

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

	CORE COURSE (12)	Ability Enhancement Compulsory Courses AEC (2)	Skill Enhancement Courses SEC (4)	Discipline Specific Elective DSE (4)
I	CC- Botany I CC- Zoology I CC- Chemistry I	English Communication		
II	CC- Botany II CC-Zoology II CC- Chemistry II	Environmental Science		
III	CC- Botany III CC-Zoology III CC- Chemistry III		Ornamental Fish & Fisheries	
IV	CC- Botany IV CC-Zoology IV CC- Chemistry IV		Apiculture	
V			Non mulberry sericulture	DSE-Botany I DSE-Zoology I (Applied Zoology or Animal Biotechnology DSE-Chemistry I
VI			Wildlife Photography and Ecotourism	DSE-Botany II DSE-Zoology II (Aquatic Biology/Insect vectors and Diseases DSE-Chemistry II

Discipline Core Courses: Zoology

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

Discipline Specific Electives: Zoology (Any two)

1. Applied Zoology
2. Animal Biotechnology
3. Aquatic Biology
4. Insect, Vector and Diseases

Skill Enhancement Courses: Zoology

1. Apiculture
2. Ornamental Fish Farming
3. Non Mulberry Sericulture
4. Wild life Photography and Ecotourism

**CORE COURSE I
ANIMAL DIVERSITY**

THEORY

(CREDITS 4)

Unit 1: Kingdom Protista

4

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

Unit 2: Phylum Porifera

3

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

Unit 3: Phylum Cnidaria

3

General characters and classification up to classes; Polymorphism in Hydrozoa

Unit 4: Phylum Platyhelminthes

3

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

Unit 5: Phylum Nematelminthes

5

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

Unit 6: Phylum Annelida

3

General characters and classification up to classes; Metamerism in Annelida

Unit 7: Phylum Arthropoda

5

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

Unit 8: Phylum Mollusca

4

General characters and classification up to classes; Torsion in gastropods

Unit 9: Phylum Echinodermata

4

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

Unit 10: Protochordates

2

General features and Phylogeny of Protochordata

Unit 11: Agnatha

2

General features of Agnatha and classification of cyclostomes up to classes

Unit 12: Pisces

4

General features and Classification up to orders; Osmoregulation in Fishes

Unit 13: Amphibia 4

General features and Classification up to orders; Parental care

Unit 14: Reptiles 4

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

Unit 15: Aves 5

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

Unit 17: Mammals 5

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”

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. Key for Identification of poisonous and non-poisonous snakes

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 II

COMPARATIVE ANATOMY AND DEVELOPMENTAL BIOLOGY OF VERTEBRATES

THEORY	(CREDITS 4)
Unit 1: Integumentary System Derivatives of integument w.r.t. glands and digital tips	4
Unit 2: Skeletal System Evolution of visceral arches	3
Unit 3: Digestive System Brief account of alimentary canal and digestive glands	4
Unit 4: Respiratory System Brief account of Gills, lungs, air sacs and swim bladder	5
Unit 5: Circulatory System Evolution of heart and aortic arches	4
Unit 6: Urinogenital System Succession of kidney, Evolution of urinogenital ducts	4
Unit 7: Nervous System Comparative account of brain	3
Unit 8: Sense Organs Types of receptors	3
Unit 9: Early Embryonic Development 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.	12
Unit 10: Late Embryonic Development 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.	10
Unit 11: Control of Development	8

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

COMPARATIVE ANATOMY AND DEVELOPMENTAL BIOLOGY OF VERTEBRATES

PRACTICAL

(CREDITS 2)

1. Osteology:

- a) Disarticulated skeleton of fowl and rabbit
- b) 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. 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 III
PHYSIOLOGY AND BIOCHEMISTRY**

THEORY

(CREDITS 4)

Unit 1: Nerve and muscle

8

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

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, Hemostasis, 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, Parathyroid, pancreas and adrenal

Unit 7: Carbohydrate Metabolism

8

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

Unit 8: Lipid Metabolism

5

Biosynthesis and β oxidation of palmitic acid

Unit 9: Protein metabolism

5

Transamination, Deamination and Urea Cycle

Unit 10: Enzymes

6

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

PHYSIOLOGY AND BIOCHEMISTRY

PRACTICAL

(CREDITS 2)

1. Preparation of hemin 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 IV
GENETICS AND EVOLUTIONARY BIOLOGY

THEORY

(CREDITS 4)

Unit 1: Introduction to Genetics

3

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

Unit 2: Mendelian Genetics and its Extension

8

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

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

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

Unit 5: Sex Determination

4

Chromosomal mechanisms, dosage compensation

Unit 6: History of Life

2

Major Events in History of Life

Unit 7: Introduction to Evolutionary Theories

5

Lamarckism, Darwinism, Neo-Darwinism

Unit 8: Direct Evidences of Evolution

5

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

Unit 9: Processes of Evolutionary Change

9

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

Unit 10: Species Concept

6

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

Unit 11: Macro-evolution**5**

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

Unit 12: Extinction**6**

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

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.
2. Study of Linkage, recombination, gene mapping using the data.
3. Study of Human Karyotypes (normal and abnormal).
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 Natural History Museum 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 CENTRIC ELECTIVE COURSES

DSE 1 ANIMAL BIOTECHNOLOGY

THEORY

(Credits 4)

Unit 1: Introduction

8

Concept and scope of biotechnology

Unit 2: Molecular Techniques in Gene manipulation

24

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

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

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

ANIMAL BIOTECHNOLOGY

PRACTICAL

(Credits 2)

1. Genomic DNA isolation from *E. coli*
2. Restriction digestion of plasmid DNA.
3. Construction of circular and linear restriction map from the data provided.
4. Calculation of transformation efficiency from the data provided.
5. To study following techniques through photographs
 - a) Southern Blotting
 - b) Northern Blotting
 - c) Western Blotting
 - d) DNA Sequencing (Sanger's Method)
 - e) PCR
 - f) DNA fingerprinting
6. 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.

DSE 2
APPLIED ZOOLOGY

THEORY**(CREDITS 4)****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: Rickettsiae and Spirochaetes 6

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

Unit 4: Parasitic Protozoa 8

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

Unit 5: Parasitic Helminthes 5

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 5

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

Unit 9: Poultry Farming 5

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

Unit 10: Fish Technology 5

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

APPLIED ZOOLOGY

PRACTICAL

(CREDITS 2)

1. Study of *Plasmodium vivax*, *Entamoeba histolytica*, *Trypanosoma gambiense*, *Ancylostoma duodenale* and *Wuchereria bancrofti* and 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*, PrenticeHall.

DCE 3
AQUATIC BIOLOGY

THEORY**(Credits 4)****UNIT 1: Aquatic Biomes**

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

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

Salinity and density of Sea water, Continental shelf, Adaptations of deep sea organisms, Coral reefs, Sea weeds.

UNIT 4: Management of Aquatic Resources

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

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 pond/ Beel water system.
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.

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

DSE 4
INSECT, VECTORS AND DISEASES

THEORY	(Credits 4)
Unit I: Introduction to Insects	6
General Features of Insects, Morphological features, Head – Eyes, Types of antennae, Mouth parts w.r.t. feeding habits	
Unit II: Concept of Vectors	6
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
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
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
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
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
Bugs as insect vectors; Blood-sucking bugs; Chagas disease, Bed bugs as mechanical vectors, Control and prevention measures	

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

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 2

APICULTURE

(CREDITS 2)

Unit 1: Biology of Bees

(4)

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

Unit 2: Rearing of Bees

(10)

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)
Bee Diseases and Enemies
Control and Preventive measures

Unit 4: Bee Economy (2)
Products of Apiculture Industry and its Uses (Honey, Bees Wax, Propolis), Pollen etc

Unit 5: Entrepreneurship in Apiculture (4)
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, New Delhi.

SEC – 1

Ornamental Fish & Fisheries

Credit-2

1. Ornamental Fish Diversity of North East India.
2. Aquarium plant diversity in the wetland of Assam.
3. Construction and management of Home Aquarium.
4. Natural feed of Ornamental Fish
5. Strategies for maintenance of natural colour of Ornamental Fish
6. Natural Breeding of Tricogaster species
7. Health management of Ornamental Fish
8. Feed formulation of Ornamental Fish
9. Development of Biological filtration in Aquarium

SEC 3

NON-MULBERRY SERICULTURE**(CREDITS 2)****Unit 1: Introduction**

Sericulture: Definition, history and present status of Mulberry and Non-Mulberry Sericulture; Silk route
 Varieties of Silk; Types and distribution of non-mulberry or wild or vanya sericigenous insects in N-E India

Unit 2: Biology of Non-mulberry Silkworm:

Life cycle of silkworm- Eri and Muga
 Structure of silk gland and Nature of Silk

Unit 3: Rearing of Silkworms (Eri and Muga Silkworm):

Food plants of Eri and Muga Silkworm

Rearing Operation:

Rearing house/Site and rearing appliances
 Disinfectants: Formalin, bleaching powder
 Rearing technology: Early age and Late age rearing
 Environmental conditions in rearing-Temperature, Humidity, Light and Air
 Types of mountages
 Harvesting and storage of cocoons
 Spinning and Reeling of silk

Unit 4: Pests and Diseases:

Pests of eri and muga silkworm
 Pathogenesis of eri and muga silkworm diseases: Protozoan, viral, fungal and bacterial
 Prevention and control measures of pests and diseases

Unit 5: Entrepreneurship in Non-Mulberry Sericulture:

Varieties of Non-Mulberry Silk products and economics in India
 Prospectus of Non-Mulberry Sericulture in India: Non-Mulberry Sericulture industry in different states, employment generation and potential
 Visit to various sericulture Govt. /Private Farm/ Centers.

SUGGESTED READINGS

- Jolly, M. S., S. K. Sen, T.N. Sonwalkar and G.K. Prashad 1979. *Non-Mulberry Sericulture*. In: Manual of Sericulture, Rome, **FAO**, 4 (29)
- Chowdhury, S.N. 1981. *Muga Silk Industry*. Directorate of Sericulture, Govt. of Assam, Guwahati-781005, Assam.
- Chowdhury, S.N. 1982. *Eri Silk Industry*. Directorate of Sericulture, Govt. of Assam, Guwahati-781005, Assam.
- Chowdhury, S.N. 1992. *Silk and Sericulture*. Directorate of Sericulture and Weaving, Govt. of Assam, Guwahati-781005, Assam.

SEC 4

Wildlife Photography and Ecotourism

CREDITS 2

Unit-I Tools and Technique of Photography

Credit-1

- Introduction to Wildlife Photography
- Still & Video Photography
- Developing expertise in Photography
- Field trips for photography in different periods of the day (Light and Dark), seasons and places (Wetlands, Wildlife Sanctuaries, National parks, Industrial sites)
- Methods of documentation

Practical

- Submission of Photography
- Preparation of Poster and Calendar

Unit-2 Eco-tourism

Credit-1

- Concepts of Eco-tourism and conservation of natural landscapes
- Scope of Eco-tourism with special reference to North East region of India
- Management of Eco-tourism & hospitality
- Development of Eco-tourism with innovative Eco-restoration ideas.

Practical

- Field visit to Wildlife sanctuaries, Eco-park, Historical and religious places, Cultural museum etc.
- Preparation of report and seminar presentation

SEC 4**RESEARCH METHODOLOGY****CREDITS 2****Unit 1: Foundations of Research****5**

Meaning, Objectives, Motivation: Research Methods vs Methodology, Types of Research: Analytical vs Descriptive, Quantitative vs Qualitative, Basic vs Applied

Unit 2: Research Design**8**

Need for research design: Features of good design, Important concepts related to good design- Observation and Facts, Prediction and Explanation, Development of Models. Developing a research plan: Problem identification, Experimentation, Determining experimental and sample designs

Unit 3: Data Collection, Analysis and Report Writing**12**

Observation and Collection of Data-Methods of data collection- Sampling Methods, Data Processing and Analysis Strategies, Technical Reports and Thesis writing, Preparation of Tables and Bibliography. Data Presentation using digital technology

Unit 4: Ethical Issues**5**

Intellectual property Rights, Commercialization, Copy Right, Royalty, Patent law, Plagiarism, Citation, Acknowledgement

SUGGESTED READINGS

- Anthony, M, Graziano, A.M. and Raulin, M.L. 2009. Research Methods: A Process of Inquiry, Allyn and Bacon.
- Walliman, N. 2011. Research Methods- The Basics. Taylor and Francis, London, New York.
- Wadhera, B.L.: Law Relating to Patents, Trade Marks, Copyright Designs and Geographical Indications, 2002, Universal Law publishing
- C.R.Kothari: Research Methodology, New Age International, 2009
- Coley, S.M. and Scheinberg, C.A. 1990, "Proposal writing". Stage Publications.

SEC 5

SERICULTURE

(CREDITS 2)

Unit 1: Introduction

(3)

Sericulture: Definition, history and present status; Silk route

Types of silkworms, Distribution and Races

Exotic and indigenous races

Mulberry and non-mulberry Sericulture

Unit 2: Biology of Silkworm

(3)

Life cycle of *Bombyx mori*

Structure of silk gland and secretion of silk

Unit 3: Rearing of Silkworms

(13)

Selection of mulberry variety and establishment of mulberry garden

Rearing house and rearing appliances

Disinfectants: Formalin, bleaching powder, RKO

Silkworm rearing technology: Early age and Late age rearing

Types of mountages

Spinning, harvesting and storage of cocoons

Unit 4: Pests and Diseases

(4)

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

(2)

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; S. Krishnaswamy, reprinted CSB, Bangalore, 1986.

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