West Bengal State University

CBCS curricula and syllabi for UG 2018

Zoology Honours

(Credit values given within brackets)

SEM	COURSES					Total credits
	CORE	DSE	GEC	AEC	SEC	
I	ZOOACOR01T (4) ZOOACOR01P (2) ZOOACOR02T (4) ZOOACOR02P (2)	-	CEMHGEC01T (4) CEMHGEC01P (2) **OR** GE course offered by any other science department	ENVSAECO1T (2)		**20**
II	ZOOACOR03T (4) ZOOACOR03P (2) ZOOACOR04T (4) ZOOACOR04P (2)		CEMHGEC02T (4) CEMHGEC02P (2) **OR** Any other GEC course offered by any other science department	ENGSAEC01T (2)		**20**
III	ZOOACOR05T (4) ZOOACOR05P (2) ZOOACOR06T (4) ZOOACOR06P (2) ZOOACOR07T (4) ZOOACOR07P (2)		BOTHGEC01T (4) BOTHGEC01P (2) **OR** Any other GEC course offered by any other science department		ZOOSSEC001 (2) OR ANY SEC offered by any other dept.	**26**
IV	ZOOACOR08T (4) ZOOACOR08P (2) ZOOACOR09T (4) ZOOACOR09P (2) ZOOACOR10T (4) ZOOACOR10P (2)		BOTHGEC02T (4) BOTHGEC02P (2) **OR** Any other GEC course offered by any other science department		ZOOSSEC003 (2) OR ANY SEC offered by any other dept.	**26**
V	ZOOACOR11T (4) ZOOACOR11P (2) ZOOACOR12T (4) ZOOACOR12P (2)	ZOOADSE01T (4) ZOOADSE01P (2) ZOOADSE02T (4) ZOOADSE02P (2) ZOOADSE03T (4) ZOOADSE03P (2) (ANY TWO TO BE CREDITED)				**24**

VI	ZOOACOR13T (4) ZOOACOR13P (2) ZOOACOR14T (4) ZOOACOR14P (2)	ZOOADSE04T (4) ZOOADSE04P (2) ZOOADSE05T (4) ZOOADSE05P (2) ZOOADSE06T (4) ZOOADSE06P (2) (ANY TWO TO BE CREDITED)				**24**
	14	4	4	2	2	**140**

COURSE DETAILS : **Cores**

Semester I

ZOOACOR01T (Theory, 4 credits= 60 classes): Non-Chordates I

Unit 1: Protista, Parazoa and Metazoa 19 classes
classes

General characteristics and Classification up to classes

Study of *Euglena*, *Amoeba* and *Paramoecium*

Life cycle and pathogenicity of *Giardia intestinalis*, *Leishmania donovani*, *Entamoeba histolytica* and *Plasmodium vivax*

Locomotion and Reproduction in Protista

Evolution of symmetry and segmentation of Metazoa

Unit 2: Porifera 7 classes

General characteristics and Classification up to classes

Canal system and spicules in sponges

Unit 3: Cnidaria 12 classes

General characteristics and Classification up to classes

Metagenesis in *Obelia*

Polymorphism in Cnidaria

Corals and coral reefs: types, formation, distribution, conservation significance

Unit 4: Ctenophora 4 Classes

General characteristics

Unit 5: Platyhelminthes 10 Classes

General characteristics and Classification up to classes

Life cycle and pathogenicity of *Fasciola hepatica* and *Taenia solium*

Unit 6: Nemathelminthes 8 Classes

General characteristics and Classification up to classes

Life cycle, and pathogenicity of *Ascaris lumbricoides, Ancylostoma duodenale and Wuchereria bancrofti*

Parasitic adaptations in helminths

Origin and evolution of parasitic helminths

ZOOACOR01P (Practicals, 2 credits = 60 classes): Non-Chordates I Lab

1. Study of whole mount of *Euglena, Amoeba and Paramoecium*, Binary fission and Conjugation in *Paramoecium*

2. Examination of freshwater pond water collected from different places for diversity of protists in it.

3. Study of Sycon (T.S. and L.S.), *Hyalonema, Euplectella, Spongilla*

4. Study of *Obelia, Physalia, Millepora, Aurelia, Tubipora, Corallium, Alcyonium, Gorgonia, Metridium, Pennatula, Fungia, Meandrina, Madrepora*

5. One specimen/slide of any Ctenophore

6. Study of adult *Fasciola hepatica, Taenia solium* and their life cycles (Slides/microphotographs)

7. Study of adult *Ascaris lumbricoides* and its life stages (Slides/micro-photographs)

8. To submit a Project Report on any related topic on pond water protozoan or invertebrate diversity/ life cycles of mosquitoes, butterfly/moth etc /coral and coral reefs.

Note:

1. Only conspicuous characters required to identify the organism to be noted along with the known systematic positions of it (for Protozoans up to Phylum and others up to Class)
2. It is wise to study the coloured photographs of the organisms suggested for the study as available from internet sources along with the preserved specimens, if are there, or otherwise.

Text Book:

- Biology of the Invertebrates by Jan A Pechenik
- Invertebrates by Brusca and Brusca 2nd Ed

Referrences:

- An introduction to Invertebrates by Janet Moore 2nd ed.
- Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science
- Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson
- Bose, Mala. Parasitoses and Zoonoses, New Central Book Agency , 2017.
- Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition.

- Students are encouraged to explore authentic websites (for e.g. wikipedia, different university websites, OCWs) at internet for reading / audio-visual materials on a particular topic if they don't find enough in the text books)

ZOOACOR02T (Theory, 4 credits= 60 classes): Ecology

Unit 1: Introduction to Ecology **4 classes**

History of ecology, Autecology and synecology, Levels of organization, Laws of limiting factors, Study of Physical factors, The Biosphere.

Unit 2: Population **20 classes**

Unitary and Modular populations
Unique and group attributes of population: Demographic factors, life tables, fecundity tables, survivorship curves, dispersal and dispersion.
Geometric, exponential and logistic growth, equation and patterns, r and K strategies Population regulation - density-dependent and independent factors
Population Interactions, Gause's Principle with laboratory and field examples, Lotka-Volterra equation for competition.

Unit 3: Community **11 classes**

Community characteristics: species diversity, abundance, dominance, richness, Vertical stratification, Ecotone and edge effect. Ecological succession and example of it.

Unit 4: Ecosystem **10 classes**

Types of ecosystem with an example in detail, Food chain: Detritus and grazing food chains, Linear and Y-shaped food chains, Food web, Energy flow through the ecosystem, Ecological pyramids and Ecological efficiencies Nutrient and biogeochemical cycle with an example of Nitrogen cycle Human modified ecosystem

Unit 5: Applied Ecology **5 classes**

Wildlife Conservation (in-situ and ex-situ conservation).

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

ZOOACOR02P (Practicals, 2 credits = 60 classes): Ecology Lab

1. Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided

2. Determination of population density of a natural/hypothetical population. Study of species diversity of a community by quadrat or any other suitable sampling method and calculation of Shannon-Weiner diversity index for the same community.

3. Study of an aquatic ecosystem: Sampling of Phytoplankton and zooplankton, Measurements of temperature, turbidity/penetration of light, determination of pH, and Dissolved Oxygen content (Winkler's method), Chemical Oxygen Demand and free CO2.

4. Excursion: Visit to a National Park/Wild life sanctuary/ any other Protected Forests within West Bengal. Report (including the actual field diary) on the study of the landscape and habitat features, Types of Forests, Major Flora and Fauna, Man-animal conflicts and other problems, Management and conservation measures.

Text book:

1. Ecology: Theories and Applications by Peter Stiling; Pearson 4th Ed. 2001.
2. Ecology: The Experimental Analysis of Distribution and Abundance (Indian Paperback edition) by Charles Krebs
3. for Unit 5, also read Conservation Biology: A Primer for South Asia by Kamaljit S. Bawa, Meera Anna Oommen, and Richard B. Primack, University Press, India)

Referrences:

- A Primer of Ecology by Gotelli; 3rd Ed. Sinauer Associates. 2000.
- Students are encouraged to explore authentic websites (for e.g. different university websites and OCWs) at internet, wikipedia for reading / audio-visual materials on a particular topic if they don't find enough in the text books or otherwise)

Semester II

ZOOACOR03T (Theory, 4 credits= 60 classes): Non-Chordates II

Unit 1: Introduction to Coelomates
Evolution of coelom and metamerism

Unit 2: Annelida
General characteristics and Classification up to classes
Excretion in Annelida

Unit 3: Arthropoda
General characteristics and Classification up to classes
Vision and Respiration in Arthropoda
Metamorphosis in Insects
Social life in bees and termites

Unit 4: Onychophora
General characteristics and Evolutionary significance

Unit 5: Mollusca
General characteristics and Classification up to classes
Respiration in Mollusca
Torsion and detorsion in Gastropoda
Pearl formation in bivalves
Evolutionary significance of trochophore larva

Unit 6: Echinodermata
General characteristics and Classification up to classes
Water-vascular system in Asteroidea
Larval forms in Echinodermata
Affinities with Chordates

Unit 7: Hemichordata
General characteristics of phylum Hemichordata. Phylogenetic relationship with non-chordates and chordates (only recent concept)*

ZOOACOR03P (Practicals, 2 credits = 60 classes): Non-Chordates II Lab

1. Study of following specimens:

Annelids - *Aphrodita, Nereis, Heteronereis, Sabella, Serpula, Chaetopterus, Pheretima, Hirudinaria*
Arthropods - *Limulus, Palamnaeus, Palaemon, Daphnia, Balanus, Sacculina, Cancer, Eupagurus, Scolopendra, Julus, Bombyx, Periplaneta,* termites and honey bees
Onychophora - *Peripatus*
Molluscs - *Chiton, Dentalium, Pila, Doris, Helix, Unio, Ostrea, Pinctada, Sepia, Octopus, Nautilus*
Echinodermates - *Pentaceros/Asterias, Ophiura, Clypeaster, Echinus, Cucumaria and Antedon*
Hemichordates- *Saccoglossus*

2. Digestive system, septal nephridia and pharyngeal nephridia of earthworm 3. T.S. through pharynx, gizzard, and typhlosolar intestine of earthworm

4. Mount of mouth parts and dissection of digestive system and nervous system of Periplaneta

5. To submit a Project Report (mostly literature review) on any related topic to larval forms (crustacean, mollusc and echinoderm)

Note:
1. Only conspicuous characters required to identify the organism to be noted. Along with it, the systematic positions of the organism are to be mentioned (up to Class).
2. It is wise to study the coloured photographs of the whole organisms or its parts suggested for the study as available from internet sources along with the preserved specimens, if are there, and otherwise. Dissections of animals other than common pests are discouraged.

Text Book:

- Biology of the Invertebrates by Jan A Pechenik, Mcgrew-Hill, 2014
  Or
- Invertebrates by Brusca and Brusca 2nd Ed, Sinauer Associates

Referrence:

- An introduction to Invertebrates by Janet Moore 2nd ed.
- Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science
- Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson
- Chaudhury,S.(2017). Economic Zoology. New Central Book Agency
- https://www.nature.com/articles/nature16150) for hemichordate phylogenetic relationship*
- Students are encouraged to explore authentic websites (for e.g. wikipedia, different university websites and OCWs) at internet for reading / audio-visual materials on a particular topic if they don't find enough in the text books or otherwise)

ZOOACOR04T (Theory, 4 credits= 60 classes): Cell Biology

Unit 1: Overview of Cells
Prokaryotic and Eukaryotic cells, Virus, Viroids, Mycoplasma, Prions

Unit 2: Plasma Membrane
Various models of plasma membrane structure
Transport across membranes: Active and Passive transport, Facilitated transport
Cell junctions: Tight junctions, Desmosomes, Gap junctions
Extracellular Matrix-Cell Interactions

Unit 3: Endomembrane System
Structure and Functions: Endoplasmic Reticulum, Golgi Apparatus, Lysosomes

Unit 4: Mitochondria and Peroxisomes
Mitochondria: Structure, Semi-autonomous nature, Endosymbiotic hypothesis Mitochondrial Respiratory Chain, Chemi-osmotic hypothesis Peroxisomes

Unit 5: Cytoskeleton
Structure and Functions: Microtubules, Microfilaments and Intermediate filaments

Unit 6: Nucleus
Structure of Nucleus: Nuclear envelope, Nuclear pore complex, Nucleolus Chromatin: Euchromatin and Heterochromatin and packaging (nucleosome)

Unit 7: Cell Division
Mitosis and Meiosis
Cell cycle and its regulation
Cancer (Concept of oncogenes and tumor suppressor genes)
Mechanisms of cell death: brief overview

Unit 8: Cell Signaling
Cell signalling transduction pathways; Types of signaling molecules and receptors
GPCR and Role of second messenger (cAMP)

ZOOACOR04P (Practicals, 2 credits = 60 classes): Cell Biology Lab

1. Preparation of temporary stained squash of onion root tip to study various stages of mitosis
2. Study of various stages of meiosis (in pre-prepared slides and/or in photographs obtained from websites).
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. Mucopolysaccharides by PAS reaction
   c. Proteins by Mercurobromophenol blue/Fast Green
5. Cell viability study by Trypan Blue staining

Text Book:

1. Campbell's Biology, 11th Edition by Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, Jane B. Reece , Published by Pearson Copyright © 2017

2. Cell Biology by Gerald Karp; Wiley, 7th Ed. 2013
   Or
   Essentials of Cell Biology by Bruce Albert et al.; W.W. Norton Co., 4th Ed, 2013
   Or
   Molecular Cell Biology by Hurvey Lodish et al.; W. H. Freeman, 6th Ed.2013

Reference:

- Students are encouraged to explore authentic websites (for e.g. wikipedia, different university websites and OCWs) at internet for reading / audio-visual materials on a particular topic if they don't find enough in the text books or otherwise)

==========

Semester III

ZOOACOR05T (Theory, 4 credits= 60 classes): Chordates

Unit 1: Introduction to Chordates
General characteristics and outline classification of Phylum Chordata

Unit 2: Protochordata
General characteristics and classification of sub-phylum Urochordata and Cephalochordata up to Classes.
Metamorphosis in Ascidia
Chordate Features and Feeding in Branchiostoma

Unit 3: Origin of Chordata
Dipleurula concept and the Echinoderm theory of origin of chordates
Advanced features of vertebrates over Protochordata

Unit 4: Agnatha
General characteristics and classification of cyclostomes up to order

Unit 5: Pisces
General characteristics and classification of Chondrichthyes and Osteichthyes up to Subclasses Accessory respiratory organ, migration and parental care in fishes Swim bladder in fishes. Classification up to Sub-Classes

Unit 6: Amphibia
General characteristics and classification up to living Orders
Metamorphosis and parental care in Amphibia

Unit 7: Reptilia
General characteristics and classification up to living Orders
Poison apparatus and Biting mechanism in Snake

Unit 8: Aves
General characteristics and classification up to Sub-Classes
Exoskeleton and migration in Birds
Principles and aerodynamics of flight

Unit 9: Mammals
General characters and classification up to living orders
Phylogenetic significance of Prototheria
Exoskeleton derivatives of mammals
Adaptive radiation in mammals with reference to locomotory appendages
Echolocation in Microchiropterans and Cetaceans

Unit 10: Zoogeography
Zoogeographical realms,
Plate tectonic and Continental drift theory,
Distribution of birds and mammals in different realms

Note: Classification schemes are to be followed as given in Kardong, 2004. All groups are to be studied up to order, except for Mammals up to class.

ZOOACOR05P (Practicals, 2 credits= 30 classes): Chordates Lab

Lab/field study of –

1. **Protochordata**
   Herdmania, Branchiostoma,
   Colonial Urochordates; Sections of Balanoglossus through proboscis and branchiogenital regions, Sections of Amphioxus through pharyngeal, intestinal and caudal regions, *Herdmania* spicules
2. **Agnatha**
   Petromyzon, Myxine
3. **Fishes**
   Scoliodon, Sphyrna, Pristis, Torpedo, Chimaera, Mystus, Heteropneustes, Labeo, Exocoetus, Echeneis, Anguilla, Hippocampus, Tetraodon, Anabas, Flat fish
4. **Amphibia**
   Ichthyophis/Ureotyphlus, Necturus, Bufo, Hyla, Alytes, Salamandra
5. **Reptilia**
   Chelone, Trionyx, Hemidactylus, Varanus, Uromastix, Chamaeleon, Ophiosaurus, Draco, Bungarus, Vipera, Naja, Hydrophis, Zamenis, Crocodylus Key for Identification of poisonous and non-poisonous snakes
6. **Aves**
   Study of six common birds from different orders (Stork, Owl/Falcon, Sun Bird, Jacanna, Duck)- types of beaks and claws.
7. **Mammalia**
   Sorex, Bat (Insectivorous and Frugivorous), Funambulus, Loris, Herpestes, Erinaceous.

8. Mount of weberian ossicles of Mystus or Grass Carp,
   Pecten from Fowl head, Dissection of Fowl head (Dissections and mounts subject to permission)

   Power point presentation on study of any two animals from two different classes by students (may be included if dissections not given permission)

Note:

1. Only conspicuous characters required to identify the animal are to be noted. Along with it, the systematic positions of the animal mentioned (up to Class) and a short note on its habits and habitat are to be noted.
2. It is wise to study the coloured photographs of the whole animal and/or its parts mentioned above for the study, as available from internet sources along with the preserved specimens (if, they are already in the museum). New collection/purchase of animals or their body parts, especially for those which are protected by conservation laws are to be avoided. Dissections of animals other than common pests are discouraged.

Text Book:

- Kardong, K. V. (2002). Vertebrates: Comparative anatomy, function evolution. McGraw Hill 4th Ed. 2005.
- Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press.

- Pough H. Vertebrate life, VIII Edition, Pearson International.

References:

- Students are encouraged to explore authentic websites (for e.g. wikipedia, different university websites and OCWs) at internet for reading / audio-visual materials on a particular topic if they don't find enough in the text books or otherwise)
- Comparative Anatomy of the Vertebrates 9th Ed (2015) by Kent; McGrew-Hill
- Elements of Chordate Anatomy by Weichert and Presch, 2017, Amazon.in

ZOOACOR06T (Theory, 4 credits= 60 classes): Physiology: Controlling and Coordinating Systems

Unit 1: Tissues **4 classes**

Structure, locations, classification and functions of epithelial tissues, connective tissues, muscular tissues and nerve tissues

Unit 2: Bone and Cartilage **4**

Structure and types of bones and cartilages, Ossification

Unit 3: Nervous System **10**

Structure of neuron, resting membrane potential, Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibers; Types of synapse, Synaptic transmission and Neuromuscular junction; Reflex action and its types

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 fiber

Unit 5: Reproductive System **6**

Histology of testis and ovary; Physiology of Reproduction

Unit 6: Endocrine System **16**

Histology and function of pituitary, thyroid, pancreas and adrenal; 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 and endocrine system; Placental hormones

ZOOACOR06P (Practicals, 2 credits= 30 classes): Physiology: Controlling and Coordinating Systems) Lab

1. Recording of simple muscle twitch with electrical stimulation (or Virtual)
2. Preparation of temporary mounts: Squamous epithelium, Striated muscle fibers and nerve cells
3. Study of permanent slides of Mammalian skin, Cartilage, Bone, Spinal cord, Nerve cell, Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid
4. Microtomy: Preparation of permanent slide of any five (lung, salivary gland, stomach, small intestine, large intestine only) mammalian (white rat) tissues

Text Book:

1. Campbell's Biology, 11th Edition by Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, Jane B. Reece , Published by Pearson Copyright © 2017.
2. Sembulingam K, Sembulingam P. 2012. Essentials of Medical Physiology. 6th Edn. Jaypee.

Or

Ganong's Review of Medical Physiology by Barret; 25th Ed, McGrew-Hill, 2016

Reference Books

1. Cormack DH. 2003. PDQ Histology. B.C. Decker Ins., London.
2. Gunasegaran JP. 2010. A Text book of Histology and a Practical Guide. Elsevier
3. Junqueria LC, Carneiro J. 2005. Basic histology text and atlas.
4. Randall D , Burggren W. 2001. Eckert Animal Physiology by. 4th edition. W. H. Freeman.
5. Ross MH, Pawlina W. 2010. Histology: A Text and Atlas. Sixth Edition. Lippincott Williams & Wilkins.
6. Eroschenko VP. 2008. diFiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott & Wilkins.

ZOOACOR07T (Theory, 4 credits= 60 classes): Biochemistry

Unit 1: Fundamentals of biochemical reactions and metabolism

Ionization of water, weak acids and bases, buffering and pH changes in living systems
Metabolism: Catabolism and Anabolism, Compartmentalization of metabolic pathways, Shuttle systems and membrane transporters; ATP as "Energy Currency of cell"; coupled reactions; Use of reducing equivalents and cofactors; Intermediary metabolism and regulatory mechanisms

Unit 2: Carbohydrates

Structure and Biological importance: Monosaccharides, Disaccharides, Polysaccharides; Derivatives of Monosachharides
Carbohydrate metabolism: Glycolysis, Citric acid cycle, Pentose phosphate pathway, Gluconeogenesis

Unit 3: Lipids

Structure and Significance: Physiologically important saturated and unsaturated fatty acids, Triacylglycerols, Phospholipids, Sphingolipid, Glycolipids, Steroids, Eicosanoids and terpinoids.
Lipid metabolism: β-oxidation of fatty acids; Fatty acid biosynthesis

Unit 4: Proteins

Amino acids Structure, Classification, General and Electro chemical properties of α-amino acids; Physiological importance of essential and non-essential amino acids
Proteins Bonds stabilizing protein structure; Levels of organization
Protein metabolism: Transamination, Deamination, Urea cycle, Fate of C-skeleton of Glucogenic and Ketogenic amino acids

Unit 5: Nucleic Acids

Structure: Purines and pyrimidines, Nucleosides, Nucleotides, Nucleic acids
Types of DNA and RNA, Complementarity of DNA, Hypo- Hyperchromaticity of DNA
Outlines of nucleotide metabolism

Unit 6: Enzymes

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; Allosteric enzymes and their kinetics; Strategy of enzyme action- Catalytic and Regulatory (Basic concept with one example each)

Unit 7: Oxidative Phosphorylation

Redox systems; Review of mitochondrial respiratory chain, Inhibitors and un-couplers of Electron Transport System

ZOOACOR07P (Practicals, 2 credits= 30 classes): Biochemistry Lab

1. Qualitative tests of functional groups in carbohydrates, proteins and lipids.

2. Paper chromatography of amino acids.

3. Quantitative estimation by Lowry Method

4. Demonstration of proteins separation by SDS-PAGE.

5. Study of the enzymatic activity of Trypsin and Lipase.

6. Performing the Acid and Alkaline phosphatase assay from serum/ tissue.

Text Book

1. Campbell's Biology, 11th Edition by Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, Jane B. Reece , Published by Pearson Copyright © 2017.
2. Cox, M.M and Nelson, D.L. (2008). Lehninger's Principles of Biochemistry, V Edition, W.H. Freeman and Co., New York.

Referrences:

1. Principles of Biochemistry by Voet, Pratt and Voet; Wiley International Student Ed. 2012
2. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2007). Biochemistry, VI Edition, W.H. Freeman and Co., New York.
3. Murray, R.K., Bender, D.A., Botham, K.M., Kennelly, P.J., Rodwell, V.W. and Well, P.A. (2009). Harper's Illustrated Biochemistry, XXVIII Edition, International Edition, The McGraw- Hill Companies Inc.
4. Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R. (2008). Molecular Biology of the Gene, VI Edition, Cold Spring Harbor Lab. Press, Pearson Pub.

==========

Semester IV

ZOOACOR08T (Theory, 4 credits= 60 classes): Comparative Anatomy

Unit 1: Integumentary System **6 Classes**

Structure, function and derivatives of integument in amphibian, birds and mammals

Unit 2: Skeletal System **6**

Overview of axial and appendicular skeleton; Jaw suspension; Visceral arches.

Unit 3: Digestive System **8**

Comparative anatomy of stomach; dentition in mammals

Unit 4: Respiratory System **6**
Respiratory organs in fish, amphibian, birds and mammals

Unit 5: Circulatory System **8**
General plan of circulation, Comparative account of heart and aortic arches

Unit 6: Urinogenital System **6**
Succession of kidney, Evolution of urinogenital ducts, Types of mammalian uteri

Unit 7: Nervous System 6
Comparative account of brain, Cranial nerves in mammals

Unit 8: Sense Organs **4**
Classification of receptors, Brief account of auditory receptors in vertebrate

ZOOACOR08P (Practicals, 2 credits= 30 classes): Comparative Anatomy Lab

1. Study of placoid, cycloid and ctenoid scales through permanent slides/photographs
2. Study of disarticulated skeleton of Toad, Pigeon and Guineapig
3. Demonstration of Carapace and plastron of turtle
4. Identification of mammalian skulls: One herbivorous (Guineapig) and one carnivorous (Dog) animal
5. Dissection of Tilapia: Circulatory system, Brain, pituitary, urinogenital system

Text Book:

1. Comparative Anatomy of the Vertebrates 9th Ed (2015) by Kent; McGrew-Hill
2. Elements of Chordate Anatomy by Weichert and Presch, 2017, Amazon.in

References:

- Hilderbrand, M and Gaslow G.E. Analysis of Vertebrate Structure, John Wiley and Sons
- Kardong, K. V. (2002). Vertebrates: Comparative anatomy, function evolution. McGraw Hill 4th Ed. 2005.

ZOOACOR09T (Theory, 4 credits= 60 classes): Physiology: Life Sustaining system

Unit 1: Physiology of Digestion **12**
Structural organisation and functions of Gastrointestinal tract and Associated glands; Mechanical and chemical digestion of food, absorption of Carbohydrates, Lipids, Proteins and Nucleic Acids; Digestive enzymes

Unit 2: Physiology of Respiration **10**
Mechanism of Respiration, Respiratory volumes and capacities, transport of Oxygen and Carbon dioxide in blood, Dissociation curves and the factors influencing it, respiratory pigments; Carbon monoxide poisoning

Unit 3: Physiology of Circulation **12**

Components of Blood and their functions; Structure and functions of haemoglobin; Haemostasis; Blood clotting system, Fibrinolytic system; Haemopoiesis: Basic steps and its regulation; Blood groups; ABO and Rh factor

Unit 4: Physiology of Heart **8**

Structure of mammalian heart, Coronary Circulation, Structure and working of conducting myocardial fibers, Origin and conduction of cardiac impulses; Cardiac Cycle and cardiac output; Blood pressure and its regulation

Unit 5: Thermoregulation & Osmoregulation

Physiological classification based on thermal biology. Thermal biology of endotherms; Osmoregulation in aquatic vertebrates; Extra-renal osmo-regulatory organs in vertebrates

Unit 6: Renal Physiology **8**

Structure of Kidney and its functional unit, Mechanism of urine formation, Regulation of acid-base balance

ZOOACOR09P (Practicals, 2 credits= 30 classes): Animal Physiology: Life Sustaining system Lab

List of Practicals

1. Determination of ABO Blood group
2. Enumeration of red blood cells and white blood cells using haemocytometer
3. Estimation of haemoglobin using Sahli's haemoglobinometer
4. Preparation of haemin and haemochromogen crystals
5. Recording of blood pressure using a sphygmomanometer/digital meter

Text Book:

1. Campbell's Biology, 11th Edition by Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, Jane B. Reece , Published by Pearson Copyright © 2017.
2. Ganong's Review of Medical Physiology by Barret; 25th Ed, McGrew-Hill, 2016

Reference Books

1. Elaine N. Marieb, 2006. Human Anatomy & Physiology, Pearson Education.
2. Eroschenko VP. 2008. diFiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott & Wilkins.
3. Fox SI. 2011. Human Physiology. 12th Edn. Mc Graw Hill
4. Gunstream SE. 2010. Anatomy and Physiology with integrated study guide. 4th Edn., Mc Graw Hill.
5. Guyton AC, Hall JE. 2006. Textbook of Medical Physiology. XI Edn. Hercourt Asia PTE Ltd. W.B. Saunders Company.
6. Hill RW, Wyse GA, Anderson M. 2012. Animal Physiology. 3rd Edn. Sineuer Associaes.
7. Sembulingam K, Sembulingam P. 2012. Essentials of Medical Physiology. 6th Edn. Jaypee Pub, New Delhi
8. Sherwood L. 2013. Human Physiology from cells to systems. 8th Edn., Brooks & Cole
9. Tortora GJ, Grabowski S. 2006. Principles of Anatomy & Physiology. XI Edition John Wiley & son
10. Vander A, Sherman J, Luciano D. 2014. Vander's Human Physiology: The Mechanism of Body Function. XIII Edn. McGraw Hills

ZOOACOR10T (Theory, 4 credits= 60 classes): Immunology

Unit 1: Overview of Immune System 4

Basic concepts of health and diseases, Historical perspective of Immunology,
Organs (Primary & Secondary lymphoid organs and its importance) and Cells of the Immune system,
Concept of Haematopoiesis and development of progenitor cells of the Immune system (Brief idea)

Unit 2: Innate and Adaptive Immunity 6

Principle of Innate and Adaptive Immunity.

- Components of innate immunity
  - Epithelial barriers (skin and mucosal membranes [concept])
  - Cellular mechanisms (phagocytes, NK cells, mast cells, eosinophils, inflammation [concept])
  - Humoral mechanisms (complement, cytokines, chemokines etc. [concept])

- Components of adaptive immunity
  - Cellular mechanisms (Cell-Mediated Immune System (CMIS) or T-Cell Immunity [concept])
  - Humoral mechanisms (Formation of Plasma B cells and Memory B cells [concept])

6

Unit 3: Antigen, Antigen presentation & MHC

Concept of Antigen, Immunogen, Allergen & Pathogen.
Adjuvants and haptens, Factors influencing immunogenicity, Epitope.
Types of Antigen Presenting Cells (APC),
Structure of Major Histocompatibility Complex (MHC) molecules.
Mechanism of antigen presentation and involvement of MHC molecules (both MHC-I & MHC-II) in details.
Co-stimulatory molecules on APC.

6

Unit 3: T Cell development

Structure of T cell receptors, Co-stimulatory molecules on T cells
Concept of synapse between APC & T cells (between MHC≈TCR & between Co-stimulatory molecules) in details.
Central differentiation of T cells; T cell selection in thymus
Peripheral differentiation of T cells; Th1 & Th2

6

Unit 4: Immunoglobulins

Structure and functions of different classes of immunoglobulins, Antigen- antibody interactions, Immunoassays (ELISA and RIA), Hybridoma technology, Monoclonal antibody production

Unit 6: Cytokines & Chemokines 4

Brief concept on types of Cytokines & Chemokines
Cytokines (source & function of IL-1, IL-2, IL-4, IL-5, IL-6, IL-8, IL-10, IL-12, Interferons, Tumor Necrosis Factors, Tumor Growth Factors, GM-CSF, M-CSF).
Chemokines **(**source & function of CCL2, CCL3, CCL4, CCL5, CxCL8, CxCL10)

Unit 7: Complement System **4**
Components and pathways of complement activation.

Unit 8: Hypersensitivity **4**
Gell and Coombs' classification and brief description of various types of hypersensitivities.

Unit 9: Immunology of diseases 6
Malaria, Visceral Leishmaniasis, Filariasis, Dengue and Tuberculosis

Unit 10: Vaccines 4
Various types of vaccines. Active & passive immunization (Artificial and natural).

ZOOACOR10P (Practicals, 2 credits= 30 classes): Immunology Lab

List of Practical
1. Demonstration of lymphoid organs.
2. Histological study of spleen, thymus and lymph nodes through slides/ photographs
3. Preparation of stained blood film to study various types of blood cells.
4. ABO blood group determination.
5. Demonstration of ELISA using kit.

(The experiments can be performed on white rats).

Text Book

1. Campbell's Biology, 11th Edition by Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, Jane B. Reece , Published by Pearson Copyright © 2017.
2. Abbas, K. Abul and Lechtman H. Andrew (2003.) Cellular and Molecular Immunology. V Edition. Saunders Publication

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 Lechtman H. Andrew (2003.) Basic Immunology E-Book: Functions and Disorders of the Immune System; 2012 Saunders Publication

==========

Semester V

ZOOACOR11T (Practicals, 2 credits= 30 classes): Molecular Biology Lab

Unit 1: Nucleic Acids
Salient features of DNA and RNA Watson and Crick Model of DNA

Unit 2: DNA Replication
Mechanism of DNA Replication in Prokaryotes, Semi-conservative, bidirectional and discontinuous Replication, RNA priming, Replication of telomeres

Unit 3: Transcription
Mechanism of Transcription in prokaryotes and eukaryotes, Transcription factors, Difference between prokaryotic and eukaryotic transcription.

Unit 4: Translation
Mechanism of protein synthesis in prokaryotes, Ribosome structure and assembly in prokaryotes, fidelity of protein synthesis, aminoacyl tRNA synthetases and charging of tRNA; Proteins involved in initiation, elongation and termination of polypeptide chain; Genetic code, Degeneracy of the genetic code and Wobble Hypothesis; Inhibitors of protein synthesis; Difference between prokaryotic and eukaryotic translation

Unit 5: Post Transcriptional Modifications and Processing of Eukaryotic RNA
Capping and Poly A tail formation in mRNA; Split genes: concept of introns and exons, splicing mechanism, alternative splicing, exon shuffling, and RNA editing, Processing of tRNA

Unit 6: Gene Regulation
Regulation of Transcription in prokaryotes: lac operon and trp operon; Regulation of Transcription in eukaryotes: Activators, enhancers, silencer, repressors, miRNA mediated gene silencing, Genetic imprinting

Unit 7: DNA Repair Mechanisms
Types of DNA repair mechanisms, RecBCD model in prokaryotes, nucleotide and base excision repair, SOS repair

Unit 8: Molecular Lab Techniques
PCR, Western and Southern blot, Northern Blot, Sanger DNA sequencing , cDNA technology

ZOOACOR11P (Practicals, 2 credits= 30 classes): Molecular Biology Lab

List of Practicals
1. Demonstration of polytene Chromosome from Drosophila /Chironomid larvae
2. Isolation and quantification of genomic DNA using spectrophotometer (A260 measurement)
3. Agarose gel electrophoresis for DNA

Text Book:
1. Campbell's Biology, 11th Edition by Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, Jane B. Reece , Published by Pearson Copyright © 2017.
2. Molecular Biology of The Gene by Watson. 7th Edition. Pearson.

References:
- Molecular Cell Biology by Harvey Lodish. 7th Edition. W.H. Freeman.
- iGenetics: A Molecular Approach by Peter. J. Russell. 3rd edition. Pearson Benjamin Cummings.
- Principles and Techniques of Biochemistry and Molecular Biology by Keith Wilson and John Walker, Cambridge Univ. Press, Paperback

ZOOACOR12T (Theory, 4 credits= 60 classes): Genetics

Unit 1: Mendelian Genetics and its Extension
Background of Mendel's experiments
Principles of Mendelian inheritance,

Incomplete dominance and co-dominance, Epistasis, Multiple alleles, Lethal alleles, Pleiotropy, Sex-linked, sex- influenced and sex-limited inheritance, Polygenic Inheritance.

Unit 2: Linkage, Crossing Over and Chromosomal Mapping
Linkage and Crossing Over, molecular basis of crossing over, Measuring Recombination frequency and linkage intensity using three factor crosses, Interference and coincidence

Unit 3: Mutations
1. Types of gene mutations (Classification), Types of chromosomal aberrations (Classification with one suitable example of each), Chromosomal aberrations, gene mutations and human diseases (Down's, Klienfelter's, Turner's, Cri du Chat, Sickle cell, Haemophilia, Thallassimia, Albinism – only genetical aspects here, details of physiological consequences not required), Sex chromosomes and sex-linked inheritance
2. Non-disjunction and variation in chromosome number; Molecular basis of mutations in relation to UV light and chemical mutagens

Unit 4: Sex Determination
Mechanisms of sex determination in Drosophila with reference to alternative splicing
Sex determination in mammals
Dosage compensation in Drosophila & Human

Unit 5: Extra-chromosomal Inheritance
Criteria for extra chromosomal inheritance, Antibiotic resistance in Chlamyadomonas, Kappa particle in Paramoecium Shell spiralling in snail

Unit 6: Recombination in Bacteria and Viruses
Conjugation, Transformation, Transduction, Complementation test in Bacteriophage

Unit 7: Transposable Genetic Elements
Transposons in bacteria,
Ac-Ds elements in maize and P elements in Drosophila,
LINE, SINE, Alu elements in humans

ZOOACOR12P (Practicals, 2 credits= 30 classes): Genetics

List of Practical

1. Chi-square analyses
   Statistical tests of data and decision making
   Chi square test for goodness of fit and student t test for comparing means of two small samples from normal populations (paired/unpaired)

2. Pedigree analysis of some inherited traits in human

3. Identification of chromosomal aberration in Drosophila from photographs

Text Book

1. Campbell's Biology, 11th Edition by Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, Jane B. Reece , Published by Pearson Copyright © 2017.
2. Principles of Genetics by Robert Tamarin; McGraw Hill, 7th Ed. 2017
   Or
   Principles of Genetics by Snustad, D.P., Simmons, M.J. (2009). 5th Ed. John Wiley and Sons Inc

Reference Books

- Developmental biology by Scott. F. Gilbert, 9th edition.
- 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

==========

Semester VI

ZOOACOR13T (Theory, 4 credits= 60 classes): Developmental Biology

Unit 1: Introduction 2

Basic concepts: Phases of Development, Cell-cell interaction, Differentiation and growth, Differential gene expression

Unit 2: Early Embryonic Development 20

Gametogenesis, Spermatogenesis, Oogenesis;
Types of eggs, Egg membranes;
Fertilization (External and Internal): Changes in gametes, Blocks to polyspermy; Planes and patterns of cleavage; Types of Blastula;
Fate maps (including Techniques);
Early development of frog and chick up to gastrulation; Embryonic induction and organizers

Unit 3: Late Embryonic Development 8

Fate of Germ Layers; Extra-embryonic membranes in birds; Implantation of embryo in humans, Placenta (Structure, types and functions of placenta)

Unit 4: Post Embryonic Development 12

Development of brain and Eye in Vertebrate Regeneration: Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each)

Unit 5: Implications of Developmental Biology 8

Teratogenesis: Teratogenic agents and their effects on embryonic development;
In vitro fertilization, Stem cell (ESC), Amniocentesis

ZOOACOR13P (Practicals, 2 credits= 30 classes): Developmental Biology Lab

List of Practical

1. Study of whole mounts of developmental stages of chick through permanent slides: Primitive streak (13 and 18 hours), 21, 24, 28, 33, 36, 48, 72, and 96 hours of incubation (Hamilton and Hamburger stages)

2. Study of the developmental stages and life cycle of Drosophila from stock culture

3. Study of different sections of placenta (microphotographs/ slides)

4. Project report on Drosophila culture/chick embryo development

Text Book:

1. Campbell's Biology, 11th Edition by Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, Jane B. Reece , Published by Pearson Copyright © 2017.
2. Developmental Biology by Gilbert, S. F. (2010), IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA

References:

- Principles of Development by Wolpert and Beddington; OUP Oxford, 2nd Ed., 2001
- Essential Developmental Biology by Slack JMW; 3rd Ed., Wiley

ZOOACOR14T (Theory, 4 credits= 60 classes): Evolutionary Biology

Unit 1: Oigin of earliest life 5

Chemogeny, RNA world, Biogeny, Origin of photosynthesis,
Evolution of eukaryotes, three domains of life

Unit 2: Historical review of evolutionary concept 7

Pre-Darwinian Concepts and theories including Lamarckism,
Darwininan Theory
Neo-Darwinian Synthesis
Anti-evolutionary ideas of Creationism and their scientific refusal

Unit 3: Evidences in favour of Evolution 4

Fossil records: types of fossils, geological time scale, transitional forms: examples of fossils depicting the evolutionary stages of the modern horses
Molecular (universality of genetic code and protein synthesis machinery) evidences

Unit 4: Sources of variations 3

Heritable variations present in natural populations (classical study of Lewontin and Hubby, 1966 in Drosphila, as example)

Unit 5: Population genetics: 16

Concept of Populations and calculation of allele frequencies in a population
Hardy-Weinberg Law and equilibrium (derivations, applications of law to find gene and genotype frequencies in human Populations)
Evolutionary forces disrupting H-W equilibrium-
Natural selection: Definition as the non-differential rate of reproductions and survivals of competing alleles, concept of fitness, selection coefficient, Types of natural selection with examples- Disrupting, Stabilizing, Directional.
Genetic Drift- outline of its mechanism, basic concepts and examples of founder's effect, bottleneck phenomenon;
Role of Gene flow and Mutation rates in changing allele frequencies in a population (No mathematical models)

Unit 6: Products of evolution 10

Inter-population variations: clines, races, Species concepts and modes of speciation (just outlines of Allopatric, Sympatric and Parapatric speciation models with examples), Isolating mechanisms
Adaptive radiations/ macroevolution as exemplified by Galapagos finches

Unit 7: Extinctions 2

Major mass extinctions in the history of life and their impacts on biodiversity on earth (brief descriptions)

Unit 8: Origin and evolution of man 6

Unique hominin characteristics contrasted with primate characteristics (including social and cultural ones),

Primate phylogeny: from Dryopithecus leading to Homo sapiens,
Molecular evidences of human origin and migrations (brief outline)

Unit 8: Molecular Phylogeny 7

The basic concept of molecular phylogeny, Neutral theory of molecular evolution, molecular clock (brief introductions)
Example of evolution in vertebrate globin genes

ZOOACOR14P (Practicals, 2 credits= 30 classes): Evolutionary Biology Lab

List of Practicals

1. Study of fossils from models/ photographs- Direct ancestors of horses, Archaeopteryx

2. Study of homology and analogy from suitable specimens (from Photographs/models)

3. Verification of Hardy-Weinberg equilibrium in a population by chi square analysis

5. Collection of a sample of height, weight, age, sex data from at least 100 individuals and applying of different statistical analyses (frequency distribution, mean, mode, standard deviations, correlations, etc) and graphical representations.

Text Book:

1. Campbell's Biology, 11th Edition by Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, Jane B. Reece , Published by Pearson Copyright © 2017.
2. Evolution by Ridley,M. 3rd Ed.(2004) Blackwell publishing
   Or
   Evolutionary Biology Douglas, J. Futuyma (1997); Sinauer Associates

Reference:

- Evolution by Barton et al, 1st Ed. 2007 Cold Spring Harbor Lab Press
- Why Evolution is True by Jerry Coyne; 2010, Penguin India
- Strickberger's Evolution by Hall and Halgrimmson; 5th Revised Ed., 2013, Jones and Bartlett,

xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

DSE: DISCIPLINE SPECIFIC ELECTIVE Courses

Semester V

(any two courses to be credited for honours)

ZOOADSE01T (Theory 4 Credits = 60 classes): Animal Behaviour and Chronobiology

Unit 1: Introduction to Animal Behaviour

1. A brief history of animal behaviour studies including the works of Fabre, Darwin, Von Frisch, Lorenz, Tinbergen, Jane Goodal, Biruté Galdikas, Dian Fossey, Salim Ali, Gopal Bhattacharyya, M. K. Chandrashekhar, Raghavendra Gadagkar.
2. The objectives of modern animal behaviour studies: Tinbergen's four questions.

3. Methods of studying behaviours: Observation vs Watching, Ad libitum observations, Focal animal studies, Instantaneous scan, etc.
4. Branches of Animal Behaviour Studies

Unit 2: Behaviours of Individuals

1. Reflexes and Orientations
2. Instinct
3. Learning: Imprinting and other Programmed Learning, Habituation, Innovations and Cultural Transmission / Social Learning

Unit 3: Social and Sexual Behaviour

1. Social Behaviour: Concept of Sociality, Types of animal Society with examples, Altruism
2. Communications in animals- different types (e.g. pheromones, visuals, tactile, acoustics, etc) with common examples
3. Insects' society with Honey bee as example; Foraging in honey bee and advantages of the waggle dance.
4. Sexual Behaviour: Asymmetry of sex, Sexual dimorphism, Mate choice, Intra-sexual selection (male rivalry), Inter-sexual selection (female choice), Sexual conflict in parental care.

Unit 4: Introduction to Chronobiology

1. Historical developments in chronobiology;
2. Biological oscillation: the concept of Average, amplitude, phase and period
3. Adaptive significance of biological clocks

Unit 5: Biological Rhythm

1. Types and characteristics of biological rhythms: Short- and Long- term rhythms; Circadian rhythms; Tidal rhythms and Lunar rhythms;
2. Concept of synchronization and masking; Photic and non-photic zeitgebers; Circannual rhythms;
3. Photoperiod and regulation of seasonal reproduction of vertebrates;Role of melatonin.

ZOOADSE01P (Practical, 2 Credits=60 Classes): Animal Behaviour and Chronobiology Lab

List of Practical

1. To study nests (non-invasively) and nesting habits of the birds and social insects (e.g. Social Wasps) .
2. To study the behavioural responses of rice weevil /wood lice to dry and humid conditions.
3. To study geotaxis behaviour in earthworms.
4. To study the phototaxis behaviour in insects/defensive behaviour in mosquito larvae.
5. Visit to Forest/ Wild life Sanctuary/Biodiversity Park/Zoological Park (within West Bengal) to study behavioural activities of animals and prepare a short report.
6. Study and actogram construction of locomotor activity of suitable animal models.
7. Study of circadian functions in humans (daily eating, sleep and temperature patterns).

Text Book:

1. Animal Behaviour: Mechanisms. Ecology. Evolution by Drickamar, Vessey, 5th Ed. Jakob; McGraw Hill.
2. Survival Strategies by Raghavendra Gadagkar, University Press

Reference:

- An Introduction to Animal Behaviour by Manning and Dawkins; 5th Ed. Cambridge Univ. Press

- Measuring Behaviour: An Introductory Guide by Martin and Bateson; 3rd Ed.Cambridge Univ. Press
- Introduction to Behavioural Ecology by Krebs and Davies; Wiley-Blackwell

ZOOADSE02T (Theory 4 Credits = 60 classes): Entomology (Insects and their Biology)

Unit 1: Introduction 3
General Features of Insects
Distribution and Success of Insects on the Earth

Unit 2: Insect Diversity and Classifications 15
Classifications of Arthropods with special reference to Insects (Insects are to be classified up to order with estimated species richness of the orders globally, in India and in West Bengal. Conspicuous/important families/Genera/species of each order have to be noted with their peculiar habits and habitats)

Unit 3: General Morphology of Insects (brief outlines) 10
External Features; Head – Eyes, Types of antennae, Mouth parts w.r.t. feeding habits
Thorax: Wings and wing types, Types of Legs adapted to diverse habitats, Peculiar Abdominal appendages and genitalia - only brief introduction.

Unit 4: Physiology of Insects 10
Structure and physiology of Insect body systems - Integumentary, digestive, excretory, circulatory, respiratory, endocrine, reproductive, and nervous system (brief outlines only)
Photoreceptors: Types, Structure and Function (brief introductions)
Metamorphosis: Types and Neuroendocrine control of metamorphosis (introductory)

Unit 5: Insect Society 10
Social insects: different types of social insects with brief outlines of their social systems
Trophallaxis in social insects such as ants, termites and bees

Unit 6: Insect Plant Interaction 8
Outline of the concept of co-evolution, role of allo-chemicals in host plant mediation, Host-plant selection by phytophagous insects; Major insect pests in paddy (brief introductions)

Unit 7: Insects as Vectors 5
Insects as mechanical and biological vectors, Brief discussion on houseflies and mosquitoes as important vectors

ZOOADSE02P (Practical, 2 Credit=60 Classes): Biology of Insects Lab

List of Practical

1. Study of life cycle of Mosquito
2. Study of different kinds of antennae, legs and mouth parts of insects (any three variants of each)
3. Mounting of insect wings, spiracles and genitalia of any insect
4. Methodology of collection, preservation and identification of insects.
5. Morphological studies of various castes of *Apis*, *Camponotus*, any Termite *(e,g, Odontotermes*) 1

6. Study of major insect pests of paddy and their damages
7. Study of Mulberry silk moth as beneficial insect

Text Book:

1. The Insects: Structure and function, Chapman, R. F., Cambridge University Press,
2. A general text book of entomology, Imms , A. D., Chapman & Hall,

References

- Principles of Insect Morphology, Snodgrass, R. E., Cornell Univ. Press, USA
- Introduction to the study of insects, Borror, D. J., Triplehorn, C. A., and Johnson, N. F., M Saunders College Publication, USA
- The Insect Societies, Wilson, E. O., Harward Univ. Press, UK
- Host Selection by Phytophagous insects, Bernays, E. A., and Chapman, R. F., Chapman and Hall, New York, USA
- Physiological system in Insects, Klowden, M. J., Academic Press, USA
- Insect Physiology and Biochemistry, Nation, J. L., CRC Press, USA
- Medical Entomology, Hati A. K., Allied Book Agency, 2010

ZOOADSE03T (Theory, 4 Credit=60 Classes): Endocrinology

Unit 1: Introduction to Endocrinology **4**

General idea of Endocrine systems, Classification, Characteristic and Transport of Hormones, Neurosecretions and Neurohormones

Unit 2: Epiphysis, Hypothalamo-hypophysial Axis **16**

Structure of pineal gland, Secretions and their functions in biological rhythms and reproduction; Structure and functions of hypothalamus and Hypothalamic nuclei, Regulation of neuroendocrine glands, Feedback mechanisms; Structure of pituitary gland, Hormones and their functions, Hypothalamo-hypophysial portal system, Disorders of pituitary gland.

Unit 3: Peripheral Endocrine Glands **16**

Structure, Hormones, Functions and Regulation of Thyroid gland, Parathyroid, Adrenal, Pancreas, Ovary and Testis; Hormones in homeostasis, Disorders of endocrine glands

Unit 4: Regulation of Hormone Action **14**

Mechanism of action of steroidal, non-steroidal hormones with receptors Bioassays of hormones using RIA & ELISA; Estrous cycle in rat and menstrual cycle in human; Multifaceted role of Vasopressin & Oxytocin; Hormonal regulation of parturition

ZOOADSE03T (Practical, 2 Credit=60 Classes): Endocrinology Lab

List of Practical

1. Dissect and display of Endocrine glands in rat.
2. Study of the permanent slides of all the endocrine glands
3. Tissue fixation, embedding in paraffin, microtomy and slide preparation of any endocrine gland
4. Estimation of plasma level of any hormone using ELISA
5. Designing of primers of any hormone

Text Book:

1. Hall JE. 2015. Guyton and Hall Textbook of Medical Physiology. 13th Edition. Saunders publication.
2. Ross MH, Pawlina W. 2010. Histology: A Text and Atlas. Sixth Edition. Lippincott Williams and Wilkins.

3. Norris DO, Carr JA. 2013. Vertebrate Endocrinology. 5 editions Academic Press;

References:

4. Fox T, Brooks A, Baidya B. 2015. Endocrinology. JP Medical, London.
5. Gardner DG, Shoback D. 2011. Greenspan's Basic and Clinical Endocrinology. 9th Edn. McGraw Hill Lange.
6. Goodman HM. 2000. Basic Medical Endocrinology. 4th Edn. Academic Press.
7. Jameson JL. 2010. Harrison's Endocrinology. 2nd Edn. McGraw Hill.
8. Melmed S, Conn PM. 2005. Endocrinology: Basic and Clinical Principles. 2nd Edn. Humana Press.
9. Melmed S, Polonsky K, Larsen PR, Kronenberg H. 2016. William's Text Book of Endocrinology. 13th Edn. Elsevier.
10. Molina PE. 2013. Endocrine Physiology. 4th Edn. McGraw Hill Lange.
11. Neal JM. 2000. Basic Endocrinology; An Interactive Approach. Blackwell Science.
12. Norris DO. 2007. Vertebrate Endocrinology. 4th Edn. Elsevier Academic Press.
13. Strauss JF, Barbieri RL. 2014. Yen & Jaffe's Reproductive Endocrinology. Elsevier Sounders

==========

Semester VI

(Any two courses to be credited for honours)

ZOOADSE04T (Theory 4 Credits = 60 classes): Fish and Fishery

Unit 1: Introduction and Classification **4**

General description of fish

Feeding habit, habitat and manner of reproduction

Classification of fish (up to Subclasses) with important examples

14

Unit 2: Morphology and Physiology

Types of fins and their modifications; Locomotion in fish; Hydrodynamics; Types of Scales, Use of scales in Classification and determination of age of fish; Gills and gas exchange; Swim Bladder: Types and role in Respiration, buoyancy; Osmoregulation in Elasmobranchs; Reproductive strategies (special reference to Indian fish); Electric organ, Bioluminescence

10

Unit 3: Fisheries

Inland Fisheries; Marine Fisheries; Environmental factors influencing the seasonal variations in fish catches in the Arabian Sea and the Bay of Bengal; Fishing crafts and Gears; Depletion of fishery resources; Application of remote sensing and GIS in fisheries; Fisheries law and regulations

16

Unit 4: Aquaculture

Sustainable Aquaculture; Extensive, semi-intensive and intensive culture of fish; Pen and cage culture; Polyculture; Composite fish culture; Brood stock management; Induced breeding of fish; Management of finfish hatcheries; Preparation and maintenance of fish aquarium; Preparation of compound diets for fish; Role of water quality in aquaculture; Fish diseases: Bacterial, viral and parasitic; Preservation and processing of harvested fish, Fishery by-products

Unit 5: Fish in research 6

Transgenic fish, Zebra fish as a model organism in research

ZOOADSE04P (Practical, Credits = 60 classes): Fish and Fishery

List of Practical

1. Morphometric and meristic characters of fishes in relation to identifications of species (with locally cultured non-indigenous fishes)
2. Study of external salient features in Petromyzon, Myxine, Pristis, Chimaera, Exocoetus, Hippocampus, Gambusia, Labeo, *Heteropneustes*, *Anabas* (all from photographs)
3. Study of different types of scales (through permanent slides/ photographs).
4. Study of crafts and gears used in Fisheries
5. Water quality criteria for Aquaculture: Assessment of pH, conductivity, Total solids, Total dissolved solids
6. Study of air breathing organs in Channa, Heteropneustes, Anabas and Clarias
7. Project Report on a visit to any fish farm/ pisciculture unit/Zebra fish rearing Lab.

Text Book:

Q. Bone and R. Moore, Biology of Fishes, Talyor and Francis Group, CRC Press, U.K.

Reference

- D. H. Evans and J. D. Claiborne, The Physiology of Fishes, Taylor and Francis Group, CRC Press,
- von der Emde, R.J. Mogdans and B.G. Kapoor. The Senses of Fish: Adaptations for the Reception of Natural Stimuli, Springer, Netherlands
- C.B.L. Srivastava, Fish Biology, Narendra Publishing House
- J.R. Norman, A history of Fishes, Hill and Wang Publishers
- S.S. Khanna and H.R. Singh, A text book of Fish Biology and Fisheries, Narendra Publishing House
- Chaudhuri, S. (2017), Economic Zoology. New Central Book Agency

ZOOADSE05T (Theory, 4 Credits = 60 classes): Parasitology

Unit 1: Introduction to Parasitology 3

Brief introduction of Parasitism and other animal associations, Parasite, Parasitoid and Vectors (mechanical and biological vector) Host parasite relationship and zoonosis

Unit 2: Parasitic Protists 15

15 Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Entamoeba histolytica*, *Giardia intestinalis*, *Trypanosoma gambiense*, *Leishmania donovani*, *Plasmodium vivax* , *Plasmodum falciparum and Toxoplasma gondii*

Unit 3: Parasitic Platyhelminthes 15

Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Fasciola hepatica*, *Paragonimus westermani*, *Schistosoma haematobium*, *Taenia solium* , *Echinococcus granulosus* and *Hymenolepis nana*

Unit 3: Parasitic Nematodes **15**

Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Ascaris lumbricoides, Ancylostoma duodenale, Wuchereria bancrofti* and *Trichinella spiralis*. Study of structure, life cycle and importance of Meloidogyne (root knot nematode), Pratylencus (lesion nematode)

Unit 4: Parasitic Arthropoda **3**

Mosquitoes and flies as vectors of human pathogen
Biology,importance and control of myiasis causing diptera
Biology, importance and control of ticks, mites, *Pediculus humanus* (head and body louse), *Xenopsylla cheopis* and *Cimex lectularius*

Unit 6: Parasitic Vertebrates **2**

A brief account of parasitic vertebrates; Cookiecutter Shark, Candiru, Hood Mockingbird and Vampire bat

ZOOADSE05P (Practical, 2 Credits = 60 classes): Parasitology

List of Practicals

- Study of life stages of *Entamoeba histolytica, Giardia intestinalis, Trypanosoma gambiense, Leishmania donovani* and *Plasmodium vivax* through permanent slides/micro photographs
- Study of adult and life stages *of Fasciola hepatica, Schistosoma haematobium, Taenia solium* and *Hymenolepis nana* through permanent slides/micro photographs
- Study of adult and life stages of *Ascaris lumbricoides, Ancylostoma duodenale, Wuchereria bancrofti* and *Trichinella spiralis* through permanent slides/micro photographs .
- Study of plant parasitic root knot nematode, Meloidogyne from the soil sample
- Study of *Pediculus humanus* (Head louse and Body louse), *Xenopsylla cheopis* and *Cimex lectularius* through permanent slides/ photographs
- Study of monogenea from the gills of fresh/marine fish [Gills can be procured from fish market as by product of the industry]
- Study of nematode/cestode parasites from the intestines of Poultry bird [Intestine can be procured from poultry/market as a by product]

Text Book:

Chatterjee K.D. (2009). Parasitology: Protozoology and Helminthology. XIII Edition, CBS Publishers & Distributors (P) Ltd

References:

- Bose, M.(2017). Parasitoses and Zoonoses. New Central Book Agency(P) Ltd
- Arora, D. R and Arora, B. (2001) Medical Parasitology. II Edition. CBS Publications and Distributors
- Meyer, Olsen & Schmidt's Essentials of Parasitology, Murray, D. Dailey, W.C. Brown Publishers
- Noble, E.R. and Noble G.A. (1982) Parasitology: The biology of animal parasites. V Edition, Lea & Febiger
- Parija, S. C. Textbook of medical parasitology, protozoology & helminthology (Text and colour Atlas), II Edition, All India Publishers & Distributers, Medical Books Publishers, Chennai, Delhi
- Rattan Lal, Ichhpujani and Rajesh Bhatia. Medical Parasitology, III Edition, Jaypee Brothers Medical Publishers (P) Ltd., New Delhi

ZOOADSE06T (Theory, 4 Credits = 60 classes): Wildlife and Conservation

Unit 1: Introduction to Wild Life **5**
Values of wild life; Importance of conservation;
Causes of depletion of Wildlife in India;

Unit 2: Evaluation and management of wild life **12**
Forest habitats: major forest types of India and West Bengal
Forest covers estimation: remote sensing and GIS

Unit 3: Management of habitats **8**
Management of Successional wild habitats
Forest fire
Restoration of degraded wild habitats
(The above topics should be learnt mostly in reference to the protected areas in West Bengal)

Unit 4: Population estimation **10**
Population and population density estimations: different methods in practice
Sex Ratio computation and Fertility status

Unit 5: Wildlife conservation practices in India **5**
Traditional Conservation ethics and practices in India
Conservation strategies and Practices: Wildlife Acts (IUCN, WPA of India, CITES etc)

Unit 6: Management planning of wild life in protected areas **5**
Estimation of carrying capacity; Eco tourism / wild life tourism in forests;
Concept of climax persistence; Ecology of perturbence.

Unit 7: Man and Wildlife **5**
Causes and consequences of human-wildlife conflicts;
Mitigation of conflict – an overview;
Wildlife/Ecotourism advantages and disadvantages

Unit 8: Protected areas **10**
Major wildlife areas in India (all from West Bengal): Sanctuaries, National Parks, Tiger and other Wildlife Reserves, Biosphere reserves, etc.
Community reserve: concepts and examples
Management challenges in Tiger reserve

ZOOADSE06P (Practical, 2 Credits = 60 classes): Wildlife and Conservation

List of Practicals

1. Identification of common local flora, mammalian fauna, avian fauna, herpeto-fauna
2. Demonstration of basic equipments needed in wildlife studies use, care and maintenance (Compass, Binoculars, Range Finders, Global Positioning System, Various types of Cameras and lenses)
3. Familiarization and study of animal evidences in the field; Identification of animals through pug marks, hoof marks, scats, pellet groups, nest, antlers, etc.
4. Demonstration of different field techniques for flora and fauna

5. Quadrat and other methods for ground cover assessment, Height-Girth relationships in trees, Canopy cover assessment in a patch of vegetations.
6. Trail / transect monitoring for abundance and diversity estimation of mammals and birds, butterflies (direct and indirect evidences)

Text Book:

1. Caughley, G., and Sinclair, A.R.E. (1994). Wildlife Ecology and Management. Blackwell Science.
2. Conservation Biology: A Primer for South Asia by Kamaljit S. Bawa, Meera Anna Oommen, and Richard B. Primack, Atree and University Press

References:

1. Woodroffe R., Thirgood, S. and Rabinowitz, A. (2005). People and Wildlife, Conflict or Coexistence? Cambridge University.
2. Bookhout, T.A. (1996). Research and Management Techniques for Wildlife and Habitats, 5 th edition. The Wildlife Society, Allen Press.
3. Sutherland, W.J. (2000). The Conservation Handbook: Research, Management and Policy. Blackwell Sciences
4. 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.

xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

General Electives

[GEC offered by the Dep. of Zoology are for the students studying with other (i.e. not offered by the dept .of Zoology) honours level core courses]

Same as offered as core courses for the BSc general students

ZOOHGEC01T: Animal Diversity	
Theory (Credits 4)	**Class**
Unit-1 Kingdom Protista	
General characters and classification of Subkingdom Protozoa up to Phylum (Levine et al., 1980); Locomotory Organelles and locomotion in Protozoa	**3**
Unit-2 Phylum Porifera	
General characters and classification up to classes; Canal System in *Sycon*	**3**
Unit-3 Phylum Cnidaria	
General characters and classification up to classes; Polymorphism in Hydrozoa	**3**
Unit-4 Phylum Platyhelminthes	
General characters and classification up to classes; Life history of *Taenia solium*	**3**
Unit-5 Phylum Nematoda	
General characters and classification up to classes; Life history of *Ascaris lumbricoides* and its parasitic adaptations	**3**
Unit-6 Phylum Annelida	
General characters and classification up to classes; Nephridia in Annelida	**3**
Unit 7 Phylum Arthropoda	
General characters and classification up to classes; Vision in insect, Metamorphosis in Insects	**5**
Unit-8 Phylum Mollusca	
General characters and classification up to classes; Respiration in *Pila*	**3**
Unit-9 Phylum Echinodermata	

General characters and classification up to classes; Water-vascular system in *Asterias*	**4**
Unit-10 Protochordates	
General features; Feeding in *Branchiostoma*	**2**
Unit-11 Agnatha	
General features and classification up to classes (Young, 1981)	**2**
Unit-12 Pisces	
General features and Classification up to Subclasses (Romer, 1959); Osmoregulation in Fishes	**3**
Unit-13 Amphibia	
General features and Classification up to living orders (Duellman & Trueb, 1986); Metamorphosis in Toad	**3**
Unit-14 Reptiles	
General features and Classification up to living Subclass (Young, 1981); Poisonous and non-poisonous snakes, Biting mechanism in snakes	**4**
Unit-15 Aves	
General features and Classification up to orders (Young, 1981); Flight adaptations in birds	**3**
Unit-16 Mammals	
Classification up to Subclasses (Young, 1981); Origin & distribution of Cranial nerves in *Cavia*	**3**

Suggested Readings [Consult Latest Editions]

1. Barnes, R. D. & Ruppert, E. E., (1994). Invertebrate Zoology. 6thEd. Brooks Cole.
2. Brusca, R. C. & Brusca, G. J. (2002). Invertebrates. 4th Ed. Sinauer Associates.
3. Kardong, K.V. (2002). Vertebrates: Comparative anatomy, function evolution. Tata McGraw Hill.
4. Kent, G.C. & Carr, R.K. (2001). Comparative anatomy of theVertebrates. 9thEd. McGraw Hill.
5. Romer, A.S. & Parsons,T.S.(1986).The vertebrate body. 6thEd. Saunders College Pub.
6. Ruppert E. E., Fox, R. & Barnes R. D. (2003). Invertebrate Zoology: a Functional Evolutionary Approach. 7th Ed. Brooks Cole.
7. Young,J. Z.(2004).The Life of Vertebrates. III Edition. Oxford university press.

ZOOHGEC01P: Animal Diversity Lab (Credits 2)

1. Spot identification of the following specimens:

Amoeba, *Euglena, Plasmodium, Paramecium, Sycon*, *Euspongia,, Obelia, Physalia, Aurelia, Tubipora, Metridium, Taenia solium,* Male and female *Ascaris lumbricoides, Aphrodite, Nereis, Pheretima, Hirudinaria, Palaemon, Cancer*, *Limulus*, *Palamnaeus, Scolopendra*, *Julus*, *Periplaneta, Apis, Chiton, Dentalium, Pila, Unio, Loligo, Sepia, Octopus, Pentaceros, Ophiura, Echinus, Cucumaria* and *Antedon, Balanoglossus, Herdmania, Branchiostoma, Petromyzon, Sphyrna, Pristis, Torpedo, Labeo, Exocoetus, Anguilla, Ichthyophis/Ureotyphlus, Salamandra, Bufo, Hyla, Chelone, Hemidactylus, Chamaeleon, Draco, Vipera, Naja, Crocodylus, Gavialis, Passer, Psittacula, Alcedo*, *Sorex*, *Pteropus*, *Funambulus, Suncus*

2. Study of the following permanent slides: Transverse section of male and female *Ascaris*
3. Identification of poisonous and non-poisonous snakes
4. 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.

Suggested Readings:

1. Chatterjee and Chatterjee: Practical Zoology
2. Ghosh, K.C. and Manna, B. (2015): Practical Zoology, New Central Book Agency, Kolkata

ZOOHGEC02T, Physiology and Biochemistry	
Theory (Credits 4)	**Class**
Unit-1 Nerve and muscle	**8**
1. Structure of a neuron, Resting membrane potential, Graded potential, Origin of Action potential and its propagation in myelinated and non-myelinated nerve fibres. **2.** Ultra-structure of skeletal muscle, Molecular and chemical basis of muscle contraction.	
Unit-2 Digestion	**5**
Physiology of digestion in the alimentary canal; Absorption of carbohydrates, proteins, lipids	
Unit-3 Respiration	**5**

Pulmonary ventilation, Respiratory volumes and capacities, Transport of Oxygen and carbon dioxide in blood	
Unit-4 Excretion	**5**
Structure of nephron, Mechanism of Urine formation, Counter-current Mechanism	
Unit-5 Cardiovascular system	**6**
Composition of blood, Homeostasis, Structure of Heart, Origin and conduction of the cardiac impulse, Cardiac cycle	
Unit-6 Reproduction and Endocrine Glands	**7**
Physiology of male reproduction: hormonal control of spermatogenesis; Physiology of female reproduction: hormonal control of menstrual cycle. Structure and function of pituitary, thyroid, pancreas and adrenal	
Unit 7 Carbohydrate: Structure and Metabolism	**8**
Introduction to Carbohydrates, Structure & Types of Carbohydrates, Isomerism, Introduction to Intermediary metabolism: Glycolysis, Krebs cycle, Pentose phosphate pathway, Gluconeogenesis, Electron transport chain	
Unit-8 Lipid: Structure and Metabolism	**5**
Introduction to Lipids: Definitions; fats and oils; classes of lipids; Lipoproteins; Biosynthesis and β oxidation of palmitic acid	
Unit-9 Protein: Structure and metabolism	**5**
Proteins and their biological functions, functions of amino acids, physicochemical properties of amino acids. Peptides – structure and properties; primary structure of protein, secondary, tertiary and quaternary structures. Transamination, Deamination and Urea Cycle.	
Unit-10 Enzymes	**4**
Introduction, Classification of Enzymes, Mechanism of action, Enzyme Kinetics, Inhibition and Regulation	
Suggested Readings 1. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edn. W.H Freeman & Co. 2. Chatterjea, MN and Shinde, R (2012) . A Textbook of Medical Biochemistry. 8th Edn. Jaypee Pub., N.Delhi 3. Guyton, A.C. and Hall, J.E. (2011). Textbook of Medical Physiology, XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company 4. Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009). Harper'sIllustrated Biochemistry. XXVIII Edition. Lange Medical Books/Mc Graw3Hill. 5. Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009). Principles of Biochemistry. IV Edition. W.H. Freeman and Co. 6. Sherwood, L. (2013). Human Physiology from cells to systems. 8th Edn., Brooks & Cole 7. Tortora, G.J. and Derrickson, B.H. (2009). Principles of Anatomy and Physiology, XII Edition, John Wiley & Sons, Inc. 8. Widmaier, E.P., Raff, H. and Strang, K.T. (2008) Vander's Human Physiology, XI Edition., McGraw Hill 9. Elaine N. Marieb, 2006. Human Anatomy & Physiology, Pearson Education.	
ZOOHGEC02P: Physiology and Biochemistry Lab (Credits 2) 1. Preparation of haemin crystals 2. Identification of permanent histological sections of mammalian pituitary, thyroid, pancreas, adrenal gland, small intestine, liver, lung, kidney 3. Qualitative tests to identify functional groups of carbohydrates in given solutions: Glucose (Benedict's test),Sucrose (Iodine test) 4. Quantitative estimation of total protein in given solutions by Lowry's method. 5. Study of activity of salivary amylase under optimum conditions.	

ZOOHGEC03T: Insect, Vectors and Diseases	
Theory (Credits 4)	**Class**
Unit-1 Introduction to Insects	**6**
General Features of Insects, Morphological features, Head – Eyes, Types of antennae, Mouth parts with respect to feeding habit	
Unit-2 Concept of Vectors	**6**
Brief introduction to Vectors (mechanical and biological), Reservoirs, Host-vector relationship, Adaptations	

as vectors, Host specificity	
Unit-3 Insects as Vectors	**8**
Detailed features of insect orders as vectors – Diptera, Siphonoptera, Siphunculata, Hemiptera	
Unit-4 Dipteran as Disease Vectors	**14**
Study of important Dipteran vectors – Mosquitoes, Sand fly, Houseflies Study of mosquito-borne diseases – Malaria, Dengue, Chikungunya, Viral encephalitis, Filariasis Control of mosquitoes	
Unit-5 Siphonaptera as Disease Vectors	**6**
Fleas as important insect vectors; Host-specificity, Study of Flea-borne diseases – Plague, Typhus fever; Control of fleas	
Unit-6 Siphunculata as Disease Vectors	**4**
Human louse (Head, Body and Pubic louse) as important insect vectors; Control of human louse	
Ùnit-7 Hempitera as Disease Vectors	**6**
Bugs as insect vectors; Blood-sucking bugs; Chagas disease, Bed bugs as mechanical vectors, Control and prevention measures	

ZOOHGEC03P: Insect Vectors and Diseases Lab (Credits 2)

List of Practical

1. Mounting and Study of different kinds of mouth parts of insects
2. Spot identification of following insect vectors through permanent slides/photographs:*Aedes*,*Culex*,*Anopheles*, *Pediculus humanuscapitis*, *Pediculus humanuscorporis*, *Phithiruspubis*, *Xenopsylla cheopis*, *Cimex lectularius*, *Phlebotomus argentipes*, *Musca domestica*
3. Study of different diseases transmitted by above insect vectors
4. Submission of a project report on any one of the insect vectors and disease transmitted

Suggested Readings

1. Anathakrishnan : Bio resources Ecology 3rdEdition
2. Goldman : Limnology, 2ndEdition
3. Odum and Barrett : Fundamentals of Ecology, 5thEdition
4. Pawlowski : Physicochemical Methods for Water and Wastewater Treatment, 1stEdition
5. Trivedi and Goyal : Chemical and biological methods for water pollution studies
6. Welch : Limnology Vols. I-II
7. Wetzel : Limnology, 3rdedition

ZOOHGEC04T , Environment and Public Health	
Theory (Credits 4)	Class
Unit 1: Introduction	
Sources of Environmental hazards, Hazard identification and accounting, Fate of toxic and persistent substances in the environment, Dose response evaluation, Exposure assessment	10
Unit 2: Climate Change	
Greenhouse gases and global warming, Acid rain, Ozone layer destruction, Effect of climate change on public health	10
Unit 3: Pollution	
Air, water, noise pollution sources and effects, Pollution control	5
Unit 4: Waste Management Technologies	
Sources of waste, types and characteristics, Sewage disposal and its management, Solid waste disposal, Biomedical waste handling and disposal, Nuclear waste handling and disposal, Waste from thermal power plants.	15
Unit 5: Diseases	
Causes, symptoms and control of tuberculosis, Asthma, Cholera, Minamata disease, typhoid, filariasis	10

Suggested Readings [Consult Latest Editions]

1. Cutter, S.L., Environmental Risk and Hazards, Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.
2. Kolluru Rao, Bartell Steven, Pitblado R and Stricoff "Risk Assessment and Management Handbook", McGraw Hill Inc., New York, 1996.
3. Kofi Asante Duah "Risk Assessment in Environmental management", John Wiley and sons, Singapore, 1998.
4. Kasperson, J.X. and Kasperson, R.E. and Kasperson, R.E., Global Environmental Risks, V. N. University Press, New York, 2003.
5. Joseph F Louvar and B Diane Louver Health and Environmental Risk Analysis fundamentals with applications, Prentice Hall, New Jersey 1997.

ZOOHGEC03P: Environment and Public Health Lab (Credits 2)

1. To determine pH, Cl, SO4, NO3 in soil and water samples from different locations.

xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

Skill Enhancement Course (SEC)

[Offered by the Department of Zoology]

ZOOSSEC001 (2 credits = 30 classes/hours): Aquarium Fish Keeping — **Class**

Unit 1: Introduction to Aquarium Fish Keeping — 6

The potential scope of Aquarium Fish Industry as a Cottage Industry, Exotic and Endemic species of Aquarium Fishes , problems of releasing aquarium fishes into natural habitats.

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 3

Live fish transport - Fish handling, packing and forwarding techniques.

Unit 5: Maintenance of Aquarium 3

General Aquarium maintenance – budget for setting up an Aquarium Fish Farm as a Cottage Industry

ZOOSSEC002 (2 credits = 30 classes/hours): VERMICOMPOST PRODUCTION

1. Natural role of earthworms in soil fertility
2. Concept of Vermicompost- the need for it
3. Productions:
    a. Suitable worm species and their availabity– for Large scale/small scale, Climate and Temperature
4. Feedstock – for small scale or home farming / large scale or commercial
5. Operations and maintenance
    a. Smells
    b. Moisture
    c. Pest species
    d. Worms escaping
    e. Nutrient levels
6. Harvesting
7. Properties of the vermicompost
8. Benefits of vermicompost
9. Use as soil conditioner
10. Applications

Reference and contacts:

- The Complete Technology Book on Vermiculture and Vermicompost by NPCS Board of Consultants and Engineers; Asia Pacific Business Press, 2004
- Vermicompost production training in 24 Parganas- North: http://www.swanirvar.in/help.php
- Audio-visual training material: https://www.google.co.in/search?rlz=1C1CHZL_enIN766IN766&ei=2Kz2Wr6yDoPIvgTLw6aYDQ&q=vermicompost+preparation&oq=vermicompost&gs_l=psy-ab.1.0.0i71k1l8.0.0.0.8499.0.0.0.0.0.0.0.0..0.0....0...1c..64.psy-ab..0.0.0....0.RNrPR98LJOg#kpvalbx=1
- https://www.youtube.com/watch?v=sQKI0Y7fj24
- https://www.youtube.com/watch?v=oGf7Oe7oP4Y
- http://www.ivri.nic.in/services/vermi.aspx

WEST BENGAL STATE UNIVERSITY

DRAFT

SYLLABUS FOR THREE-YEAR DEGREE COURSE IN ZOOLOGY (GENERAL) UNDER CHOICE BASED CREDIT SYSTEM (CBCS)

(With effect from the session 2018-2019)

BSc General with Zoology
(Credit values given within brackets)

Core Courses for Zoology (CC)

Core Course (CC)			
CC- 1A: Animal Diversity	**CC- 1B: Human Physiology and Biochemistry**	**CC- 1C: Insect Vector and diseases**	**CC- 1D: Environment and Public Health**

Choices for Discipline Specific Electives (DSE)

Discipline Specific Elective (DSE) Any Four (2) Course from 1 to 4			
Applied Zoology	**Food Nutrition and Health**	**Aquatic Biology**	**Immunology**

Choices for Skill Enhancement Courses (SEC)

Skill Enhancement Course-1 & Skill Enhancement Course-2, any two course from 4	
Aquarium Fish Keeping	**Vermicompost**

Sem	Core*	DSE	GE	AECC	SEC	Total credits
I	ZOOGCOR01T (4) ZOOGCOR01P (2) **(Animal Diversity)** CEMGCOR01T (4) CEMGCOR01P (2) BOTGCOR01T (4) BOTGCOR01P (2)			ENVSAEC01T (2)		**20**
II	ZOOGCOR02T (4) ZOOGCOR02P (2) **(Human Physiology & Biochemistry)** CEMGCOR02T (4) CEMGCOR02P (2) BOTGCOR02T (4) BOTGCOR02P (2)			ENGSAEC01T (2)		**20**
III	ZOOGCOR03T (4) ZOOGCOR03P (2) **(Insect Vectors and Diseases)** CEMGCOR03T (4) CEMGCOR03P (2) ZOOGCOR03T (4) ZOOGCOR03P (2)				ZOOSSEC01M (2) **(Aquarium Fish Keeping)** **OR** An SEC offered by any other department	**20**
IV	ZOOGCOR04T (4) ZOOGCOR03P (2) **(Environment and Public Health)** CEMGCOR04T (4) CEMGCOR04P (2)				ZOOSSEC02M (2) **Vermicompost Production** **OR** An SEC offered by any other department	**20**

	BOTGCOR04T (4) BOTGCOR04P (2)					
V		ZOOGDSE01T (4) ZOOGDSE01P (2) **(Applied Zoology)** **OR** ZOOGDSE02T (4) ZOOGDSE02P (2) **(Food Nutrition and Health)** ---------- BOTGDSE01T (4) BOTGDSE01P (2) OR BOTGDSE02T (4) BOTGDSE02P (2) ---------- CEMGDSE01T (4) CEMGDSE01P (2) OR CEMGDSE02T (4) CEMGDSE02P (2)			An SEC offered by any other department	**20**
VI		ZOOGDSE03T (4) ZOOGDSE03P (2) **(Aquatic Biology)** OR ZOOGDSE04T (4) ZOOGDSE04P (2) **(Immunology)** ---------- BOTGDSE03T (4) BOTGDSE03P (2) OR BOTGDSE04T (4) BOTGDSE04P (2) ---------- CEMGDSE03T (4) CEMGDSE03P (2) OR CEMGDSE04T (4) CEMGDSE04P (2)			An SEC offered by any other department	**20**
Total number of	**12**	**6**	**0**	**2**	**4**	**120**

Core Courses for Zoology (CC)

ZOOGCOR01T: Animal Diversity	
Theory (Credits 4)	**Class**
Unit-1 Kingdom Protista	
General characters and classification of Subkingdom Protozoa up to Phylum (Levine et al., 1980); Locomotory Organelles and locomotion in Protozoa	**3**
Unit-2 Phylum Porifera	
General characters and classification up to classes; Canal System in *Sycon*	**3**
Unit-3 Phylum Cnidaria	
General characters and classification up to classes; Polymorphism in Hydrozoa	**3**
Unit-4 Phylum Platyhelminthes	
General characters and classification up to classes; Life history of *Taenia solium*	**3**
Unit-5 Phylum Nematoda	
General characters and classification up to classes; Life history of *Ascaris lumbricoides* and its parasitic adaptations	**3**
Unit-6 Phylum Annelida	
General characters and classification up to classes; Nephridia in Annelida	**3**
Unit 7 Phylum Arthropoda	
General characters and classification up to classes; Vision in insect, Metamorphosis in Insects	**5**
Unit-8 Phylum Mollusca	
General characters and classification up to classes; Respiration in *Pila*	**3**
Unit-9 Phylum Echinodermata	
General characters and classification up to classes; Water-vascular system in *Asterias*	**4**
Unit-10 Protochordates	
General features; Feeding in *Branchiostoma*	**2**
Unit-11 Agnatha	
General features and classification up to classes (Young, 1981)	**2**
Unit-12 Pisces	
General features and Classification up to Subclasses (Romer, 1959); Osmoregulation in Fishes	**3**
Unit-13 Amphibia	
General features and Classification up to living orders (Duellman & Trueb, 1986); Metamorphosis in Toad	**3**
Unit-14 Reptiles	
General features and Classification up to living Subclass (Young, 1981); Poisonous and non-poisonous snakes, Biting mechanism in snakes	**4**
Unit-15 Aves	
General features and Classification up to orders (Young, 1981); Flight adaptations in birds	**3**
Unit-16 Mammals	
Classification up to Subclasses (Young, 1981); Origin & distribution of Cranial nerves in *Cavia*	**3**

Suggested Readings [Consult Latest Editions]

1. Barnes, R. D. & Ruppert, E. E., (1994). Invertebrate Zoology. 6thEd. Brooks Cole.
2. Brusca, R. C. & Brusca, G. J. (2002). Invertebrates. 4th Ed. Sinauer Associates.
3. Kardong, K.V. (2002). Vertebrates: Comparative anatomy, function evolution. Tata McGraw Hill.
4. Kent, G.C. & Carr, R.K. (2001). Comparative anatomy of theVertebrates. 9thEd. McGraw Hill.
5. Romer, A.S. & Parsons,T.S.(1986).The vertebrate body. 6thEd. Saunders College Pub.
6. Ruppert E. E., Fox, R. & Barnes R. D. (2003). Invertebrate Zoology: a Functional Evolutionary Approach. 7th Ed. Brooks Cole.
7. Young,J. Z.(2004).The Life of Vertebrates. III Edition. Oxford university press.

ZOOGCOR01P: Animal Diversity Lab (Credits 2)

1. Spot identification of the following specimens:

Amoeba, *Euglena, Plasmodium, Paramecium, Sycon*, *Euspongia,, Obelia, Physalia, Aurelia, Tubipora, Metridium, Taenia solium,* Male and female *Ascaris lumbricoides, Aphrodite, Nereis, Pheretima, Hirudinaria, Palaemon, Cancer*, *Limulus*, *Palamnaeus, Scolopendra*, *Julus*, *Periplaneta, Apis, Chiton, Dentalium, Pila, Unio, Loligo, Sepia, Octopus, Pentaceros, Ophiura, Echinus, Cucumaria* and *Antedon, Balanoglossus, Herdmania, Branchiostoma, Petromyzon, Sphyrna, Pristis, Torpedo, Labeo, Exocoetus, Anguilla, Ichthyophis/Ureotyphlus, Salamandra, Bufo, Hyla, Chelone, Hemidactylus, Chamaeleon, Draco, Vipera, Naja, Crocodylus, Gavialis, Passer, Psittacula, Alcedo*,

Sorex, *Pteropus*, *Funambulus, Suncus*

2. Study of the following permanent slides: Transverse section of male and female *Ascaris*

3. Identification of poisonous and non-poisonous snakes

4. 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.

Suggested Readings:

1. Chatterjee and Chatterjee: Practical Zoology
2. Ghosh, K.C. and Manna, B. (2015): Practical Zoology, New Central Book Agency, Kolkata

ZOOGCOR02T, Physiology and Biochemistry	
Theory (Credits 4)	**Class**
Unit-1 Nerve and muscle	**8**
1. Structure of a neuron, Resting membrane potential, Graded potential, Origin of Action potential and its propagation in myelinated and non-myelinated nerve fibres. **2.** Ultra-structure of skeletal muscle, Molecular and chemical basis of muscle contraction.	
Unit-2 Digestion	**5**
Physiology of digestion in the alimentary canal; Absorption of carbohydrates, proteins, lipids	
Unit-3 Respiration	**5**
Pulmonary ventilation, Respiratory volumes and capacities, Transport of Oxygen and carbon dioxide in blood	
Unit-4 Excretion	**5**
Structure of nephron, Mechanism of Urine formation, Counter-current Mechanism	
Unit-5 Cardiovascular system	**6**
Composition of blood, Homeostasis, Structure of Heart, Origin and conduction of the cardiac impulse, Cardiac cycle	
Unit-6 Reproduction and Endocrine Glands	**7**
Physiology of male reproduction: hormonal control of spermatogenesis; Physiology of female reproduction: hormonal control of menstrual cycle. Structure and function of pituitary, thyroid, pancreas and adrenal	
Unit 7 Carbohydrate: Structure and Metabolism	**8**
Introduction to Carbohydrates, Structure & Types of Carbohydrates, Isomerism, Introduction to Intermediary metabolism: Glycolysis, Krebs cycle, Pentose phosphate pathway, Gluconeogenesis, Electron transport chain	
Unit-8 Lipid: Structure and Metabolism	**5**
Introduction to Lipids: Definitions; fats and oils; classes of lipids; Lipoproteins; Biosynthesis and β oxidation of palmitic acid	
Unit-9 Protein: Structure and metabolism	**5**
Proteins and their biological functions, functions of amino acids, physicochemical properties of amino acids. Peptides – structure and properties; primary structure of protein, secondary, tertiary and quaternary structures. Transamination, Deamination and Urea Cycle.	
Unit-10 Enzymes	**4**
Introduction, Classification of Enzymes, Mechanism of action, Enzyme Kinetics, Inhibition and Regulation	
Suggested Readings 1. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edn. W.H Freeman & Co. 2. Chatterjea, MN and Shinde, R (2012) . A Textbook of Medical Biochemistry. 8th Edn. Jaypee Pub., N.Delhi 3. Guyton, A.C. and Hall, J.E. (2011). Textbook of Medical Physiology, XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company 4. Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009). Harper'sIllustrated Biochemistry. XXVIII Edition. Lange Medical Books/Mc Graw3Hill. 5. Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009). Principles of Biochemistry. IV Edition. W.H. Freeman and Co. 6. Sherwood, L. (2013). Human Physiology from cells to systems. 8th Edn., Brooks & Cole 7. Tortora, G.J. and Derrickson, B.H. (2009). Principles of Anatomy and Physiology, XII Edition, John Wiley & Sons, Inc. 8. Widmaier, E.P., Raff, H. and Strang, K.T. (2008) Vander's Human Physiology, XI Edition., McGraw Hill 9. Elaine N. Marieb, 2006. Human Anatomy & Physiology, Pearson Education.	

ZOOGCOR02P: Physiology and Biochemistry Lab (Credits 2)

1. Preparation of haemin crystals
2. Identification of permanent histological sections of mammalian pituitary, thyroid, pancreas, adrenal gland, small intestine, liver, lung, kidney
3. Qualitative tests to identify functional groups of carbohydrates in given solutions: Glucose (Benedict's test),Sucrose (Iodine test)
4. Quantitative estimation of total protein in given solutions by Lowry's method.
5. Study of activity of salivary amylase under optimum conditions.

ZOOGCOR03T: Insect, Vectors and Diseases	
Theory (Credits 4)	**Class**
Unit-1 Introduction to Insects	**6**
General Features of Insects, Morphological features, Head – Eyes, Types of antennae, Mouth parts with respect to feeding habit	
Unit-2 Concept of Vectors	**6**
Brief introduction to Vectors (mechanical and biological), Reservoirs, Host-vector relationship, Adaptations as vectors, Host specificity	
Unit-3 Insects as Vectors	**8**
Detailed features of insect orders as vectors – Diptera, Siphonoptera, Siphunculata, Hemiptera	
Unit-4 Dipteran as Disease Vectors	**14**
Study of important Dipteran vectors – Mosquitoes, Sand fly, Houseflies Study of mosquito-borne diseases – Malaria, Dengue, Chikungunya, Viral encephalitis, Filariasis Control of mosquitoes	
Unit-5 Siphonaptera as Disease Vectors	**6**
Fleas as important insect vectors; Host-specificity, Study of Flea-borne diseases – Plague, Typhus fever; Control of fleas	
Unit-6 Siphunculata as Disease Vectors	**4**
Human louse (Head, Body and Pubic louse) as important insect vectors; Control of human louse	
Ùnit-7 Hempitera as Disease Vectors	**6**
Bugs as insect vectors; Blood-sucking bugs; Chagas disease, Bed bugs as mechanical vectors, Control and prevention measures	

ZOOGCOR03P: Insect Vectors and Diseases Lab (Credits 2)

List of Practical

1. Mounting and Study of different kinds of mouth parts of insects
2. Spot identification of following insect vectors through permanent slides/photographs:*Aedes*,*Culex*,*Anopheles*, *Pediculus humanuscapitis*, *Pediculus humanuscorporis*, *Phithiruspubis*, *Xenopsylla cheopis*, *Cimex lectularius*, *Phlebotomus argentipes*, *Musca domestica*
3. Study of different diseases transmitted by above insect vectors
4. Submission of a project report on any one of the insect vectors and disease transmitted

Suggested Readings

1. Anathakrishnan : Bio resources Ecology 3rdEdition
2. Goldman : Limnology, 2ndEdition
3. Odum and Barrett : Fundamentals of Ecology, 5thEdition
4. Pawlowski : Physicochemical Methods for Water and Wastewater Treatment, 1stEdition
5. Trivedi and Goyal : Chemical and biological methods for water pollution studies
6. Welch : Limnology Vols. I-II
7. Wetzel : Limnology, 3rdedition
8. Bose, M. (2017). Parasitoses and Zoonoses, New Central Book Agency

ZOOGCOR04T , Environment and Public Health	
Theory (Credits 4)	Class
Unit 1: Introduction	
Sources of Environmental hazards, Hazard identification and accounting, Fate of toxic and persistent substances in the environment, Dose response evaluation, Exposure assessment	10
Unit 2: Climate Change	
Greenhouse gases and global warming, Acid rain, Ozone layer destruction, Effect of climate change on public health	10
Unit 3: Pollution	
Air, water, noise pollution sources and effects, Pollution control	5
Unit 4: Waste Management Technologies	
Sources of waste, types and characteristics, Sewage disposal and its management, Solid waste disposal, Biomedical waste handling and disposal, Nuclear waste handling and disposal, Waste from thermal power plants.	15
Unit 5: Diseases	
Causes, symptoms and control of tuberculosis, Asthma, Cholera, Minamata disease, typhoid, filariasis	10

Suggested Readings [Consult Latest Editions]

1. Cutter, S.L., Environmental Risk and Hazards, Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.
2. Kolluru Rao, Bartell Steven, Pitblado R and Stricoff "Risk Assessment and Management Handbook", McGraw Hill Inc., New York, 1996.
3. Kofi Asante Duah "Risk Assessment in Environmental management", John Wiley and sons, Singapore, 1998.
4. Kasperson, J.X. and Kasperson, R.E. and Kasperson, R.E., Global Environmental Risks, V. N. University Press, New York, 2003.
5. Joseph F Louvar and B Diane Louver Health and Environmental Risk Analysis fundamentals with applications, Prentice Hall, New Jersey 1997.
6. Bose, M. (2017). Parasitoses and Zoonoses, New Central Book Agency

ZOOGCOR03P: Environment and Public Health Lab (Credits 2)

1. To determine pH, Cl, SO4, NO3 in soil and water samples from different locations.

Discipline Specific Electives (DSE)

DSE 1 Credits: 6	
ZOOGDSE01T: Applied Zoology	
Theory (Credits 4)	**Class**
Unit-1 Introduction to Host-parasite Relationship	**3**
Host, Definitive host, Intermediate host, Parasitism, Symbiosis, Commensalism, Reservoir, Zoonosis	
Unit-2 Epidemiology of Diseases	**7**
Transmission, Prevention and control of diseases: Tuberculosis, Typhoid	
Unit-3 Rickettsia and Spirochetes	**3**
Brief account of *Rickettsia prowazekii, Borrelia recurrentis* and *Treponema pallidum*.	
Unit-4 Parasitic Protozoa	**6**
Life history and pathogenicity of *Entamoeba histolytica, Plasmodium vivax* and *Trypanosoma gambiense*	
Unit-5 Parasitic Helminthes	**4**
Life history and pathogenicity of *Ancylostoma duodenale* and *Wuchereria bancrofti*	
Unit-6 Insects of Economic Importance	**8**
Biology, Control and damage caused by *Helicoverpa armigera*, *Pyrilla perpusilla* and *Papilio demoleus, Callosobruchus chinensis, Sitophilus oryzae* and *Tribolium castaneum*	
Unit-7 Insects of Medical Importance	**8**
Medical importance and control of *Pediculus humanus corporis*, *Anopheles, Culex, Aedes, Xenopsylla cheopis*	
Unit-8 Animal Husbandry	**3**
Preservation of semen and artificial insemination in cattle	
Unit-9 Poultry Farming	**4**
Principles of poultry breeding, Management of breeding stock and broilers, Processing and preservation of eggs	

Unit-10 Fish Technology	**4**
Genetic improvements in aquaculture industry; Induced breeding and transportation of fish seed	

Suggested Readings

1. Arora, D. R and Arora, B. (2001). *Medical Parasitology*. II Edition. CBS Publications and Distributors.
2. Atwal, A.S. (1986). *Agricultural Pests of India and South East Asia*, Kalyani Publishers.
3. Banerjee, G.C. (). Animal husbandry.
4. Banerjee, G.C. (). Animal husbandry.
5. Chatterjee, K. D. (2009).Parasitology: Protozoology and Helminthology. XIII Edition, CBS Publishers & Distributors(P) Ltd
6. Dennis, H. (2009). *Agricultural Entomology.* Timber Press (OR).
7. Dunham R.A. (2004). *Aquaculture and Fisheries Biotechnology Genetic Approache*s. CABI publications, U.K.
8. Hafez, E. S. E. (1962). *Reproduction in Farm Animals*. Lea & Fabiger Publisher
9. Kumar and Corton. *Pathological Basis of Diseases*.
10. Paniker, C.K.J., Ghosh, S. [Ed} (2013). Paniker's Text Book of Medical Parasitology. Jaypee, New Delhi.
11. Parija, S.C. Text book of medical parasitology, protozoology & helminthology (Text and colour Atlas), II Edition, All India Publishers & Distributers, Medical Books Publishers, Chennai, Delhi
12. Park, K. (2007). *Preventive and Social Medicine*. XVI Edition. B.B Publishers.
13. Pedigo, L.P. (2002). *Entomology and Pest Management*, Prentice Hall.
14.RatanLalIchhpujaniandRajeshBhatia.MedicalParasitology,IIIEdition,JaypeeBrothersMedicalPublishers(P)Ltd.,NewDelhi
15. Bose, M. (2017). Parasitoses and Zoonoses, New Central Book Agency
16. Chaudhuri, S. (2017). Economic Zoology, New Central Book Agency

ZOOGDSE01P: Applied Zoology, Lab (Credits 2)

1. Study and Identification of *Plasmodium vivax*, *Entamoeba histolytica, Ancylostoma duodenale* and *Wuchereria bancrofti* and their life stages through permanent slides/photomicrographs or specimens.
2. Study and Identification of arthropod vectors associated with human diseases: *Pediculus, Culex,Anopheles, Aedes* and *Xenopsylla.*
3. Study and Identification of insect damage to different plant parts/stored grains through damaged products/photographs.
4. Identifying features and economic importance of *Nilaparvata lugens, Apion corchori, Scirpophaga incertulus, Callosobruchus chinensis, Sitophilus oryzae* and *Tribolium castaneum*
5. Visit to poultry farm/ animal breeding centre/ vector biology/ parasitology Centre. Submission of visit report
6. Maintenance of freshwater aquarium.

DSE 2 Credits: 6	
ZOOGDSE02T: Food, Nutrition and Health	
Theory (Credits 4)	**Class**
Unit 1: Basic concept of food and nutrition	6
Food Components and food-nutrients Concept of a balanced diet, nutrient needs and dietary pattern for various groups- adults, pregnant and lactating mothers, infants, school children, adolescents and elderly	
Unit 2: Nutritional Biochemistry	16
Carbohydrates, Lipids, Proteins- Definition, Classification, their dietary source and role Vitamins- Fat-soluble and Water-soluble vitamins- their dietary source and importance Minerals- Iron, calcium, phosphorus, iodine, selenium and zinc: their biological functions	
Unit 3: Health	14
Introduction to health- Definition, concept of health and disease Major nutritional Deficiency diseases- Protein Energy Malnutrition (kwashiorkor and marasmus), Vitamin A deficiency disorders, Iron deficiency disorders, Iodine deficiency disorders- their causes, symptoms, treatment, prevention and government programmes, if any. Life style related diseases- hypertension, diabetes mellitus, and obesity- their causes and prevention through dietary and lifestyle modifications Social health problems- smoking, alcoholism, drug dependence and Acquired Immuno Deficiency Syndrome (AIDS) - their causes, treatment and prevention Common ailments- cold, cough, and fevers, their causes and treatment Concepts of Nutrigenomics and health informatics	

Unit 4: Food hygiene and Community health	14
Potable water- sources and methods of purification at domestic level Food and Water borne infections: Bacterial infection: cholera, typhoid fever, dysentery; Viral infection: hepatitis, poliomyelitis, Protozoan infection: Amoebiasis, Giardiasis; Helminths infection: Taeniasis, Ascariasis, Vector borne diseases: Malaria and Dengue, their transmission, causative agent, sources of infection, symptoms and prevention Brief account of food spoilage: Causes of food spoilage and their preventive measures	
SUGGESTED READINGS 1. Mudambi, SR and Rajagopal, MV. Fundamentals of Foods, Nutrition and Diet Therapy; Fifth Ed; 2007; New Age International Publishers 2. Srilakshmi B. Nutrition Science; 2002; New Age International (P) Ltd. 3. Srilakshmi B. Food Science; Fourth Ed; 2007; New Age International (P) Ltd. 4. Swaminathan M. Handbook of Foods and Nutrition; Fifth Ed; 1986; BAPPCO. 5. Bamji MS, Rao NP, and Reddy V. Text Book of Human Nutrition; 2009; Oxford & IBH Publishing Co. Pvt Ltd. 6. Wardlaw GM, Hampl JS. Perspectives in Nutrition; Seventh Ed; 2007; McGraw Hill. 7. Lakra P, Singh MD. Textbook of Nutrition and Health; First Ed; 2008; Academic Excellence. 8. Manay MS, Shadaksharaswamy. Food-Facts and Principles; 1998; New Age International (P) Ltd. 9. Gibney et al. Public Health Nutrition; 2004; Blackwell Publishing	
ZOOGDSE02P: Food Nutrition and Health, Lab (Credits 2) 1To detect adulteration in a) Ghee b) Sugars c) Tea leaves and d) Turmeric 2. Lactose and calcium estimation in food by titrimetry 3. Methylene Blue Reductase Test (MBRT) of milk. Gram staining of bacteria. 4. Study of the stored grain pests and mosquito vectors (Anopheles, Culex and Aedes) from slides/ photograph (Sitophilus oryzae, Trogoderma granarium, identification, habitat and food sources, damage caused and control. Preparation of temporary mounts of the above stored grain pests. 5. Project- Undertake computer aided diet analysis and Anthropometric nutritional assessment for different age groups. OR Identify nutrient rich sources of foods (fruits and vegetables), their seasonal availability and price OR Study of nutrition labelling on selected foods	

DSE 3 Credits: 6	
ZOOGDSE03T: Aquatic Biology	
Theory (Credits 4)	**Class**
Unit-1 Aquatic Biomes	**10**
Brief introduction to the aquatic biomes: Fresh water ecosystem(lakes, wetlands, streams and rivers), estuaries, intertidal zones, oceanic pelagic zone, marine benthic zone and coral reefs	
Unit-2 Freshwater Biology	**20**
Lakes: Origin and classification, Lake as an Ecosystem, Lake morphometry, Physico–chemical Characteristics: Light, Temperature, Thermal stratification, Dissolved Solids, Carbonate, Bicarbonates, Phosphates and Nitrates, Turbidity, dissolved gases (Oxygen, Carbon dioxide). Nutrient Cycles in Lakes (Nitrogen, Sulphur and Phosphorous). **Streams:** Different stages of stream development, Physico-chemical environment, Adaptation of hill- stream fishes.	
Unit-3 Marine Biology	**10**
Salinity and density of Sea water, Continental shelf, Adaptations of deep sea organisms, Coral reefs, Sea weeds.	
Unit-4 Management of Aquatic Resources	**10**
Causes of pollution: Agricultural, Industrial, Sewage, Thermal and Oil spills, Eutrophication, Management and conservation (legislations), Sewage treatment; Water quality assessment- BOD and COD.	
Suggested Readings 1. Anathakrishnan : Bio resources Ecology 3rdEdition 2. Goldman : Limnology, 2ndEdition 3. Odum and Barrett : Fundamentals of Ecology, 5thEdition 4. Pawlowski : Physicochemical Methods for Water and Wastewater Treatment, 1stEdition 5. Trivedi and Goyal : Chemical and biological methods for water pollution studies	

6. Welch : Limnology Vols. I-II
7. Wetzel : Limnology, 3rdedition
8. Chaudhuri, S. (2017). Economic Zoology, New Central Book Agency

ZOOGDSE03P: Aquatic Biology, Lab (Credits 2)

1. Determine the area of a lake using graphimetric and gravimetric method.
2. Identify the important macrophytes, phytoplanktons and zooplanktons present in a lake ecosystem.
3. Determine the amount of transparency, Dissolved Oxygen, and Free Carbon dioxide, in water collected from a nearby lake / water body.
4. Instruments used in limnology (Secchi disc, Van Dorn Bottle, Conductivity meter, Turbidity meter, PONAR grab sampler) and their significance.
5. A Project Report on a Sewage treatment plant/Marine bio reserve/ Fisheries Institutes.

DSE 4 Credits:6	
ZOOGDSE04T: Theory (Credits 4) Immunology	**Class**
Unit-1 Overview of the Immune System	**5**
Introduction to basic concepts in immunology, components of immune system, principles of innate and adaptive immune system	
Unit-2 Cells and Organs of the Immune System	**8**
Haematopoiesis, Cells of immune system and organs (primary and secondary lymphoid organs) of the immune system	
Unit-3 Antigens	**5**
Basic properties of antigens, B and T cell epitopes, haptens and adjuvants	
Unit-4 Antibodies	**8**
Structure, classes and function of antibodies, monoclonal antibodies, antigen antibody interactions as tools for research and diagnosis	
Unit-5 Working of the immune system	**12**
Structure and functions of MHC, exogenous and endogenous pathways of antigen presentation and processing, Basic properties and functions of cytokines, Complement system: Components and pathways	
Unit-6 Immune system in health and disease	**10**
Gell and Coombs' classification and brief description of various types of hypersensitivities, Introduction to concepts of autoimmunity and immunodeficiency	
Ùnit-7 Vaccines	**2**
General introduction to vaccines, Types of vaccines	
Suggested Readings 1. Abbas, K. Abul and Lechtman H. Andrew (2003.) Cellular and Molecular Immunology. V Edition. SaundersP ublication. 2. Abbas, K. Abul and Lechtman H. Andrew (2011.) Basic Immunology: Functions and Disorders of Immune System. Saunders Elsevier Publication. 3. Delves, Martin, Burton and Roitt (2006). Roitt's Essential Immunology. 11th Edn. Blackwell Pub. 4.Kindt,T.J.,Goldsby,R.A.,Osborne,B.A.andKuby,J(2006).Immunology,VIEdition.W.H.FreemanandCompany. 5. Parija, SC (2012). Text book of Microbiology and Immunology. 2nd Edn. Elsevier. 6. Playfair, JHL and Chain, BM (2001) Immunology at a glance. 7th Edn. Blackwell Pub. 7. Virella, G (2007). Medical Immunology 6th Edn. Informa Healthcare.	

ZOOGDSE04P: Immunology, Lab (Credits 2)

1. Demonstration of lymphoid organs in human through model/ photograph.
2. Histological study of spleen, thymus and lymph nodes through slides/photographs
3. Preparation of stained blood film to study various types of blood cells.
4. ABO blood group determination

Skill Enhancement Courses (SEC)

ZOOSSEC01M: Credits:2 Aquarium Fish Keeping	
Aquarium Fish Keeping	**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, Sword tail, Gold fish, Angel fish, Blue morph, Anemone fish and Butterfly fish	
Unit 3: Food and feeding of Aquarium fishes	**7**
Use of live fish feed organisms. Preparation and composition of formulated fish feeds, Aquarium fish as larval predator	
Unit 4: Fish Transportation	**3**
Live fish transport - Fish handling, packing and forwarding techniques.	
Unit 5: Maintenance of Aquarium	**3**
General Aquarium maintenance – budget for setting up an Aquarium Fish Farm as a Cottage Industry	

ZOOSSEC02M (2 credits): Vermicompost Production	
Vermicompost Production	**Class**
Unit 1: Introduction to Vermicompost Production	4
Natural role of earthworms in soil fertility, Concept of Vermicompost- the need for it	
Unit 2: Productions	8
Suitable worm species and their availabity– for Large scale/small scale, Climate and Temperature, Feedstock – for small scale or home farming / large scale or commercial	
Unit 3: Operations and maintenance	8
Smells, Moisture, Pest species, Worms escaping, Nutrient levels	
Unit 4: Harvesting	2
Unit 5: Properties of the vermicompost	2
Unit 6: Benefits of vermicompost	1
Unit 7: Use as soil conditioner	1
Unit 8: Applications of vermicompost	1
Unit 9: Visit to Vermicompost centre and Submission of Report	
Suggested References 1. https://en.wikipedia.org/wiki/Vermicompost You tube audio-visual training: 2.https://www.google.co.in/search?rlz=1C1CHZL_enIN766IN766&ei=2Kz2Wr6yDoPIvgTLw6aYDQ&q=vermicompost+preparation&oq=vermicompost&gs_l=psy-ab.1.0.0i71k1l8.0.0.0.8499.0.0.0.0.0.0.0.0..0.0....0...1c..64.psy-ab..0.0.0....0.RNrPR98LJOg#kpvalbx=1 3. https://www.youtube.com/watch?v=sQKI0Y7fj24 4. https://www.youtube.com/watch?v=oGf7Oe7oP4Y 5. http://www.ivri.nic.in/services/vermi.aspx 6. Vermicompost production training in 24 Parganas- North: http://www.swanirvar.in/help.php	