10: Protochordates		2
General Characters ; Pharynx and feeding mechanism in *Amphioxus*		Subrata Kr. Basu
Unit 11: Agnatha		2
General features of Agnatha and classification of cyclostomes up to classes (Young, 1981)		Mohua Guha

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

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

(All Teachers)

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		Sutirtha Sarkar
Unit 2: Digestive System		4
Stomach and Dentition		Sutirtha Sarkar
Unit 3: Respiratory System		6

Brief account of Gills, lungs, air sacs and swim bladder	Saswati Biswas
Unit 4: Circulatory System	6
Evolution of heart and aortic arches	Saswati Biswas
Unit 5: Urino-genital System	6
Succession of kidney, Evolution of urino-genital ducts	Subrata Kr. Basu
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	Mohua Guha
Unit 7: Late Embryonic Development	10
Placenta types and function; Metamorphic events in frog life cycle and its hormonal regulation	Subrata Kr. Basu

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.		

(All Teachers)

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		Saswati Biswas
Unit 2: Digestion		6
Physiology of digestion in the alimentary canal; Absorption of carbohydrates, proteins, lipids		Shampa Sarkar
Unit 3: Respiration		6
Pulmonary ventilation, Transport of Oxygen and carbon		Shampa Sarkar
Unit 4: Cardio-vascular system		6

Composition of blood, Structure of Heart, Origin and conduction of the cardiac impulse, cardiac cycle	Saswati Biswas
Unit 5: Excretion	6
Structure of nephron, Mechanism of Urine formation; Counter-current Mechanism	Anirban Sinha
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.	Shampa Sarkar & Saswati Biswas
Unit 7: Carbohydrate Metabolism	4
Glycolysis, Kreb's cycle, Glycogenesis, Electron Transport Chain.	Anirban Sinha
Unit 8: Lipid metabolism	
Beta oxidation of Palmitic acid {saturated (C 16:0)} and Linoleic acid {unsaturated (C 18:2)}	Anirban Sinha
Unit 9: Protein Metabolism	4
Transamination, Deamination, Urea cycle	Shukla Mukherjee
Unit 10. Enzyme	2
Enzyme Classification, factors affecting enzyme action, Inhibition.	Shukla Mukherjee

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.		

(All Teachers)

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).		Saswati Biswas
Unit 2: Linkage, Crossing Over		8
Linkage and crossing over, Complete & Incomplete Linkage, Recombination frequency as a measure of linkage intensity. Holiday Model		Saswati Biswas
Unit 3: Mutation		

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

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.	

(All Teachers)

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

ll Marks 80	Credits 2	30 Hours
it l: Introduction to Aquarium Fish Keeping		2
e potential scope of Aquarium Fish Industry as a Cottage Industry, Exotic and Endemic cies of Aquarium Fishes		
it 2: Biology of Aquarium Fishes		10
mmon characters and sexual dimorphism of Fresh water and Marine Aquarium fishes such as ppy, Molly, Sword tail, Gold fish, Angel fish, Blue morph, Anemone fish and Butterfly fish		
it 3: Food and feeding of Aquarium fishes		8
e of live fish feed organisms. Preparation and composition of formulated fish feeds		
it 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		

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