

ZOOLOGY HONOURS

CBCS SYLLABUS

(2020)

2.2. Scheme for CBCS Curriculum (Zoology Honours)

YE AR	SEM ES TER	CORE COURSE (CC) (14T+14L) (Credit 14x4+ 14x2)	ABILITY ENHANSMENT COMPULSORY COURSE (AECC)(2T) (Credit 2x2)	SKILL ENHANSMENT COMPULSORY COURSE (SEC)(2T) (Credit 2x2)	DISCIPLINE SPECIFIC ELECTIVES (DSE) (4T+4L) (Credit 4x4+ 4x2)	GENERIC ELECTIVES (GE) (4T+4L) (Credit 4x4+ 4x2) (For other Disciplines)	TOTAL CREDI TS
1	I	CC-1 NON-CHORDATE I CC-2 ECOLOGY	AECC-1 ENVIRONMENTAL SCIENCE			GE1 PAPER-1 * Gr.A-ANIMAL DIVERSITY Gr. B-INSECT VECTORS Gr.C-AQUATIC BIOLOGY	20
	II	CC-3 NON-CHORDATE II CC-4 CELL BIOLOGY					
2	III	CC-5 CHORDATES		SEC PAPER-1 * Gr.A- APICULTURE Gr.B-AQUADIUM FISH KEEPING		GE2 PAPER-1 * Gr.A-ANIMAL DIVERSITY Gr. B-INSECT VECTORS Gr.C-AQUATIC BIOLOGY	26
		CC-6 ANIMAL PHYSIOLOGY: CONTROLLING & COORDINATING SYSTEM					
		CC-7 GENETICS					
	IV	CC-8 COMPARATIVE ANATOMY OF VERTEBRATES CC-9 ANIMAL PHYSIOLOGY: LIFE SUSTAINING SYSTEMS CC-10 FUNDAMENTALS OF BIOCHEMISTRY		SEC PAPER- 2 * Gr.A- SERICULTURE Gr.B-MEDICAL DIAGNOSTIC TECHNIQUES		GE2 PAPER-2* Gr.A-HUMAN PHYSIOLOGY Gr.B-FOOD NUTRITION & HEALTH Gr.C-ENVIRONMENT AND PUBLIC HEALTH Gr.D-ANIMAL CELL BIOTECHNOLOGY	26
3	V	CC-11 MOLECULAR BIOLOGY			DSE PAPER-1* Gr.A- REPRODUCTIVE BIOLOGY, Gr. B-ENDOCRINOLOGY		24
		CC-12 IMMUNOLOGY					
	VI	CC-13 DEVELOPMENTAL BIOLOGY			DSE PAPER-3 * Gr.A- MICROBIOLOGY Gr.B-PARASITOLOGY		24
		CC-14 EVOLUTIONARY BIOLOGY AND BIOSTATISTICS			DSE PAPER-4 * Gr.A- ANIMAL BIOTECHNOLOGY Gr.B- FISH & FISHERIES Gr.C- BIOLOGY OF INSECTS		
TOTAL		56+28=84	4	4	16+8=24	16+8=24	140

*Students have to select any one group for the respective course

SEMESTER-I

1. CC1- Non-Chordates I (THEORY)

Non-Chordates I		
	4 Credits	Class
Unit 1: Basics of Animal Classification		4
Definitions: Classification, Systematics and Taxonomy; Levels of Taxonomy: Alpha, Beta & Gamma Taxonomy; Taxonomic Hierarchy, Taxonomic types: Primary, Secondary (Definition) Codes of Zoological Nomenclature; Principle of priority; Synonymy and Homonymy. Kingdom concept of classification (Whittaker)		
Unit 2: Protista		15
Protozoa General characteristics and Classification up to phylum (according to Levine et. al., 1981), Locomotion in <i>Amoeba</i> ; Conjugation in <i>Paramecium</i> . Life cycle and pathogenicity of <i>Plasmodium vivax</i>		
Unit 3: Porifera		6
General characteristics and Classification up to classes; Cell types, Spicules in sponges, Canal system in <i>Sycon</i>		
Unit 4: Cnidaria		10
General characteristics and Classification up to classes Metagenesis (Definition) Corals and coral reefs diversity, function & conservation		
Unit 5: Ctenophora		2
General characteristic		

Unit 6: Platyhelminthes	6
General characteristics and Classification up to classes Life cycle of <i>Taenia solium</i>	
Unit 7: Nematoda	7
General characteristics and Classification up to classes Life cycle of <i>Wuchereria bancrofti</i>	
Reference Books	
<ul style="list-style-type: none"> ▶ Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition. ▶ Invertebrates by Brusca & Brusca. Second edition, 2002. 	
Classification for metazoans to be followed from: Rupert and Barnes, 1994, 6th Edition.	

2. CC1 –Non-Chordates I (Lab)

Non-Chordates I	
	2 credits
List of Practical	
<ol style="list-style-type: none"> 1. Preparation of whole mount of <i>Paramecium</i> (only protocol) 2. Identification with reasons: <i>Amoeba</i>, <i>Euglena</i>, <i>Opalina</i>, <i>Paramecium</i>, (from the photographs) 3. Identification with reasons: (from the photographs) <i>Sycon</i>, <i>Obelia</i>, <i>Physalia</i>, <i>Aurelia</i>, <i>Tubipora</i>, <i>Gorgonia</i>, <i>Metridium</i>, <i>Pennatula</i>, <i>Fungia</i>, 4. Spot identification (from the photographs) of adult <i>Fasciola hepatica</i>, <i>Taenia solium</i> and <i>Ascaris lumbricoides</i> 5. Staining/mounting of any protozoa from gut of cockroach (only protocol) 	

3. CC2 –Ecology (THEORY)

Ecology		
	4 Credits	Class
Unit 1: Introduction to Ecology		4
Autecology and synecology, Laws of limiting factors, Study of Physical factors (light and temperature), The Biosphere - Introduction.		
Unit 2: Population		20
Unique and group attributes of population: Demographic factors, life tables, survivorship curves Exponential and logistic growth, equation and patterns, r and k strategies, Population Interactions, Gause's Principle with laboratory examples, Lotka-Volterra equation for competition.		
Unit 3: Community		11
Community characteristics: species diversity, abundance, dominance, richness, Ecotone and edge effect. Ecological succession in a pond ecosystem.		
Unit 4: Ecosystem		10
Types of ecosystem, Food chain: Detritus and grazing food chains, Linear and Y-shaped food chains, Food web, Energy flow through the ecosystem, Ecological pyramids General concept of biogeochemical cycle with an example of Nitrogen cycle		
Unit 5: Applied Ecology		5
Wildlife Conservation (in-situ and ex-situ conservation).		
Reference Books		
<ul style="list-style-type: none"> ▶ Krebs, C. J. (2001). Ecology. VI Edition. Benjamin Cummings. ▶ Odum, E.P., (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole ▶ Robert Leo Smith Ecology and field biology Harper and Row publisher ▶ Ecology: Theories & Application (2001). 4th Edition by Peter Stilling. ▶ Ecology by Cain, Bowman & Hacker. 3rd edition. Sinauer associates 		

4. CC2–Ecology (Lab)

Ecology	
	2 Credits
List of Practical	
<ol style="list-style-type: none">1. Study of life tables and plotting of survivorship curves of different types from the hypothetical provided2. Determination of population density in a hypothetical community by quadrat method and calculation of Shannon-Weiner diversity index for the same community3. Study of an aquatic ecosystem: Dissolved Oxygen content (Winkler's method) (protocol only), free CO₂ (protocol only)4. Submission of a report on wild life diversity of any National Park/ Wild life sanctuary	

5. GE 1 (Group-A) -Animal Diversity (THEORY)

Animal Diversity		
	4 Credits	Class
Unit 1: Protista		3
Protozoa General characters of Protozoa		
Unit 2: Porifera		3
General characters of Porifera		
Unit 3: Radiata		3
General characters of Cnidarians		
Unit 4: Aceolomates		2
General characters of Platyhelminthes		
Unit 5: Pseudocoelomates		3
General characters of Nematoda		
Unit 6: Annelida		3
General characters of Annelida		
Unit 7: Arthropoda		4
General characters		
Unit 8: Mollusca		4
General characters of mollusc		
Unit 9: Echinodermata		4
General characters of Echinodermata Water Vascular system in Starfish		

Unit 10: Protochordata	2
Salient features of Urochordata and Cephalochordata	
Unit 11: Pisces	3
General Characters, Migration of Fish	
Unit 12: Amphibia	4
General characters	
Unit 13: Reptilia	4
General Characters, Differences between poisonous and non-poisonous snakes, poison apparatus, venom	
Unit 14: Aves	4
General Characters	
Unit 15: Mammalia	4
General Characters	
Reference Books	
<ul style="list-style-type: none"> ▶ Barnes, R.D. (1992). Invertebrate Zoology. Saunders College Pub. USA. ▶ Ruppert, Fox and Barnes (2006) Invertebrate Zoology. A functional Evolutionary Approach 7th Edition, Thomson Books/Cole ▶ Campbell & Reece (2005). Biology, Pearson Education, (Singapore) Pvt. Ltd. 	
<ul style="list-style-type: none"> ▶ Kardong, K. V. (2002). Vertebrates Comparative Anatomy. Function and Evolution. Tata McGraw Hill Publishing Company. New Delhi. ▶ Raven, P. H. and Johnson, G. B. (2004). Biology, 6th edition, Tata McGraw Hill Publications. New Delhi. 	

6. GE 1 (Group-A) –Animal Diversity (Lab)

Animal Diversity

2 Credits

List of Practical

1. Spot identification (photographs):
 - a. Non Chordates: *Paramecium*, *Sycon*, *Metridium*, *Taenia*, *Ascaris*, *Nereis*, *Limulus*, *Chiton*, *Octopus*, *Asterias*,
 - b. Chordates: *Amphioxus*, *Scoliodon*, *Hippocampus*, *Labeo*, *Ichthyophis*, Salamander, *Draco*, *Naja*, Owl and Bat.
2. Identification of following specimen through photographs:

Cross section of *Sycon*, T. S. of Earthworm passing through typhlosolar intestine. Bipinnarialarva.

7. GE 1 (Group-B) -Insect Vectors and Diseases (THEORY)

Insect Vectors and Diseases		
	4 Credits	Class
Unit 1: Introduction to Insects		2
General Features of Insects, Types of antennae, Mouth parts (with reference to feeding)		
Unit 2: Concept of Vectors		4
Brief introduction to Carriers and Vectors (mechanical and biological vectors), Reservoirs,		
Unit 3: Insects as Vectors		6
Detailed features of orders with insects as vectors – Diptera, Siphonaptera, Siphunculata, Hemiptera		
Unit 4: Dipteran as Disease Vectors		20
Dipterans as important insect vectors – Mosquitoes		
Study of mosquito-borne diseases – Malaria, Dengue,		
Control of mosquitoes		
Unit 5: Siphonaptera as Disease Vectors		6
Fleas as important insect vectors, Study of Flea-borne diseases – Plague, Control of fleas		
Unit 6: Siphunculata as Disease Vectors		6
Human louse (Head louse) as important insect vectors; Control of human louse		
Unit 7: Hemiptera as Disease Vectors		6
Bugs as insect vectors; Blood-sucking bugs; Bed bugs as mechanical vectors, Control measures		
Reference Books		
<ul style="list-style-type: none"> ▶ Imms, A.D. (1977). A General Text Book of Entomology. Chapman & Hall, UK ▶ Chapman, R.F. (1998). The Insects: Structure and Function. IV Edition, Cambridge University Press, UK ▶ Pedigo L.P. (2002). Entomology and Pest Management. Prentice Hall Publication ▶ Mathews, G. (2011). Integrated Vector Management: Controlling Vectors of Malaria and Other Insect Vector Borne Diseases. Wiley-Blackwell ▶ Mosquito (2000) Chandra G, Sribhumi Publication Co. Kolkata ▶ Medical Entomology, Hati A. K Allied Book Agency, Kolkata 		

8. GE 1 (Group-B) –Insect Vectors and Diseases (Lab)

Insect Vectors and Diseases	
	2 Credits
List of Practical	
<ol style="list-style-type: none">1. Identification of different kinds of mouth parts of insects (photographs)2. Identification of following insect vectors through photographs: <i>Aedes</i>, <i>Culex</i>, <i>Anopheles</i>, <i>Phithirus pubis</i>, <i>Phlebotomus argentipes</i>, <i>Musca domestica</i>3. Study of different diseases transmitted by above insect vectors4. Submission of a project report on any one of the insect vectors and disease transmitted	

9 . GE 1 (Group-C)-Aquatic Biology (THEORY)

Aquatic Biology		
	4 Credits	Class
Unit 1: Aquatic Biomes		10
Brief introduction to the aquatic biomes: Freshwater ecosystem (lakes, and rivers), estuaries, intertidal zones, oceanic pelagic zone, marine benthic zone		
Unit 2: Freshwater Biology		20
Lakes: Lake as an Ecosystem, Physico–chemical Characteristics: Light, Temperature, Thermal stratification, Turbidity, dissolved gases (Oxygen, Carbon dioxide). Nutrient Cycles in Lakes (Nitrogen).		
Unit 3: Marine Biology		10
Salinity and density of Sea water, Continental shelf, Adaptations of deep sea organisms, Coral reefs		
Unit 4: Management of Aquatic Resources		10
Causes of pollution: Agricultural, Industrial, Sewage, and Oil spills, Eutrophication, Sewage treatment Water quality assessment- BOD and COD.		
Reference Books		
<ul style="list-style-type: none"> ▶ Anathakrishnan : Bioresources Ecology 3rd Edition ▶ Goldman : Limnology, 2nd Edition ▶ Odum and Barrett : Fundamentals of Ecology, 5th Edition ▶ Pawlowski: Physicochemical Methods for Water and Wastewater Treatment, 1st Edition ▶ Wetzel : Limnology, 3rd edition ▶ Trivedi and Goyal : Chemical and biological methods for water pollution studies ▶ Welch : Limnology Vols. I-II 		

10. GE 1 (Group-C)–Aquatic Biology (Lab)

Aquatic Biology	
	2 Credits
List of Practical	
<ol style="list-style-type: none">1. Identification of the important zooplanktons present in a pond ecosystem. (from photograph)2. Instruments used in limnology (Secchi disc, Van Dorn Bottle, Conductivity meter, Turbidity meter, PONAR grab sampler) and their significance (from photograph).	

(OUT OF THREE GROUPS OF GE 1 STUDENTS HAVE TO SELECT ANY ONE GROUP)

SEMESTER-III

23. CC 5 – Chordates (THEORY)

Chordates		
	4 Credits	Class
Unit 1: Introduction to Chordates		2
General characteristics and outline classification of Phylum Chordata (upto class level)		
Unit 2: Protochordata		6
General characteristics and classification of sub-phylum Urochordata and Cephalochordata up to Classes. Retrogressive metamorphosis in <i>Ascidia</i> .		
Unit 3: Agnatha		2
General characteristics Zoological importance of ammocoete larva		
Unit 4: Pisces		6
General characteristics of Chondrichthyes and Osteichthyes Migration in fishes		
Unit 5: Amphibia		6
General characteristics and classification up to living Orders. Metamorphosis in toad, Neoteny		
Unit 6: Reptilia		8
General characteristics and classification up to living Orders. Poison apparatus in poisonous Snakes		
Unit 7: Aves		8
General characteristics Double respiration in Birds , Principles and aerodynamics of flight		
Unit 8: Mammals		8
General characters General characters of Prototheria, Echolocation in Micro chiropterans		
Unit 9: Zoogeography		2
Zoogeographical realms, distribution of birds (flightless) and mammals in different realms		

Reference Books

- ▶ Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press.
- ▶ Pough H. Vertebrate life, VIII Edition, Pearson International.
- ▶ Darlington P.J. The Geographical Distribution of Animals, R.E. Krieger Pub Co.
- ▶ Hall B.K. and Hallgrímsson B. (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.
- ▶ Parker, T. J. & Haswell, W. (1972). Text Book of Zoology, Volume II: Marshall and Willam (Eds.) 7th Ed. Macmillan Press, London.
- ▶ Kardong, K. V. (2002). Vertebrates: Comparative anatomy, function evolution. Tata McGraw Hill.
- ▶ Kent, G. C. & Carr, R. K. (2001). Comparative anatomy of the Vertebrates. 9th Ed. McGraw Hill.
- ▶ Nelson, J.S., (2006) : Fishes of the World, 4th Edn., Wiley.
- ▶ Romer, A. S. & Parsons, T. S. (1986). The vertebrate body. 6th Ed. Saunders College Publishing.
- ▶ Jordan, E.L. & Verma, P.S. (2003). Chordate Zoology. S. Chand & Company Ltd. New Delhi.
- ▶ Sinha, K. S., Adhikari, S., Ganguly, B. B. & Bharati Goswami, B. D. (2001). Biology of Animals. Vol. II. New Central Book Agency (p) Ltd.

- ▶ Futuyama, D. (1997). Evolutionary Biology. 3rd Ed. Sinauer Associates, INC.

Note: Classifications for Protochordata, Agnatha, Reptilia, Aves and Mammalia to be followed from Young (1981), for Pisces to be followed from Romer (1959), for Amphibia to be followed from Duellman and Trueb (1986)/ Young (1981).

24. CC 5–Chordates (Lab)

Chordates

2 Credits

List of Practical

Identification with reasons:

1. Protochordata

Branchiostoma

2. Agnatha

Petromyzon, Myxine

3. Fishes

Scoliodon Torpedo, Heteropneustes, Labeo, Hippocampus, Tetradon, Anabas

4. Amphibia

Necturus, Axolotl, - Tylotriton, Hyla

5. Reptilia

Chelone, Varanus, Chamaeleon, Draco, Bungarus, Vipera, Naja, Key for Identification of poisonous and non-poisonous snakes

6. Mammalia: Bat (Insectivorous and Frugivorous),

25. CC 6 - Animal Physiology: Controlling & Coordinating Systems (THEORY)

Animal Physiology: Controlling & Coordinating Systems		
	4 Credits	Class
Unit 1: Tissues		4
Structure, location, classification and functions of epithelial tissue, connective tissue, muscular tissue and nervous tissue		
Unit 2: Nervous System		10
Structure and types of neuron, resting membrane potential, Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibers; Types of synapse, Synaptic transmission		
Unit 3: Muscular system		10
Ultra structure of skeletal muscle; Molecular and chemical basis of skeletal muscle contraction;		
Unit 5: Reproductive System		6
Roles of Hormones in Reproduction		
Unit 6: Endocrine System		16
Function of pituitary, thyroid, pancreas and adrenal gland		
Classification of hormones; Mechanism of Hormone action		
Signal transduction pathways for Steroidal, Protein and peptide hormones		
Reference Books		
<ul style="list-style-type: none"> ▶ Histology: A Text and Atlas. Sixth Edition. Ross & Pawlina. Lippincott Williams & Wilkins. ▶ Eckert Animal Physiology by David Randall and Warren Burggren. 4th edition. W. H. Freeman. 		

26. CC 6–Animal Physiology: Controlling & Coordinating Systems (Lab)

Animal Physiology: Controlling & Coordinating Systems	
	2 Credits
List of Practical	
<ol style="list-style-type: none">1. Identification of permanent slides of Mammalian Pituitary, Pancreas, Testis, Ovary, Adrenal, and Thyroid (through photographs)2. Microtomy: Preparation of permanent slide (protocol only) of mammalian tissues	

27. CC 7 – Genetics (THEORY)

Genetic		
	4 Credits	Class
Unit 1: Mendelian Genetics and its Extension		10
Principles of inheritance, Incomplete dominance and co-dominance, Multiple alleles, Sex-linked inheritance,		
Unit 2: Linkage, Crossing Over		10
Linkage and Crossing Over, molecular mechanism of crossing over (Holliday model)		
Unit 3: Mutations		10
Types of gene mutations (Classification), Types of chromosomal aberrations (Classification with one suitable example of each), Non-disjunction and variation in chromosome number;		
Unit 4: Sex Determination		8
Mechanisms of sex determination in <i>Drosophila</i> Sex determination in mammals, Dosage compensation in Human		
Unit 5: Extra-chromosomal Inheritance		4
Criteria for extra chromosomal inheritance Kappa particle in <i>Paramoecium</i>		
Unit 6: Recombination in Bacteria		6
Conjugation		
Reference Books		
▶ Developmental biology by Scott. F. Gilbert, 9 th edition.		
▶ Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc		
▶ Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. X Edition. Benjamin Cummings		
▶ Russell, P. J. (2009). Genetics- A Molecular Approach.III Edition. Benjamin Cummings		
▶ Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B.		

28. CC 7–Genetics (Lab)

Genetics	
	2 Credits
List of Practical	
<ol style="list-style-type: none">1. Chi-square analyses2. Pedigree analysis of some human inherited traits	

29. SEC 1 (Group-A) –Apiculture (THEORY)

Apiculture		
	2 Credits	Class
Unit 1: Biology of Bees		2
Classification and Life cycle of Honey Bees		
Unit 2: Rearing of Bees		10
Artificial Bee rearing (Apiary), Beehives – Newton and Langstroth		
Selection of Bee Species for Apiculture		
Unit 3: Diseases and Enemies		5
Bee Diseases		
Control and Preventive measures		
Unit 4: Bee Economy		2
Products of Apiculture Industry and its Uses (Honey, Bees Wax, Propolis), Pollen etc		
*Submission of a report on apiary/modern bee industry (20 marks)		
Reference Books		
▶ Prost, P. J. (1962). Apiculture. Oxford and IBH, New Delhi.		
▶ Bisht D.S., Apiculture, ICAR Publication.		
▶ Singh S., Beekeeping in India, Indian council of Agricultural Research, New Delhi.		

30. SEC Paper 1 (Group-B)-Aquarium Fish Keeping (THEORY)

Aquarium Fish Keeping		
	2 Credits	Class
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, Gold fish, Angel fish		
Unit 3: Food and feeding of Aquarium fishes		7
Use of live fish feed organisms. Preparation and composition of formulated fish feeds,		
Unit 4: Fish Transportation		3
Live fish transport - Fish handling, packing and forwarding techniques.		
<ul style="list-style-type: none"> • Submission of a report on Aquarium maintenance (20 marks) 		
Reference Books:		
▶ Anshuman D. Dholakia. 2016. Ornamental Fish Culture and Aquarium Management. Astral International.		
▶ Harishanker J. Alappat;A. 2011. Biju Kumar. Aquarium Fishes: A Colourful Profile. BR Publishing Corporation		
▶ Sarih K. Swain, N. Sarangi and S. Ayyappan. 2010. Ornamental Fish Farming. Indian Council of Agricultural Research.		

(OUT OF TWO GROUPS OF SEC PAPER 1 STUDENTS HAVE TO SELECT ANY ONE GROUP)

31. GE 3 (Group-A) -Animal Diversity (THEORY)

Animal Diversity		
	4 Credits	Class
Unit 1: Protista		3
Protozoa General characters of Protozoa		
Unit 2: Porifera		3
General characters of Porifera		
Unit 3: Radiata		3
General characters of Cnidarians		
Unit 4: Aceolomates		2
General characters of Platyhelminthes		
Unit 5: Pseudocoelomates		3
General characters of Nematoda		
Unit 6: Annelida		3
General characters of Annelida		
Unit 7: Arthropoda		4
General characters		
Unit 8: Mollusca		4
General characters of mollusc		
Unit 9: Echinodermata		4
General characters of Echinodermata Water Vascular system in Starfish		

Unit 10: Protochordata	2
Salient features of Urochordata and Cephalochordata	
Unit 11: Pisces	3
General Characters, Migration of Fish	
Unit 12: Amphibia	4
General characters	
Unit 13: Reptilia	4
General Characters, Differences between poisonous and non-poisonous snakes, poison apparatus, venom	
Unit 14: Aves	4
General Characters	
Unit 15: Mammalia	4
General Characters	
Reference Books	
<ul style="list-style-type: none"> ▶ Barnes, R.D. (1992). Invertebrate Zoology. Saunders College Pub. USA. ▶ Ruppert, Fox and Barnes (2006) Invertebrate Zoology. A functional Evolutionary Approach 7th Edition, Thomson Books/Cole ▶ Campbell & Reece (2005). Biology, Pearson Education, (Singapore) Pvt. Ltd. 	
<ul style="list-style-type: none"> ▶ Kardong, K. V. (2002). Vertebrates Comparative Anatomy. Function and Evolution. Tata McGraw Hill Publishing Company. New Delhi. ▶ Raven, P. H. and Johnson, G. B. (2004). Biology, 6th edition, Tata McGraw Hill Publications. New Delhi. 	

32. GE 3 (Group-A) –Animal Diversity (Lab)

Animal Diversity	
	2 Credits
List of Practical	
<p>1. Spot identification (photographs):</p> <ul style="list-style-type: none">a. Non Chordates: <i>Paramecium</i>, <i>Sycon</i>, <i>Metridium</i>, <i>Taenia</i>, <i>Ascaris</i>, <i>Nereis</i>, <i>Limulus</i>, <i>Chiton</i>, <i>Octopus</i>, <i>Asterias</i>,b. Chordates: <i>Amphioxus</i>, <i>Scoliodon</i>, <i>Hippocampus</i>, <i>Labeo</i>, <i>Ichthyophis</i>, Salamander, <i>Draco</i>, <i>Naja</i>, Owl and Bat.	
<p>2. Identification of following specimen through photographs: Cross section of <i>Sycon</i>, T. S. of Earthworm passing through typhlosolar intestine. Bipinnarialarva.</p>	

33. GE 3 (Group-B) -Insect Vectors and Diseases (THEORY)

Insect Vectors and Diseases		
	4 Credits	Class
Unit 1: Introduction to Insects		2
General Features of Insects, Types of antennae, Mouth parts (with reference to feeding)		
Unit 2: Concept of Vectors		4
Brief introduction to Carriers and Vectors (mechanical and biological vectors), Reservoirs,		
Unit 3: Insects as Vectors		6
Detailed features of orders with insects as vectors – Diptera, Siphonaptera, Siphunculata, Hemiptera		
Unit 4: Dipteran as Disease Vectors		20
Dipterans as important insect vectors – Mosquitoes		
Study of mosquito-borne diseases – Malaria, Dengue,		
Control of mosquitoes		
Unit 5: Siphonaptera as Disease Vectors		6
Fleas as important insect vectors, Study of Flea-borne diseases – Plague, Control of fleas		
Unit 6: Siphunculata as Disease Vectors		6
Human louse (Head louse) as important insect vectors; Control of human louse		
Unit 7: Hemiptera as Disease Vectors		6
Bugs as insect vectors; Blood-sucking bugs; Bed bugs as mechanical vectors, Control measures		
Reference Books		
<ul style="list-style-type: none"> ▶ Imms, A.D. (1977). A General Text Book of Entomology. Chapman & Hall, UK ▶ Chapman, R.F. (1998). The Insects: Structure and Function. IV Edition, Cambridge University Press, UK ▶ Pedigo L.P. (2002). Entomology and Pest Management. Prentice Hall Publication ▶ Mathews, G. (2011). Integrated Vector Management: Controlling Vectors of Malaria and Other Insect Vector Borne Diseases. Wiley-Blackwell ▶ Mosquito (2000) Chandra G, Sribhumi Publication Co. Kolkata ▶ Medical Entomology, Hati A. K Allied Book Agency, Kolkata 		

34. GE 3 (Group-B) –Insect Vectors and Diseases (Lab)

Insect Vectors and Diseases	
	2 Credits
List of Practical	
<ol style="list-style-type: none">1. Identification of different kinds of mouth parts of insects (photographs)2. Identification of following insect vectors through photographs: <i>Aedes</i>, <i>Culex</i>, <i>Anopheles</i>, <i>Phithirus pubis</i>, <i>Phlebotomus argentipes</i>, <i>Musca domestica</i>3. Study of different diseases transmitted by above insect vectors4. Submission of a project report on any one of the insect vectors and disease transmitted	

35 . GE 3 (Group-C)-Aquatic Biology (THEORY)

Aquatic Biology		
	4 Credits	Class
Unit 1: Aquatic Biomes		10
Brief introduction to the aquatic biomes: Freshwater ecosystem (lakes, and rivers), estuaries, intertidal zones, oceanic pelagic zone, marine benthic zone		
Unit 2: Freshwater Biology		20
Lakes: Lake as an Ecosystem, Physico–chemical Characteristics: Light, Temperature, Thermal stratification, Turbidity, dissolved gases (Oxygen, Carbon dioxide). Nutrient Cycles in Lakes (Nitrogen).		
Unit 3: Marine Biology		10
Salinity and density of Sea water, Continental shelf, Adaptations of deep sea organisms, Coral reefs		
Unit 4: Management of Aquatic Resources		10
Causes of pollution: Agricultural, Industrial, Sewage, and Oil spills, Eutrophication, Sewage treatment Water quality assessment- BOD and COD.		
Reference Books		
<ul style="list-style-type: none"> ▶ Anathakrishnan : Bioresources Ecology 3rd Edition ▶ Goldman : Limnology, 2nd Edition ▶ Odum and Barrett : Fundamentals of Ecology, 5th Edition ▶ Pawlowski: Physicochemical Methods for Water and Wastewater Treatment, 1st Edition ▶ Wetzel : Limnology, 3rd edition ▶ Trivedi and Goyal : Chemical and biological methods for water pollution studies ▶ Welch : Limnology Vols. I-II 		

36. GE 3 (Group-C)–Aquatic Biology (Lab)

Aquatic Biology	
	2 Credits
List of Practical	
<ol style="list-style-type: none">1. Identification of the important zooplanktons present in a pond ecosystem. (from photograph)2. Instruments used in limnology (Secchi disc, Van Dorn Bottle, Conductivity meter, Turbidity meter, PONAR grab sampler) and their significance (from photograph).	

(OUT OF THREE GROUPS OF GE 3 STUDENTS HAVE TO SELECT ANY ONE GROUP)

SEMESTER-V

53. CC 11 - Molecular Biology (THEORY)

Molecular Biology		
	4 Credits	Class
Unit 1: Nucleic Acids		5
Watson and Crick Model of DNA, Clover leaf model of tRNA		
Unit 2: DNA Replication		10
Mechanism of DNA Replication in Prokaryotes		
Unit 3: Transcription		10
Mechanism of Transcription in prokaryotes		
Unit 4: Translation		12
Mechanism of protein synthesis in prokaryotes, Ribosome structure and assembly in prokaryotes, aminoacyl tRNA synthetases and charging of tRNA; Genetic code, Degeneracy of the genetic code and Wobble Hypothesis		
Unit 5: Gene Regulation		4
Regulation of Transcription in prokaryotes: <i>lac</i> operon		
Unit 6: DNA Repair Mechanisms		4
Types of DNA repair mechanisms, nucleotide and base excision repair		
Unit 7: Molecular Techniques		5
Basic Principles of PCR, Sanger DNA sequencing		
Reference Books		
<ul style="list-style-type: none"> ▶ Molecular Cell Biology by Harvey Lodish. 7th Edition. W.H. Freeman. ▶ Molecular Biology of The Gene by Watson. 7th Edition. Pearson. ▶ iGenetics: A Molecular Approach by Peter. J. Russell. 3rd edition. Pearson Benjamin Cummings. 		
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54. CC 11–Molecular Biology (Lab)

Molecular Biology	
	2 Credits
List of Practical	
<ol style="list-style-type: none">1. Demonstration of polytene and lampbrush chromosome from photograph2. Quantification of DNA using colorimeter (diphenylamine method) (Protocol only)3. Agarose gel electrophoresis for DNA (Protocol only)	

55. CC 12 – Immunology (THEORY)

Immunology		
	4 Credits	Class
Unit 1: Overview of Immune System		2
Cells and organs of the Immune system		
Unit 2: Innate and Adaptive Immunity		12
Innate immunity, Adaptive immunity (Cell mediated and humoral). Structure of B and T cell Receptor and T-cell signaling		
Unit 3: Antigens		4
Antigenicity and immunogenicity, Immunogens, Adjuvants and haptens, B and T-Cell epitopes		
Unit 4: Immunoglobulins		8
Structure and functions of different classes of immunoglobulins, Antigen- antibody interactions, Immunoassays (ELISA)		
Unit 5: Major Histocompatibility Complex		2
Structure and functions of Class I and Class II MHC molecules.		
Unit 6: Cytokines		2
Types, properties and functions of cytokines.		
Unit 7: Complement System		6
Components and pathways of complement activation (Classical).		
Unit 8: Hypersensitivity		4
Gell and Coombs' classification of hypersensitivities.		
Unit 9: Vaccines		4
Various types of vaccines. Active & passive immunization (Artificial and natural).		
Reference Books		
▶ Kindt, T. J., Goldsby, R.A., Osborne, B. A. and Kuby, J (2006). Immunology, VI Edition. W.H. Freeman and Company.		
▶ Abbas, K. Abul and Lichtman H. Andrew (2003.) Cellular and Molecular Immunology. V Edition. Saunders Publication.		
▶ Ashim Kumar Chakraborty (2005). Immunology and Immunotechnology. Oxford University Press		
▶ Delves, Peter J.; Martin, Seamus J.; Burton, Dennis R.; Roitt, Ivan M. (2011). Roitt's Essential Immunology. Hoboken, NJ: Wiley-Blackwell		
▶ David Male Jonathan Brostoff David Roth Ivan Roitt (2012). Immunology 8th Edition, Elsevier		

56. CC 12–Immunology (Lab)

Immunology	
	2 Credits
List of Practical	
<ol style="list-style-type: none">1. Demonstration of lymphoid organs.(through photographs)2. Identification of spleen, thymus and lymph nodes (through photographs)3. Study of various types of leukocytes (through photographs)	

57. DSE Paper 1 (Group A) -Reproductive Biology (THEORY)

Reproductive Biology		
	4 Credits	Class
Unit 1: Reproductive Endocrinology		10
<p>Gonadal Hormones, hypothalamo – hypophyseal – gonadal axis, regulation of gonadotrophin secretion in human (male and female)</p> <p>Reproductive system: Development and differentiation of gonads</p>		
Unit 2: Functional anatomy of male reproduction		14
Histoarchitecture of testis in human; Androgen synthesis		
Unit 3: Functional anatomy of female reproduction		18
<p>Histoarchitecture of ovary in human Steroidogenesis Reproductive cycles (human) and their regulation, fertilization; Hormonal control of implantation; Mechanism of parturition and its hormonal regulation; Lactation and its regulation</p>		
Unit 4: Reproductive Health		8
<p>Infertility in male and female: causes, diagnosis and management</p> <p>Assisted Reproductive Technology: in vitro fertilization, IUI</p> <p>Modern contraceptive technologies</p>		
Reference Books		
<ul style="list-style-type: none"> ▶ Ross & Pawlina. Histology: A text and Atlas. 6th edition. ▶ Guyton & Hall. Medical Physiology. 11th edition. ▶ Knobil, E. et al. (eds). The Physiology of Reproduction. Raven Press Ltd. ▶ Hatcher, R.A. et al. The Essentials of Contraceptive Technology. Population Information Programme. 		

58. DSE Paper 1 (Group A) -- Reproductive Biology (Lab)

Reproductive Biology	
	2 Credits
List of Practicals	
<ol style="list-style-type: none">1. Report on animal house: set up and maintenance of animal house, breeding techniques, care of normal and experimental animals.2. Tissue fixation, embedding in paraffin, microtomy and slide preparation of endocrine gland (protocol only)3. Identification of histological sections from photomicrographs of rat/human: testis, epididymis, ovary, fallopian tube, uterus (proliferative and secretory stages)	

59. DSE Paper 1 (Group B) –Endocrinology (THEORY)

Endocrinology		
	4 Credits	Class
Unit 1: Introduction to Endocrinology		4
Classification, Characteristic of Hormones		
Unit 2: Epiphysis, Hypothalamo-hypophysial Axis		16
Secretions and their functions of pineal gland in biological rhythms Hormones and their functions of Piptuitary gland, Disorders of pituitary gland.		
Unit 3: Peripheral Endocrine Glands		16
Hormones of Thyroid gland, Adrenal, Pancreas, Ovary, Testis and their functions Hormones in glucose homeostasis, Disorders of endocrine glands		
Unit 4: Regulation of Hormone Action		14
Estrous cycle in rat and menstrual cycle in human Multifaceted role of Vasopressin & Oxytocin.		
Reference Books		
▶ Guyton and Hall. Textbook of Medical Physiology. 13th Edition		
▶ Histology: A Text and Atlas. Sixth Edition. Ross & Pawlina. Lippincott Williams & Wilkins.		
▶ Vertebrate Endocrinology by David O. Norris,		

60. DSE Paper 1 (Group B) --Endocrinology Lab

Endocrinology	
	2 Credits
List of Practical	
<ol style="list-style-type: none">1. Demonstration of Endocrine glands in rat (through photographs).2. Identification of the permanent slides of all the endocrine glands (from photographs).3. Tissue fixation, embedding in paraffin, microtomy and slide preparation of endocrine gland (Protocol)	

61. DSE Paper 2 (Group A) -Animal Behaviour and Chronobiology (THEORY)

Animal Behaviour and Chronobiology		
	4 Credits	Class
Unit 1: Introduction to Animal Behaviour		5
Brief contributions of Karl Von Frish, Ivan Pavlov, Konrad Lorenz, Niko Tinbergen		
Unit 2: Patterns of Behaviour		6
Individual Behavioural patterns; Instinct vs. Learnt Behaviour; classical and operant conditioning, Imprinting.		
Unit 3: Social and Sexual Behaviour		15
Social Behaviour: Communication: Chemical communications in insects Altruism; Reciprocal altruism and Kin selection. Sexual Behaviour: Mate choice, Intra-sexual selection (male rivalry), Inter-sexual selection (female choice)		
Unit 4: Biological Rhythm		14
Types and characteristics of biological rhythms: Short- and Long- term rhythms; Circadian rhythms; Tidal rhythms and Lunar rhythms; Circannual rhythms; Photoperiod and regulation of seasonal reproduction of vertebrates; Role of melatonin.		
Reference Books		
<ul style="list-style-type: none"> ▶ Animal Behaviour by Drickamar. ▶ John Alcock, Animal Behaviour, Sinauer Associate Inc., USA. ▶ Paul W. Sherman and John Alcock, Exploring Animal Behaviour, Sinauer Associate Inc., Massachusetts, USA. ▶ Chronobiology Biological Timekeeping: Jay. C. Dunlap, Jennifer. J. Loros, Patricia J. DeCoursey (ed). 2004, Sinauer Associates, Inc. Publishers, Sunderland, MA, USA ▶ Insect Clocks D.S. Saunders, C.G.H. Steel, X., Afopoulou (ed.) R.D. Lewis. (3rdEd) 2002 Baren and Noble Inc. New York, USA ▶ Biological Rhythms: Vinod Kumar (2002) Narosa Publishing House, Delhi/ Springer-Verlag, Germany. 		

62. DSE Paper 2 (Group A) –Animal Behaviour and Chronobiology (Lab)

Animal Behaviour and Chronobiology

2 Credits

List of Practical

1. To study the aggressive behavior of fish. (from photographs)
2. To study the learning behavior of rat, (from hypothetical data)
3. Submission of a report on behavioral activities of any animal in Forest

63. DSE Paper 2 (Group B) – Wild Life Conservation and Management (THEORY)

Wild Life Conservation and Management		
	4 Credits	Class
Unit 1: Introduction to Wild Life		6
Importance of conservation; Causes of depletion;		
Unit 2: Evaluation and management of wild life		8
Habitat analysis, Physical parameters: Soil and water Biological Parameters: food, cover, forage, Standard evaluation procedures: remote sensing and GIS.		
Unit 3: Management of habitats		6
Setting back succession; Grazing logging; Advancing the successional process; Preservation of general genetic diversity Restoration of degraded habitats		
Unit 4: Population estimation		12
Population density, Natality, Birth rate, Mortality, fertility schedules and sex ratio computation; Pug marks and census method.		
Unit 5: Aims and objectives of wildlife conservation		6
Wildlife conservation in India- in-situ conservation and ex-situ conservation: necessity for wildlife conservation		
Unit 6: Management planning of wild life in protected areas		5
Eco tourism / wild life tourism in forests		
Unit 7: Man and Wildlife		3
Causes and consequences of human-wildlife conflicts		
Unit 8: Protected areas		4
National parks & sanctuaries, Community reserve; Important features of protected areas in India; Tiger conservation - Tiger reserves in India; Management challenges in Tiger reserve.		

Reference Books

- ▶ Caughley, G., and Sinclair, A.R.E. (1994). Wildlife Ecology and Management. Blackwell Science.
- ▶ Woodroffe R., Thirgood, S. and Rabinowitz, A. (2005). People and Wildlife, Conflict or Co-existence? Cambridge University.
- ▶ Bookhout, T.A. (1996). Research and Management Techniques for Wildlife and Habitats, 5 th edition. The Wildlife Society, Allen Press.
- ▶ Sutherland, W.J. (2000). The Conservation Handbook: Research, Management and Policy. Blackwell Sciences
- ▶ Hunter M.L., Gibbs, J.B. and Sterling, E.J. (2008). Problem-Solving in Conservation Biology and Wildlife Management: Exercises for Class, Field, and Laboratory. Blackwell Publishing.

64. DSE Paper 2 (Group B) –Wild Life Conservation and Management (Lab)

Wild Life Conservation and Management

2 Credits

List of Practical

1. Submission of a report on mammalian fauna/ avian fauna/ herpeto-fauna of any protected area of North Bengal.
2. Knowledge of basic equipment needed in wildlife studies use, care and maintenance (Compass, Binoculars, Range Finders, Global Positioning System, Various types of Cameras and lenses)
3. Identification of animals through pug marks, hoof marks, nest, antlers, (photograph)

(OUT OF TWO GROUPS OF DSE PAPER 2 STUDENTS HAVE TO SELECT ANY ONE GROUP)