

Syllabus and Structure

For

B. Sc. with Zoology (Non-Hons.)

Dibrugarh University

2019

Under

Choice Based Credit System (CBCS)

Passed in the Board of Studies in Life Sciences, Dibrugarh

University held on 8th April, 2019.

**SCHEME AND SYLLABUS
UNDER CHOICE BASED CREDIT SYSTEM
B.Sc. WITH ZOOLOGY**

Proposed scheme for choice based credit system in B. Sc. with Zoology (Non Hons.)

	DISCIPLINE CORE COURSE (12)	Ability Enhancement Compulsory Course (AECC) (2)	Skill Enhancement Course (SEC) (2)	Discipline Specific Elective DSE (6)
I	DCC-1, Paper I	(English/MIL Communication)/ Environmental Science		
	DCC- 2 (Zoology) Paper I: Animal Diversity			
	DCC- 3, Paper I			
II	DCC – 1 Paper II	Environmental Science /(English/MIL Communication)		
	DCC- 2 (Zoology) Paper II: Comparative Anatomy and Developmental Biology of Vertebrates			
	DCC- 3 Paper II			
III	DCC-1 Paper III		SEC-1	
	DCC- 2 (Zoology) Paper III: Physiology and Biochemistry			
	DCC- 3 Paper III			
IV	DCC-1 Paper IV		SEC -2	
	DCC- 2 (Zoology) Paper IV: Genetics and Evolutionary Biology			
	DCC-3: Paper IV			
V			SEC-3	DSE- 1 Paper-I
				DSE- Zoology Paper-I
				DSE-3 Paper-I
VI			SEC-4	DSE- 1 Paper-II
				DSE- Zoology Paper-II
				DSE-3 Paper-II

SEMESTER	COURSE OPTED	COURSE NAME	Credits
I	Ability Enhancement Compulsory Course-I	English/MIL communications/ Environmental Science	2
	Discipline Core Course -1, Paper- I (Theory)	DCC-1, Paper -I	4
	Discipline Core Course -1, Paper -I (Practical)	DCC-1, Paper- I (Practical)	2
	ZNC101T	Animal Diversity	4
	ZNC101P	Animal Diversity (Practical)	2
	Discipline Core Course -3, Paper- I (Theory)	DCC-3, Paper- I	4
	Discipline Core Course -3, Paper- I (Practical)	DCC- 3 Paper-I (Practical)	2
II	Ability Enhancement Compulsory Course-II	English/MIL communications/ Environmental Science	2
	Discipline Core Course -1, Paper- II (Theory)	DCC-1, Paper -II	4
	Discipline Core Course -1, Paper –II (Practical)	DCC-1, Paper- II (Practical)	2
	ZNC202T	Comparative Anatomy and Developmental Biology of Vertebrates	4
	ZNC202P	Comparative Anatomy and Developmental Biology of Vertebrates (Practical)	2
	Discipline Core Course -3, Paper- II (Theory)	DCC-3, Paper- II	4
	Discipline Core Course -3, Paper- II (Practical)	DCC- 3 Paper-II (Practical)	2
III	Discipline Core Course -1, Paper- III (Theory)	DCC-1, Paper -III	4
	Discipline Core Course -1, Paper – III (Practical)	DCC-1, Paper- III (Practical)	2
	ZNC303T	Physiology and Biochemistry	4
	ZNC303P	Physiology and Biochemistry (Practical)	2
	Discipline Core Course -3, Paper- III (Theory)	DCC-3, Paper- III	4
	Discipline Core Course -3, Paper- III (Practical)	DCC- 3 Paper-III (Practical)	4
	ZNS301	(I). Medical Diagnostics	2
IV	Discipline Core Course -1, Paper- IV (Theory)	DCC-1, Paper -IV	4
	Discipline Core Course -1, Paper – IV (Practical)	DCC-1, Paper- IV (Practical)	2
	ZNC404T	Genetics and Evolutionary Biology	4

	ZNC404P	Genetics and Evolutionary Biology (Practical)	2
	Discipline Core Course -3, Paper-IV (Theory)	DCC-3, Paper- IV	4
	Discipline Core Course -3, Paper-IV (Practical)	DCC- 3 Paper-IV (Practical)	2
	ZNS402 <i>Students may opt any one course from (II) to (III)</i>	(II) Aquarium Fish Keeping (III) Apiculture	2
V	ZNS503	(IV) Sericulture	2
	Discipline Specific Elective-1 Paper- I	DSE- 1 Paper -I	4
	Discipline Specific Elective –1 Paper -I (Practical)	DSE- 1 Paper -I (Practical)	2
	ZND501T <i>Students may select any one course from (I) to (III)</i>	(I) Applied Zoology (II) Animal Biotechnology (III) Aquatic Biology	4
	ZND501P <i>Students will select one relevant practical course based on theory course.</i>	Practical (I) Applied Zoology (II) Animal Biotechnology (III) Aquatic Biology	2
	Discipline Specific Elective –3 Paper -I	DSE- 3 Paper- I	4
	Discipline Specific Elective – 3 Paper- I (Practical)	DSE- 3 Paper I (Practical)	2
VI	ZNS604	(V) Freshwater Aquaculture	2
	Discipline Specific Elective-1 Paper- II	DSE- 1 Paper -II	4
	Discipline Specific Elective –1 Paper -II (Practical)	DSE- 1 Paper -II (Practical)	2
	ZND602T <i>Students may select any one course from (IV) to (VII)</i>	(IV) Immunology (V) Reproductive Biology (VI) Insect, vector and diseases (VII) Dissertation/Project	4 (4+2=6)
	ZND602P <i>Students will select one relevant practical course based on theory course.</i>	Practical (IV) Immunology (V) Reproductive Biology (VI) Insect, vector and diseases	2
	Discipline Specific Elective – 3 Paper- II	DSE-3 Paper- II	4
	Discipline Specific Elective –3 Paper -II (Practical)	DSE-3 Paper II (Practical)	2
Total Credits			

***CODING PATTERN:**

***ZNC= ZOOLOGY NON HONS. CORE COURSE**

***ZNS= ZOOLOGY NON HONS. SKILL ENHANCEMENT COURSE**

***ZND= ZOOLOGY NON HONS. DISCIPLINE SPECIFIC ELECTIVE COURSE**

***DCC= DISCIPLINE CORE COURSE**

***DSE= DISCIPLINE SPECIFIC ELECTIVE**

***SEC= SKILL ENHANCEMENT COURSE**

Details of Courses

Discipline Core Courses (DCC) Zoology:

1. Animal Diversity
2. Comparative Anatomy and Developmental Biology of Vertebrates
3. Physiology and Biochemistry
4. Genetics and Evolutionary Biology

Discipline Specific Electives (DSE) Zoology: (Any two)

- I. Applied Zoology
- II. Animal Biotechnology
- III. Aquatic Biology
- IV. Immunology
- V. Reproductive Biology
- VI. Insect, Vector and Diseases
- VII. Dissertation/Project

Skill Enhancement Courses (SEC) Zoology: (Any four)

- I. Medical Diagnostics
- II. Aquarium Fish Keeping
- III. Apiculture
- IV. Sericulture
- V. Freshwater Aquaculture

Core Course Code: ZNC101T

CORE COURSE I ANIMAL DIVERSITY

**The objective of the course is to expose the students to diversity of animal, their classification, structural anatomy and some important biological processes.*

THEORY

(CREDITS 4)

(Lectures=60)

Unit 1: Kingdom Protista

4 Lectures

General characters and classification up to classes; Locomotory Organelles and locomotion in Protozoa

Unit 2: Phylum Porifera

3 Lectures

General characters and classification up to classes; Canal System in *Sycon*

Unit 3: Phylum Cnidaria

3 Lectures

General characters and classification up to classes; Polymorphism in Hydrozoa

Unit 4: Phylum Platyhelminthes

3 Lectures

General characters and classification up to classes; Life history of *Taenia solium*

Unit 5: Phylum Nemathelminthes

5 Lectures

General characters and classification up to classes; Life history of *Ascaris lumbricoides* and its parasitic adaptations

Unit 6: Phylum Annelida

3 Lectures

General characters and classification up to classes; Metamerism in Annelida

Unit 7: Phylum Arthropoda

5 Lectures

General characters and classification up to classes; Vision in Arthropoda, Metamorphosis in Insects

Unit 8: Phylum Mollusca

4 Lectures

General characters and classification up to classes; Torsion in gastropods

Unit 9: Phylum Echinodermata

4 Lectures

General characters and classification up to classes; Water-vascular system in Asteroidea

Unit 10: Protochordates

2 Lectures

General features and Phylogeny of Protochordata

Unit 11: Agnatha

2 Lectures

General features of Agnatha and classification of cyclostomes up to classes

Unit 12: Pisces

4 Lectures

orders; Osmoregulation in Fishes

General features and Classification up to

Unit 13: Amphibia

4 Lectures

General features and Classification up to orders; Parental care

Unit 14: Reptiles

4 Lectures

General features and Classification up to orders; Poisonous and non-poisonous snakes, Biting mechanism in snakes

Unit 15: Aves

5 Lectures

General features and Classification up to orders; Flight adaptations in birds

Unit 17: Mammals

5 Lectures

Classification up to orders; Origin of mammals

Note: Classification of Unit 1-9 to be followed from —Barnes, R.D. (1982). *Invertebrate Zoology*, V Edition

Core Course Code: ZNC101P

ANIMAL DIVERSITY

PRACTICAL

(CREDITS 2)

1. Study of the following specimens:

Amoeba, Euglena, Plasmodium, Paramecium, Sycon, Hyalonema, and Euplectella, 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, Any six common birds from different orders, Sorex, Bat, Funambulus, Loris

2. Study of the following permanent slides:

T.S. and L.S. of *Sycon*, Study of life history stages of *Taenia*, T.S. of Male and female *Ascaris*

3. To study and prepare a chart of key for 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

Ruppert and Barnes, R.D. (2006). *Invertebrate Zoology*, VIII Edition. Holt Saunders International Edition.

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

Young, J. Z. (2004). *The Life of Vertebrates*. III Edition. Oxford university press.

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

Hall B.K. and Hallgrimsson B. (2008). *Strickberger's Evolution*. IV Edition. Jones and Bartlett Publishers Inc.

Core Course Code: ZNC202T

CORE COURSE II:

COMPARATIVE ANATOMY AND DEVELOPMENTAL BIOLOGY OF VERTEBRATES

** The objective of the course is to expose the students about the anatomy of vertebrates and also to provide valuable information about the origin and developmental stages of the vertebrates.*

THEORY

(CREDITS 4)

(Lectures =60)

Unit 1: Integumentary System

4 Lectures

Derivatives of integument w.r.t. glands and digital tips

Unit 2: Skeletal System

3 Lectures

Evolution of visceral arches

Unit 3: Digestive System

4 Lectures

Brief account of alimentary canal and digestive glands

Unit 4: Respiratory System

5 Lectures

Brief account of Gills, lungs, air sacs and swim bladder

Unit 5: Circulatory System

4 Lectures

Evolution of heart and aortic arches

Unit 6: Urinogenital System

4 Lectures

Succession of kidney, Evolution of urinogenital ducts

Unit 7: Nervous System

3 Lectures

Comparative account of brain

Unit 8: Sense Organs

3 Lectures

Types of receptors

Unit 9: Early Embryonic Development

12 Lectures

Gametogenesis: Spermatogenesis and oogenesis w.r.t. mammals, vitellogenesis in birds;
Fertilization: external (amphibians), internal (mammals), blocks to polyspermy; Early development of frog and humans (structure of mature egg and its membranes, patterns of cleavage, fate map, up to formation of gastrula); types of morphogenetic movements; Fate of germ layers; Neurulation in frog embryo.

Unit 10: Late Embryonic Development

10 Lectures

Implantation of embryo in humans, Formation of human placenta and functions, other types of placenta on the basis of histology; Metamorphic events in frog life cycle and its hormonal regulation.

Unit 11: Control of Development

8 Lectures

Fundamental processes in development (brief idea) – Gene activation, determination, induction, Differentiation, morphogenesis, intercellular communication, cell movements and cell death

Core Course Code: ZNC202P

COMPARATIVE ANATOMY AND DEVELOPMENTAL BIOLOGY OF VERTEBRATES

PRACTICAL

(CREDITS 2)

1. Osteology:
 - a) Disarticulated skeleton of fowl and rabbit
 - b) Model of carapace and plastron of turtle /tortoise
 - c) Mammalian skulls: One herbivorous and one carnivorous animal.
2. Frog - Study of developmental stages - whole mounts and sections through permanent slides – cleavage stages, blastula, gastrula, neurula, tail bud stage, tadpole external and internal gill stages.
3. Study of the different types of placenta- histological sections through permanent slides or photomicrographs.
4. Comparative study of swim bladder of different fish by diagram.
5. Examination of gametes - frog/rat - sperm and ova through permanent slides or photomicrographs.

SUGGESTED READINGS

Kardong, K.V. (2005) *Vertebrates' Comparative Anatomy, Function and Evolution*.IV Edition. McGraw-Hill Higher Education.

Kent, G.C. and Carr R.K. (2000). *Comparative Anatomy of the Vertebrates*. IX Edition.

The McGraw-Hill Companies.

Hilderbrand, M and Gaslow G.E. *Analysis of Vertebrate Structure*, John Wiley and Sons.

Walter, H.E. and Sayles, L.P; *Biology of Vertebrates*, Khosla Publishing House.

Gilbert, S. F. (2006). *Developmental Biology*, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.

Balinsky, B.I. (2008). *An introduction to Embryology*, International Thomson Computer Press.

Carlson, Bruce M (1996). *Patten's Foundations of Embryology*, McGraw Hill, Inc.

Core Course Code: ZNC303T

**CORE COURSE III:
PHYSIOLOGY AND BIOCHEMISTRY**

**The objective of this course is to provide a strong foundation for understanding the complexities of animal body: their anatomy, physiology and biomolecules that constitute living organisms*

THEORY

(CREDITS 4)

(Lectures =60)

Unit 1: Nerve and muscle

8 Lectures

Structure of a neuron, Resting membrane potential, Graded potential, Origin of Action potential and its propagation in myelinated and non-myelinated nerve fibres, Ultra-structure of skeletal muscle, Molecular and chemical basis of muscle contraction

Unit 2: Digestion

5 Lectures

Physiology of digestion in the alimentary canal; Absorption of carbohydrates, proteins, lipids

Unit 3: Respiration

5 Lectures

Pulmonary ventilation, Respiratory volumes and capacities, Transport of Oxygen and carbon dioxide in blood

Unit 4: Excretion

5 Lectures

Structure of nephron, Mechanism of Urine formation, Counter-current Mechanism

Unit 5: Cardiovascular system

6 Lectures

Composition of blood, Hemostasis, Structure of Heart, Origin and conduction of the cardiac impulse, Cardiac cycle

Unit 6: Reproduction and Endocrine Glands

7 Lectures

Physiology of male reproduction: hormonal control of spermatogenesis; Physiology of female reproduction: hormonal control of menstrual cycle
Structure and function of pituitary, thyroid, Parathyroid, pancreas and adrenal

Unit 7: Carbohydrate Metabolism

8 Lectures

Glycolysis, Krebs Cycle, Pentose phosphate pathway, Gluconeogenesis, Glycogen metabolism, Review of electron transport chain

Unit 8: Lipid Metabolism**5 Lectures**Biosynthesis and β oxidation of palmitic acid**Unit 9: Protein metabolism****5 Lectures**

Transamination, Deamination and Urea Cycle

Unit 10: Enzymes**6 Lectures**

Introduction, Mechanism of action, Enzyme Kinetics, Inhibition and Regulation

Core Course Code: ZNC303P
PHYSIOLOGY AND BIOCHEMISTRY

PRACTICAL**(CREDITS 2)**

1. Preparation of hemin and hemochromogen crystals
2. Study of permanent histological sections of mammalian pituitary, thyroid, pancreas, adrenal gland
3. Study of permanent slides of spinal cord, duodenum, liver, lung, kidney, bone, cartilage
4. Qualitative tests to identify functional groups of carbohydrates in given solutions (Glucose, Fructose, Sucrose, Lactose)
2. Estimation of total protein in given solutions by Lowry's method.
3. Study of activity of salivary amylase under optimum conditions

SUGGESTED READINGS

- Tortora, G.J. and Derrickson, B.H. (2009). *Principles of Anatomy and Physiology*, XII Edition, John Wiley & Sons, Inc.
- Widmaier, E.P., Raff, H. and Strang, K.T. (2008) *Vander's Human Physiology*, XI Edition., McGraw Hill
- Guyton, A.C. and Hall, J.E. (2011). *Textbook of Medical Physiology*, XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company
- Berg, J. M., Tymoczko, J. L and Stryer, L. (2006). *Biochemistry*. VI Edition. W.H Freeman and Co.
- Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009). *Principles of Biochemistry*. IV Edition. W.H. Freeman and Co.
- Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009). *Harper's Illustrated Biochemistry*. XXVIII Edition. Lange Medical Books/Mc Graw3Hill.

Core Course Code: ZNC404T
CORE COURSE IV:
GENETICS AND EVOLUTIONARY BIOLOGY

THEORY (CREDITS 4)

(Lectures =60)

Unit 1: Introduction to Genetics 3 Lectures

Mendel's work on transmission of traits, Genetic Variation, Molecular basis of Genetic Information

Unit 2: Mendelian Genetics and its Extension 8 Lectures

Principles of Inheritance, Chromosome theory of inheritance, Incomplete dominance and co-dominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, sex linked inheritance, extra-chromosomal inheritance

Unit 3: Linkage, Crossing Over and Chromosomal Mapping 9 Lectures

Linkage and crossing over, Recombination frequency as a measure of linkage intensity, two factor and three factor crosses, Interference and coincidence, Somatic cell genetics - an alternative approach to gene mapping

Unit 4: Mutations 7 Lectures

Chromosomal Mutations: Deletion, Duplication, Inversion, Translocation, Aneuploidy and Polyploidy; Gene mutations: Induced versus Spontaneous mutations, Back versus Suppressor mutations,

Unit 5: Sex Determination 4 Lectures

Chromosomal mechanisms, dosage compensation

Unit 6: History of Life 2 Lectures

Major Events in History of Life: geological time scale, origin of life

Unit 7: Introduction to Evolutionary Theories 5 Lectures

Lamarckism, Darwinism, Neo-Darwinism

Unit 8: Direct Evidences of Evolution 5 Lectures

Types of fossils, Incompleteness of fossil record, Dating of fossils, Phylogeny of horse

Unit 9: Processes of Evolutionary Change 9 Lectures

Organic variations; Isolating Mechanisms; Natural selection (Example: Industrial melanism); Types of natural selection (Directional, Stabilizing, Disruptive), Artificial selection

Unit 10: Species Concept**6 Lectures**

Biological species concept (Advantages and Limitations); Modes of speciation (Allopatric, Sympatric)

Unit 11: Macro-evolution**5 Lectures**

Macro-evolutionary Principles (example: Darwin's Finches)

Unit 12: Extinction**6 Lectures**

Mass extinction (Causes, Names of five major extinctions, K-T extinction in detail), Role of extinction in evolution

Core Course Code: ZNC404P

GENETICS AND EVOLUTIONARY BIOLOGY

PRACTICAL

(CREDITS 2)

1. Study of Mendelian Inheritance and gene interactions (Non Mendelian Inheritance) using suitable examples. Verify the results using Chi-square test. (using the data)
2. Study of Linkage, recombination, gene mapping using the data.
3. Study of Human Karyotypes (normal and abnormal). (using the data)
4. Study of fossil evidences from plaster cast models and pictures
5. Study of homology and analogy from suitable specimens/ pictures
6. Charts:
 - a) Phylogeny of horse with diagrams/ cut outs of limbs and teeth of horse ancestors
 - b) Darwin's Finches with diagrams/ cut outs of beaks of different species
7. Visit to Museum/Protected areas and submission of report

SUGGESTED READINGS

Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). *Principles of Genetics*. VIII Edition. Wiley India.

Snustad, D.P., Simmons, M.J. (2009). *Principles of Genetics*. V Edition. John Wiley and Sons Inc.

Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). *Concepts of Genetics*. X Edition. Benjamin Cummings.

Russell, P. J. (2009). *Genetics- A Molecular Approach*. III Edition. Benjamin Cummings.

Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. *Introduction to Genetic Analysis*. IX Edition. W. H. Freeman and Co.

Ridley, M. (2004). *Evolution*. III Edition. Blackwell Publishing

Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). *Evolution*. Cold Spring, Harbour Laboratory Press.

Hall, B. K. and Hallgrimsson, B. (2008). *Evolution*. IV Edition. Jones and Bartlett Publishers

Campbell, N. A. and Reece J. B. (2011). *Biology*. IX Edition, Pearson, Benjamin, Cummings.

Douglas, J. Futuyma (1997). *Evolutionary Biology*. Sinauer Associates.

DISCIPLINE SPECIFIC ELECTIVE COURSE

Course Code: ZND501T(I)

DSE-ZOOLOGY

APPLIED ZOOLOGY

THEORY

(CREDITS 4)

(Lectures =60)

Unit 1: Introduction to Host-parasite Relationship

3 Lectures

Host, Definitive host, Intermediate host, Parasitism, Symbiosis, Commensalism, Reservoir, Zoonosis

Unit 2: Epidemiology of Diseases

7 Lectures

Transmission, Prevention and control of diseases: Tuberculosis, typhoid

Unit 3: Rickettsiae and Spirochaetes

6 Lectures

Brief account of *Rickettsia prowazekii*, *Borrelia recurrentis* and *Treponema pallidum*

Unit 4: Parasitic Protozoa

8 Lectures

Life history and pathogenicity of *Entamoeba histolytica*, *Plasmodium vivax* and *Trypanosoma gambiense*

Unit 5: Parasitic Helminthes

5 Lectures

Life history and pathogenicity of *Ancylostoma duodenale* and *Wuchereria bancrofti*

Unit 6: Insects of Economic Importance

8 Lectures

Biology, Control and damage caused by *Helicoverpa armigera*, *Pyrrilla perpusilla* and *Papilio demoleus*, *Callosobruchus chinensis*, *Sitophilus oryzae* and *Tribolium castaneum*

Unit 7: Insects of Medical Importance

8 Lectures

Medical importance and control of *Pediculus humanus corporis*, *Anopheles*, *Culex*, *Aedes*, *Xenopsylla cheopis*

Unit 8: Animal Husbandry

5 Lectures

Preservation and artificial insemination in cattle; Induction of early puberty and synchronization of estrus in cattle

Unit 9: Poultry Farming

5 Lectures

Principles of poultry breeding, Management of breeding stock and broilers, Processing and preservation of eggs

Genetic improvements in aquaculture industry; Induced breeding and transportation of fish seed

DSE-ZOOLOGY
Course Code: ZND501P(I)

APPLIED ZOOLOGY

PRACTICAL

(CREDITS 2)

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

SUGGESTED READINGS

- Park, K. (2007). *Preventive and Social Medicine*. XVI Edition. B.B Publishers.
- Arora, D. R and Arora, B. (2001). *Medical Parasitology*. II Edition. CBS Publications and Distributors.
- Kumar and Corton. *Pathological Basis of Diseases*.
- Atwal, A.S. (1986). *Agricultural Pests of India and South East Asia*, Kalyani Publishers.
- Dennis, H. (2009). *Agricultural Entomology*. Timber Press (OR).
- Hafez, E. S. E. (1962). *Reproduction in Farm Animals*. Lea & Fabiger Publisher
- Dunham R.A. (2004). *Aquaculture and Fisheries Biotechnology Genetic Approaches*. CABI publications, U.K.
- Pedigo, L.P. (2002). *Entomology and Pest Management*, Prentice Hall.

DSE-ZOOLOGY
Course Code: ZND501T (II)
ANIMAL BIOTECHNOLOGY

THEORY

(Credits 4)

Unit 1: Introduction

(Lectures =60)
8 Lectures

Concept and scope of biotechnology

Unit 2: Molecular Techniques in Gene manipulation

24 Lectures

Cloning vectors: Plasmids, Cosmids, Phagemids, Lambda Bacteriophage, M13, BAC, YAC, MAC and Expression vectors (characteristics)

Restriction enzymes: Nomenclature, detailed study of Type II. Transformation techniques: Calcium chloride method and electroporation.

Construction of genomic and cDNA libraries and screening by colony and plaque hybridization
Southern, Northern and Western blotting; DNA sequencing: Sanger method

Polymerase Chain Reaction, DNA Finger Printing and DNA micro array

Unit 3: Genetically Modified Organisms

18 Lectures

Production of cloned and transgenic animals: Nuclear Transplantation, Retroviral Method, DNA microinjection

Applications of transgenic animals: Production of pharmaceuticals, production of donor organs, knockout mice.

Production of transgenic plants: *Agrobacterium* mediated transformation. Applications of transgenic plants: insect and herbicide resistant plants.

Unit 4: Culture Techniques and Applications

10 Lectures

Animal cell culture, Expressing cloned genes in mammalian cells, Molecular diagnosis of genetic diseases (Cystic fibrosis, Sickle cell anemia)

Recombinant DNA in medicines: Recombinant insulin and human growth hormone, Gene therapy

Course Code: ZND501P(II)
ANIMAL BIOTECHNOLOGY

PRACTICAL

(Credits 2)

1. Genomic DNA isolation from *E. coli*
2. Plasmid DNA isolation (pUC 18/19) from *E. coli*
3. Restriction digestion of plasmid DNA.
4. Construction of circular and linear restriction map from the data provided.
5. Calculation of transformation efficiency from the data provided.
6. To study following techniques through photographs a) Southern Blotting
b) PCR
c) DNA fingerprinting
7. Project report on animal cell culture

SUGGESTED READINGS

Brown, T.A. (1998). *Molecular Biology Labfax II: Gene Cloning and DNA Analysis*. II Edition, Academic Press, California, USA.

Glick, B.R. and Pasternak, J.J. (2009). *Molecular Biotechnology - Principles and Applications of Recombinant DNA*. IV Edition, ASM press, Washington, USA.

Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009) *An Introduction to Genetic Analysis*. IX Edition. Freeman and Co., N.Y., USA.

Snustad, D.P. and Simmons, M.J. (2009). *Principles of Genetics*. V Edition, John Wiley and Sons Inc.

Watson, J.D., Myers, R.M., Caudy, A. and Witkowski, J.K. (2007). *Recombinant DNA- Genes and Genomes- A Short Course*. III Edition, Freeman and Co., N.Y., USA.

Beauchamp, T.I. and Childress, J.F. (2008). *Principles of Biomedical Ethics*. VI Edition, Oxford University Press.

Course Code: ZND501T(III)
DSE-ZOOLOGY
AQUATIC BIOLOGY

THEORY

(Credits 4)

(Lectures =60)

UNIT 1: Aquatic Biomes

10 Lectures

Brief introduction of the aquatic biomes: Freshwater ecosystem (lakes, wetlands, streams and rivers), estuaries, intertidal zones, oceanic pelagic zone, marine benthic zone and coral reefs.

UNIT 2: Freshwater Biology

15 Lectures

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.

River: Ecology of river, riverine biota (Fish, prawn, molluscs and mammals)

Streams: Different stages of stream development, Physico-chemical environment, Adaptation of hill-stream fishes and coldwater fishes

UNIT 3: Marine Biology

10 Lectures

Salinity and density of Sea water, Continental shelf, Adaptations of deep sea organisms, Sea weeds, major fish and invertebrate groups

UNIT 4: Wetland Biology

15 Lectures

Definition & types of wetlands, major wetlands in Assam, wetland biota: Major invertebrates (insects & prawns) and vertebrates (fish, reptiles and avian fauna)

UNIT 5: Management of Aquatic Resources

10 Lectures

Causes of pollution: Agricultural, Industrial, Sewage, Thermal and Oil spills, Eutrophication, Management and conservation (legislations), Sewage treatment Water quality assessment- BOD and COD, Bioindicator

DSE-ZOOLOGY
Course Code: ZND501P(III)
AQUATIC BIOLOGY

PRACTICAL

(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 Turbidity/transparency, Dissolved Oxygen, Free Carbon dioxide, Alkalinity (carbonates & bicarbonates) 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 visit to a Sewage treatment plant/Marine bio-reserve/Fisheries Institutes/Wetlands

SUGGESTED READINGS

Anathakrishnan : Bioresources Ecology 3rd Edition

Goldman : Limnology, 2nd Edition

Odum and Barrett : Fundamentals of Ecology, 5th Edition

Pawlowski : Physicochemical Methods for Water and Wastewater Treatment, 1st Edition

Wetzel : Limnology, 3rd edition

Trivedi and Goyal : Chemical and biological methods for water pollution studies

Welch : Limnology Vols. I-II

Course Code: ZND602T(IV)
DSE-ZOOLOGY
IMMUNOLOGY

THEORY

(CREDITS 4)
(Lectures =60)

Unit 1: Overview of the Immune System

10 Lectures

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 Lectures

Haematopoiesis, Cells of immune system and organs (primary and secondary lymphoid organs) of the immune system

Unit 3: Antigens

8 Lectures

Basic properties of antigens, B and T cell epitopes, haptens and adjuvants

Unit 4: Antibodies

8 Lectures

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 Lectures

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 Lectures

Gell and Coombs' classification and brief description of various types of hypersensitivities, Introduction to concepts of autoimmunity and immunodeficiency,

Unit 7: Vaccines

4 Lectures

General introduction to vaccines, Various types of vaccines

DSE-ZOOLOGY
Course Code: ZND602T(IV)
IMMUNOLOGY

PRACTICAL

(CREDITS 2)

- 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. Ouchterlony's double immuno-diffusion method.
5. ABO blood group determination.
6. Demonstration of ELISA

(*Subject to UGC guidelines)

SUGGESTED READINGS

Kindt, T. J., Goldsby, R.A., Osborne, B. A. and Kuby, J (2006). *Immunology*, VI Edition. W.H. Freeman and Company.

David, M., Jonathan, B., David, R. B. and Ivan R. (2006). *Immunology*, VII Edition, Mosby, Elsevier Publication.

Abbas, K. Abul and Lechtman H. Andrew (2003.) *Cellular and Molecular Immunology*. V Edition. Saunders Publication.

Course Code: ZND602T(V)
DSE-ZOOLOGY

REPRODUCTIVE BIOLOGY

THEORY

(CREDITS 4)

(Lectures =60)

Unit 1: Reproductive Endocrinology

14 Lectures

Gonadal hormones and mechanism of hormone action, steroids, glycoprotein hormones, and prostaglandins, hypothalamo – hypophyseal – gonadal axis, regulation of gonadotrophin secretion in male and female; Reproductive System: Development and differentiation of gonads, genital ducts, external genitalia, mechanism of sex differentiation.

Unit 2: Functional anatomy of male reproduction

17 Lectures

Outline and histological of male reproductive system in rat and human; Testis: Cellular functions, germ cell, stem cell renewal; Spermatogenesis: hormonal regulation; Epididymal function and sperm maturation; Accessory glands functions; Sperm transportation in male tract

Unit 3: Functional anatomy of female reproduction

17 Lectures

Outline and histological of female reproductive system in rat and human; Ovary: folliculogenesis, ovulation, corpus luteum formation and regression; Steroidogenesis and secretion of ovarian hormones; Reproductive cycles (rat and human) and their regulation, changes in the female tract; Ovum transport in the fallopian tubes; Sperm transport in the female tract, fertilization; Implantation, gestation, parturition and Lactation

Unit 4: Reproductive Health

12 Lectures

Infertility in male and female: causes, Assisted Reproductive Technology: sex selection, sperm banks, frozen embryos, in vitro fertilization, ET, EFT, IUT, ZIFT, GIFT, ICSI, PROST; Modern contraceptive technologies; Demographic terminology used in family planning

DSE-ZOOLOGY
Course Code: ZND602P(V)
REPRODUCTIVE BIOLOGY

PRACTICAL

(CREDITS 2)

1. Study of animal house: set up and maintenance of animal house, breeding techniques, care of normal and experimental animals. **(theoretical)**
2. Examination of vaginal smear rats from live animals.
3. Surgical techniques: principles of surgery in endocrinology. Ovaryectomy, hysterectomy, castration and vasectomy in rats. (demonstration by video)
4. Examination of histological sections from photomicrographs/ permanent slides of rat/human: testis, epididymis and accessory glands of male reproductive systems; Sections of ovary, fallopian tube, uterus (proliferative and secretory stages), cervix and vagina.
5. Study of modern contraceptive devices

SUGGESTED READINGS

Austin, C.R. and Short, R.V. reproduction in Mammals. Cambridge University Press.

Degroot, L.J. and Jameson, J.L. (eds). Endocrinology. W.B. Saunders and Company.

Knobil, E. et al. (eds). The Physiology of Reproduction. Raven Press Ltd.

Hatcher, R.A. et al. The Essentials of Contraceptive Technology. Population Information Programme.

Course Code: ZND602T (VI)
DSE-ZOOLOGY
INSECT, VECTORS AND DISEASES

THEORY

(Credits 4)

(Lectures =60)

Unit I: Introduction to Insects

6 Lectures

General Features of Insects, Morphological features, Head – Eyes, Types of antennae, Mouth parts w.r.t. feeding habits

Unit II: Concept of Vectors

6 Lectures

Brief introduction of Carrier and Vectors (mechanical and biological vector), Reservoirs, Host-vector relationship, Vectorial capacity, Adaptations as vectors, Host Specificity

Unit III: Insects as Vectors

8 Lectures

Classification of insects up to orders, detailed features of orders with insects as vectors – Diptera, Siphonaptera, Siphunculata, Hemiptera

Unit IV: Dipteran as Disease Vectors

24 Lectures

Dipterans as important insect vectors – Mosquitoes, Sand fly, Houseflies;

Study of mosquito-borne diseases – Malaria, Dengue, Chikungunya, Viral encephalitis, Filariasis; Control of mosquitoes

Study of sand fly-borne diseases – Visceral Leishmaniasis, Cutaneous Leishmaniasis, Phlebotomus fever; Control of Sand fly

Study of house fly as important mechanical vector, Myiasis, Control of house fly

Unit IV: Siphonaptera as Disease Vectors

6 Lectures

Fleas as important insect vectors; Host-specificity, Study of Flea-borne diseases – Plague, Typhus fever; Control of fleas

Unit V: Siphunculata as Disease Vectors

4 Lectures

Human louse (Head, Body and Pubic louse) as important insect vectors; Study of louse-borne diseases –Typhus fever, Relapsing fever, Trench fever, Vagabond's disease, Phthiriasis; Control of human louse

Unit VI: Hemiptera as Disease Vectors

6 Lectures

Bugs as insect vectors; Blood-sucking bugs; Chagas disease, Bed bugs as mechanical vectors, Control and prevention measures

Course Code: ZND602P(VI)
DSE-ZOOLOGY
INSECT VECTORS AND DISEASES

PRACTICAL

(CREDITS 2)

1. Study of different kinds of mouth parts of insects
2. Study of following insect vectors through permanent slides/ photographs: *Aedes*, *Culex*, *Anopheles*, *Pediculus humanus capitis*, *Pediculus humanus corporis*, *Phthirus pubis*, *Xenopsylla cheopis*, *Cimex lectularius*, *Phlebotomus argentipes*, *Musca domestica*, through permanent slides/ photographs
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

Imms, A.D. (1977). *A General Text Book of Entomology*. Chapman & Hall, UK

Chapman, R.F. (1998). *The Insects: Structure and Function*. IV Edition, Cambridge University Press, UK

Pedigo L.P. (2002). *Entomology and Pest Management*. Prentice Hall Publication

Mathews, G. (2011). *Integrated Vector Management: Controlling Vectors of Malaria and Other Insect Vector Borne Diseases*. Wiley-Blackwell

SKILL ENHANCEMENT COURSES

SEC- ZOOLOGY

Course Code: ZNS301(I)
MEDICAL DIAGNOSTICS

THEORY

(Credits 2)

(Lectures=30)

Unit 1: Introduction to Medical Diagnostics and its Importance

2 Lectures

Unit 2: Diagnostics Methods Used for Analysis of Blood

10 Lectures

Blood composition, Preparation of blood smear and Differential Leucocyte Count (D.L.C) using Leishman's stain, Platelet count using haemocytometer, Erythrocyte Sedimentary Rate (E.S.R), Packed Cell Volume (P.C.V.)

Unit 3: Diagnostic Methods Used for Urine Analysis

6 Lectures

Urine Analysis: Physical characteristics; Abnormal constituents

Unit 4: Non-infectious Diseases

6 Lectures

Causes, types, symptoms, complications, diagnosis and prevention of Diabetes (Type I and Type II), Hypertension (Primary and secondary), Testing of blood glucose using Glucometer/Kit

Unit 5: Infectious Diseases

3 Lectures

Causes, types, symptoms, diagnosis and prevention of Tuberculosis and Hepatitis

Unit 6: Tumours

3 Lectures

Types (Benign/Malignant), Detection and metastasis; Medical imaging: X-Ray of Bone fracture, MRI and CT Scan (using photographs).

SUGGESTED READINGS

Park, K. (2007), *Preventive and Social Medicine*, B.B. Publishers

Godkar P.B. and Godkar D.P. *Textbook of Medical Laboratory Technology*, II Edition, Bhalani Publishing House

Cheesbrough M., *A Laboratory Manual for Rural Tropical Hospitals, A Basis for Training Courses*

Guyton A.C. and Hall J.E. *Textbook of Medical Physiology*, Saunders

Robbins and Cortan, *Pathologic Basis of Disease*, VIII Edition, Saunders

Prakash, G. (2012), *Lab Manual on Blood Analysis and Medical Diagnostics*, S. Chand and Co. Ltd.

SEC- ZOOLOGY
Course Code: ZNS402(II)
AQUARIUM FISH KEEPING

THEORY

(CREDITS 2)

(Lectures =30)

Unit1: Introduction to Aquarium Fish Keeping

5 Lectures

The potential scope of Aquarium Fish Industry as a Cottage Industry, Exotic and Endemic species of Aquarium Fishes

Unit 2: Biology of Aquarium Fishes

7 Lectures

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, Botia, Gourami

Unit 3: Food and feeding of Aquarium fishes

5 Lectures

Use of live fish feed organisms. Preparation and composition of formulated fish feeds

Unit 4: Fish Transportation

3 Lectures

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

Unit 5: Maintenance of Aquarium

5 Lectures

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

SEC- ZOOLOGY
Course Code: ZNS402(III)
APICULTURE

THEORY

(CREDITS 2)

(Lectures =30)

Unit 1: Biology of Bees

4 Lectures

History, Classification and Biology of Honey Bees, Bee species
Social Organization of Bee Colony, Bee plants

Unit 2: Rearing of Bees

10 Lectures

Artificial Bee rearing (Apiary), Beehives – Newton and Langstroth
Bee Pasturage
Selection of Bee Species for Apiculture
Bee Keeping Equipment
Methods of Extraction of Honey (Indigenous and Modern)

Unit 3: Diseases and Enemies

5 Lectures

Bee Diseases and Enemies
Control and Preventive measures

Unit 4: Bee Economy

2 Lectures

Products of Apiculture Industry and its Uses (Honey, Bees Wax, Propolis), Pollen
etc

Unit 5: Entrepreneurship in Apiculture

4 Lectures

Bee Keeping Industry – Recent Efforts, Modern Methods in employing artificial
Beehives for cross pollination in horticultural gardens

SUGGESTED READINGS

Prost, P. J. (1962). *Apiculture*. Oxford and IBH, New Delhi.

Bisht D.S., *Apiculture*, ICAR Publication.

Singh S., *Beekeeping in India*, Indian council of Agricultural Research, NewDelh

SEC- ZOOLOGY
Course Code: ZNS503(IV)
SERICULTURE

THEORY

(CREDITS 2)
(Lectures =30)

Unit 1: Introduction

3 Lectures

Sericulture: Definition, history and present status; Silk route

Types of silkworms, Distribution and Races, Hybrids

Exotic and indigenous races

Mulberry and non-mulberry Sericulture

Unit 2: Biology of Silkworm

3 Lectures

Life cycle of *Bombyx mori*

Structure of silk gland and secretion of silk

Sex linked traits

Unit 3: Rearing of Silkworms

15 Lectures

Mulberry silkworm rearing: Selection of mulberry variety and establishment of mulberry garden

Rearing house and rearing appliances

Disinfectants: Formalin, bleaching powder, RKO

Silkworm rearing technology: Early age and Late age rearing

Types of mountages

Spinning, harvesting and storage of cocoons

Non mulberry silkworm rearing: Host plants of non mulberry silkworm, maintenance of host plants of

Anthereae assama, rearing technology of *Anthereae*

spp and *samia cynthia ricini*.

Unit 4: Pests and Diseases

4 Lectures

Pests of silkworm: Uzi fly, dermestid beetles and vertebrates

Pathogenesis of silkworm diseases: Protozoan, viral, fungal and bacterial

Control and prevention of pests and diseases

Unit 5: Entrepreneurship in Sericulture

5 Lectures

Prospectus of Sericulture in India: Sericulture industry in different states, employment, potential in mulberry and non-mulberry sericulture. Visit to various sericulture centres.

SUGGESTED READINGS

Handbook of Practical Sericulture: S.R. Ullal and M.N. Narasimhanna CSB, Bangalore

Appropriate Sericultural Techniques; Ed. M. S. Jolly, Director, CSR & TI, Mysore.

Handbook of Silkworm Rearing: Agriculture and Technical Manual-1, Fuzi Pub. Co. Ltd., Tokyo, Japan 1972.

Manual of Silkworm Egg Production; M. N. Narasimhanna, CSB, Bangalore 1988.

Silkworm Rearing; Wupang—Chun and Chen Da-Chung, Pub. By FAO, Rome 1988.

A Guide for Bivoltine Sericulture; K. Sengupta, Director, CSR & TI, Mysore 1989

Improved Method of Rearing Young age silkworm; S₃ Krishnaswamy, reprinted CSB, Bangalore, 1986.

SEC- ZOOLOGY
Course Code: ZNS604(V)
Freshwater Aquaculture

THEORY

(Credit 2)
(Lectures =30)

Unit 1:

4 Lectures

Introduction to Aquaculture, Basic concept of extensive, intensive and superintensive aquaculture, Background aquaculture, monoculture, polyculture and integrated farming.

Unit 2:

6 Lectures

Rearing of Larval and brood fishes, Traditional and Chinese hatcheries, feed preparation for carps and catfishes, Live food culture, Transportation of fish seeds and brooders.

Unit 3:

8 Lectures

Captive breeding of carp, catfishes and live bearers, Diagnostic characters of brood fishes, Breeding of carps and catfishes in simulated environments, Induce breeding of carps and catfishes, Standardisation of hormonal doses.

Unit 4:

7 Lectures

Maintenance of fish health and prophylactic measures, Diagnostic of fungal, bacterial, protozoan and ectoparasites, Control measures for common fish diseases.