**Choice Based Credit System (CBCS)**

# UNIVERSITY OF DELHI

## FACULTY OF SCIENCE

## UNDERGRADUATE PROGRAMME
**(Courses effective from Academic Year 2015-16)**

## SYLLABUS OF COURSES TO BE OFFERED
**Core Courses, Elective Courses & Ability Enhancement Courses**

**Disclaimer:** The CBCS syllabus is uploaded as given by the Faculty concerned to the Academic Council. The same has been approved as it is by the Academic Council on 13.7.2015 and Executive Council on 14.7.2015. Any query may kindly be addressed to the concerned Faculty.

**Undergraduate Programme Secretariat**

## Preamble

The University Grants Commission (UGC) has initiated several measures to bring equity, efficiency and excellence in the Higher Education System of country. The important measures taken to enhance academic standards and quality in higher education include innovation and improvements in curriculum, teaching-learning process, examination and evaluation systems, besides governance and other matters.

The UGC has formulated various regulations and guidelines from time to time to improve the higher education system and maintain minimum standards and quality across the Higher Educational Institutions (HEIs) in India. The academic reforms recommended by the UGC in the recent past have led to overall improvement in the higher education system. However, due to lot of diversity in the system of higher education, there are multiple approaches followed by universities towards examination, evaluation and grading system. While the HEIs must have the flexibility and freedom in designing the examination and evaluation methods that best fits the curriculum, syllabi and teaching–learning methods, there is a need to devise a sensible system for awarding the grades based on the performance of students. Presently the performance of the students is reported using the conventional system of marks secured in the examinations or grades or both. The conversion from marks to letter grades and the letter grades used vary widely across the HEIs in the country. This creates difficulty for the academia and the employers to understand and infer the performance of the students graduating from different universities and colleges based on grades.

The grading system is considered to be better than the conventional marks system and hence it has been followed in the top institutions in India and abroad. So it is desirable to introduce uniform grading system. This will facilitate student mobility across institutions within and across countries and also enable potential employers to assess the performance of students. To bring in the desired uniformity, in grading system and method for computing the cumulative grade point average (CGPA) based on the performance of students in the examinations, the UGC has formulated these guidelines.

## CHOICE BASED CREDIT SYSTEM (CBCS):

The CBCS provides an opportunity for the students to choose courses from the prescribed courses comprising core, elective/minor or skill based courses. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. Therefore, it is necessary to introduce uniform grading system in the entire higher education in India. This will benefit the students to move across institutions within India to begin with and across countries. The uniform grading system will also enable potential employers in assessing the performance of the candidates. In order to bring uniformity in evaluation system and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in examinations, the UGC has formulated the guidelines to be followed.

**Outline of Choice Based Credit System:**

1. **Core Course:** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.
2. **Elective Course:** Generally a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/ subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course.
   - **2.1 Discipline Specific Elective (DSE) Course**: Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The University/Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).
   - **2.2 Dissertation/Project**: An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project.
   - **2.3 Generic Elective (GE) Course**: An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective.
     P.S.: A core course offered in a discipline/subject may be treated as an elective by other discipline/subject and vice versa and such electives may also be referred to as Generic Elective.
3. **Ability Enhancement Courses (AEC)/Competency Improvement Courses/Skill Development Courses/Foundation Course:** The Ability Enhancement (AE) Courses may be of two kinds: AE Compulsory Course (AECC) and AE Elective Course (AEEC). "AECC" courses are the courses based upon the content that leads to Knowledge enhancement. They ((i) Environmental Science, (ii) English/MIL Communication) are mandatory for all disciplines. AEEC courses are value-based and/or skill-based and are aimed at providing hands-on-training, competencies, skills, etc.
   - **3.1** AE Compulsory Course (AECC): Environmental Science, English Communication/MIL Communication.
   - **3.2** AE Elective Course (AEEC): These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based instruction.

**Project work/Dissertation** is considered as a special course involving application of knowledge in solving / analyzing /exploring a real life situation / difficult problem. A Project/Dissertation work would be of 6 credits. A Project/Dissertation work may be given in lieu of a discipline specific elective paper.

**Details of courses under B.A (Honors), B.Com (Honors) & B.Sc. (Honors)**

| Course | *Credits | |
|---|---|---|
| | Theory+ Practical | Theory + Tutorial |
| **I. Core Course** | | |
| **(14 Papers)** | 14X4= 56 | 14X5=70 |
| **Core Course Practical / Tutorial*** | | |
| **(14 Papers)** | 14X2=28 | 14X1=14 |
| **II. Elective Course** | | |
| **(8 Papers)** | | |
| A.1. Discipline Specific Elective | 4X4=16 | 4X5=20 |
| **(4 Papers)** | | |
| A.2. Discipline Specific Elective Practical/ Tutorial* | 4 X 2=8 | 4X1=4 |
| **(4 Papers)** | | |
| B.1. Generic Elective/ Interdisciplinary | 4X4=16 | 4X5=20 |
| **(4 Papers)** | | |
| B.2. Generic Elective Practical/ Tutorial* | 4 X 2=8 | 4X1=4 |
| **(4 Papers)** | | |

- **Optional Dissertation or project work in place of one Discipline Specific** E**lective paper (6 credits) in 6th Semester**

| | | |
|---|---|---|
| **III. Ability Enhancement Courses** | | |
| 1. **Ability Enhancement Compulsory** | | |
| **(2 Papers of 2 credit each)** | 2 X 2=4 | 2 X 2=4 |
| Environmental Science | | |
| English/MIL Communication | | |
| 2. **Ability Enhancement Elective** (Skill Based) | | |
| (Minimum 2) | 2 X 2=4 | 2 X 2=4 |
| **(2 Papers of 2 credit each)** | | |
| **Total credit** | **140** | **140** |

**Institute should evolve a system/policy about ECA/ General Interest/Hobby/Sports/NCC/NSS/related courses on its own.**

*** wherever there is a practical there will be no tutorial and vice-versa**

# SCHEME AND SYLLABUS FORCHOICE BASED CREDIT SYSTEM

# FOR B.Sc. HONOURS ZOOLOGY

| **Semester** | **Core Course(14)** | **Ability Enhancement Compulsory Course (2)** | **Skill Enhancement Course SEC (2)** | **Discipline SpecificElective DCE (4)** | **Generic Elective GE (4)** |
|---|---|---|---|---|---|
| I | Non-chordates I: Protista to Pseudocoelomates | English Communication | | | GE-1 |
| | Principles of Ecology | | | | |
| II | Non-chordates II: Coelomates | Environmental Science | | | GE-2 |
| | Cell Biology | | | | |
| III | Diversity of Chordates | | **SEC -1** | | GE-3 |
| | Physiology: Controlling and Coordinating Systems | | | | |
| | Fundamentals of Biochemistry | | | | |
| IV | Comparative Anatomy of Vertebrates | | **SEC -2** | | GE-4 |
| | Physiology: Life Sustaining Systems | | | | |
| | Biochemistry of Metabolic Processes | | | | |
| V | Molecular Biology | | | DSE-1 | |
| | Principles of Genetics | | | DSE-2 | |
| VI | Developmental Biology | | | DSE -3 | , |
| | Evolutionary Biology | | | DSE-4 | |

| Semester | Course Opted | Course Name | Credits |
|---|---|---|---|
| I | Ability Enhancement Compulsory Course-I | English communications/ Environmental Science | 2 |
| | Core course-I | Non-chordates I: Protista to Pseudocoelomates | 4 |
| | Core Course-I Practical | | 2 |
| | Core course-II | Principles of Ecology | 4 |
| | Core Course-II Practical | | 2 |
| | Generic Elective -1 | GE-1 | 4 |
| | Generic Elective -1 Practical/Tutorial | | 2 |
| II | Ability Enhancement Compulsory Course-II | English Communications/ Environmental Science | 2 |
| | Core course-III | Non-chordates II: Coelomates | 4 |
| | Core Course-III Practical | | 2 |
| | Core course-IV | Cell Biology | 4 |
| | Core Course-IV Practical | | 2 |
| | Generic Elective -2 | GE-2 | 4 |
| | Generic Elective -2 Practical | | 2 |
| III | Core course-V | Diversity of Chordata | 4 |
| | Core Course-V Practical | | 2 |
| | Core course-VI | Physiology: Controlling and Coordinating systems | 4 |
| | Core Course-VI Practical | | 2 |
| | Core course-VII | Fundamentals of Biochemistry | 4 |
| | Core Course-VII Practical | | 2 |
| | Skill Enhancement Course-1 | SEC-1 | 4 |
| | Generic Elective -3 | GE-3 | 4 |
| | Generic Elective -3 Practical | | 2 |
| IV | Core course-VIII | Comparative anatomy of vertebrates | 4 |
| | Course-VIII Practical | | 2 |
| | Core course-IX | Physiology: Life Sustaining Systems | 4 |
| | Course-IX Practical | | 2 |
| | Core course-X | Biochemistry of Metabolic Processes | 4 |
| | Core Course- X Practical | | 2 |
| | Skill Enhancement Course-2 | SEC-2 | 4 |
| | Generic Elective -4 | GE-4 | 4 |
| | Generic Elective - | | 2 |
| | 4Practical | | |
| V | Core course-XI | Molecular Biology | 4 |
| | Core Course-XI Practical | | 2 |
| | Core course-XII | Principles of Genetics | 4 |
| | Core Course-XII Practical | | 2 |

| Semester | Course Opted | Course Name | Credits |
|---|---|---|---|
| | Discipline Specific Elective -1 | DSE-1 | 4 |
| | Discipline Specific Elective -1 Practical | | 2 |
| | Discipline Specific Elective -2 | DSE-2 | 4 |
| | Discipline Specific Elective- 2 Practical/Tutorial | | 2 |
| VI | Core course-XIII | Developmental Biology | 4 |
| | Core Course-XIII Practical/Tutorial | | 2 |
| | Core course-XIV | Evolutionary Biology | 4 |
| | Core Course-XIV Practical/Tutorial | | 2 |
| | Discipline Centric Elective -3 | DSE-3 | 4 |
| | Discipline Centric Elective -3 Practical/Tutorial | | 2 |
| | Discipline Centric Elective-4 | DSE-4 | 4 |
| | Discipline Centric Elective -1 Practical/Tutorial | | 2 |
| | | | **Total: 140** |

## CORE COURSE I

## NON-CHORDATES I: PROTISTS TO PSEUDOCOELOMATES

**THEORY** **(Credits 4)**

**Unit 1: Protista, Parazoa and Metazoa** **19**

General characteristics and Classification up to classes
Study of *Euglena*, *Amoeba* and *Paramecium*
Life cycle and pathogenicity of *Plasmodium vivax* and *Entamoeba histolytica*
Locomotion and Reproduction in Protista
Evolution of symmetry and segmentation of Metazoa

**Unit 2: Porifera** **7**

General characteristics and Classification up to classes
Canal system in sponges

**Unit 3: Cnidaria** **12**

General characteristics and Classification up to classes
Metagenesis in *Obelia*
Polymorphism in Cnidaria
Corals and coral reefs

**Unit 4: Ctenophora** **4**

General characteristics and Evolutionary significance

**Unit 5: Platyhelminthes** **10**

General characteristics and Classification up to classes
Life cycle and pathogenicity of *Fasciola hepatica* and *Taenia solium*

**Unit 6: Nemathelminthes** **8**

General characteristics and Classification up to classes
Life cycle, and pathogenicity of *Ascaris lumbricoides* and *Wuchereria bancrofti*
Parasitic adaptations in helminthes

**Note:** Classification to be followed from "Barnes, R.D. (1982). *Invertebrate Zoology*, V Edition"

## NON-CHORDATES I: PROTISTS TO PSEUDOCOELOMATES

**PRACTICAL** **(Credits 2)**

1. Study of whole mount of *Euglena*, *Amoeba* and *Paramecium*, Binary fission and Conjugation in *Paramecium*
2. Examination of pond water collected from different places for diversity in protista
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/micro-photographs)
7. Study of adult *Ascaris lumbricoides* and its life stages (Slides/micro-photographs)
8. To submit a Project Report on any related topic on life cycles/coral/ coral reefs.

**Note:**Classification to be followed from "Barnes, R.D. (1982). *Invertebrate Zoology*, V Edition"

**SUGGESTED READINGS**


- Barnes, R.D. (1982). *Invertebrate Zoology*, V 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
- Barrington, E.J.W. (1979). *Invertebrate Structure and Functions*. II Edition, E.L.B.S. and Nelson
- Boradale, L.A. and Potts, E.A. (1961). *Invertebrates: A Manual for the use of Students*. Asia Publishing Home

## CORE COURSE II

## PRINCIPLES OF ECOLOGY

**THEORY** **(Credits 4)**

**Unit 1: Introduction to Ecology** **6**

History of ecology, Autecology and synecology, Levels of organization, Laws of limiting factors, Study of physical factors

**Unit 2: Population** **24**

Unitary and Modular populations
Unique and group attributes of population: Density, natality, mortality, life tables, fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion
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 and Predation, functional and numerical responses

**Unit 3: Community** **12**

Community characteristics: species richness, dominance, diversity, abundance, vertical stratification, Ecotone and edge effect; Ecological succession with one example
Theories pertaining to climax community

**Unit 4: Ecosystem** **14**

Types of ecosystems with one 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 one example of Nitrogen cycle
Human modified ecosystem

**Unit 5: Applied Ecology** **4**

Ecology in Wildlife Conservation and Management

## PRINCIPLES OF ECOLOGY

### PRACTICALS (Credits 2)

1. Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided
2. Determination of population density in a natural/hypothetical community by quadrate method and calculation of Shannon-Weiner diversity index for the same community
3. Study of an aquatic ecosystem: Phytoplankton and zooplankton, Measurement of area, temperature, turbidity/penetration of light, determination of pH, and Dissolved Oxygen content (Winkler's method), Chemical Oxygen Demand and free $CO_2$
4. Report on a visit to National Park/Biodiversity Park/Wild life sanctuary

### SUGGESTED READINGS


- Colinvaux, P. A. (1993). Ecology. II Edition. Wiley, John and Sons, Inc.
- Krebs, C. J. (2001). Ecology. VI Edition. Benjamin Cummings.
- Odum, E.P., (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole
- Robert Leo Smith Ecology and field biology Harper and Row publisher
- Ricklefs, R.E., (2000). Ecology. V Edition. Chiron Pres

## CORE COURSE III

## NON-CHORDATES II: COELOMATES

**THEORY** **(Credits 4)**

**Unit 1: Introduction to Coelomates** **2**

Evolution of coelom and metamerism

**Unit 2: Annelida** **10**

General characteristics and Classification up to classes
Excretion in Annelida

**Unit 3: Arthropoda** **17**

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

**Unit 4: Onychophora** **4**

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** **12**

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

**Note:** Classification to be followed from "Barnes, R.D. (1982). *Invertebrate Zoology*, V Edition, Holt Saunders International Edition"

## NON-CHORDATES II: COELOMATES

**PRACTICAL** **(Credits 2)**

1. Study of followingspecimens:
   Annelids - *Aphrodite, 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*
2. Study of 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 on any related topic to larval forms (crustacean, mollusc and echinoderm)

**Note:** Classification to be followed from "Barnes, R.D. (1982). *Invertebrate Zoology*, V Edition, Holt Saunders International Edition"

**SUGGESTED READINGS**


- Barnes, R.D. (1982). *Invertebrate Zoology,* V 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
- Barrington, E.J.W. (1979). *Invertebrate Structure and Functions*. II Edition, E.L.B.S. and Nelson
- Boradale, L.A. and Potts, E.A. (1961). *Invertebrates: A Manual for the use of Students*. Asia Publishing Home

## CORE COURSE IV

## CELL BIOLOGY

**THEORY** **(Credits 4)**

**Unit 1: Overview of Cells** **3**

Prokaryotic and Eukaryotic cells, Virus, Viroids, Mycoplasma, Prions

**Unit 2: Plasma Membrane** **7**

Various models of plasma membrane structure
Transport across membranes: Active and Passive transport, Facilitated transport
Cell junctions: Tight junctions, Desmosomes, Gap junctions

**Unit 3: Endomembrane System** **10**

Structure and Functions: Endoplasmic Reticulum, Golgi Apparatus, Lysosomes

**Unit 4: Mitochondria and Peroxisomes** **8**

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

**Unit 5: Cytoskeleton** **8**

Structure and Functions: Microtubules, Microfilaments and Intermediate filaments

**Unit 6: Nucleus** **12**

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

**Unit 7: Cell Division** **8**

Mitosis, Meiosis, Cell cycle and its regulation

**Unit 8: Cell Signaling** **4**

GPCR and Role of second messenger (cAMP)

## CELL BIOLOGY

**PRACTICAL** **(Credits 2)**

1. Preparation of temporary stained squash of onion root tip to study various stages of mitosis
2. Study of various stages of meiosis.
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:
   i DNA by Feulgen reaction
   ii DNA and RNA by MGP
   iii Mucopolysaccharides by PAS reaction
   iv Proteins by Mercurobromophenol blue/Fast Green

### SUGGESTED READINGS


- Karp, G. (2010). *Cell and Molecular Biology: Concepts and Experiments*. VI Edition. John Wiley and Sons. Inc.
- De Robertis, E.D.P. and De Robertis, E.M.F. (2006). *Cell and Molecular Biology*. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
- Cooper, G.M. and Hausman, R.E. (2009). *The Cell: A Molecular Approach*. V Edition. ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA.
- Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). *The World of theCell*. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
- Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008). *Molecular Biology of the Cell*, V Edition, Garland publishing Inc., New York and London.

## CORE COURSE V

## DIVERSITY OF CHORDATA

**THEORY** **(Credits 4)**

**Unit 1: Introduction to Chordates** **2**

General characteristics and outline classification

**Unit 2: Protochordata** **8**

General characteristics of Hemichordata, Urochordata and Cephalochordata; Study of larval forms in protochordates*;* Retrogressive metamorphosis in Urochordata

**Unit 3: Origin of Chordata** **3**

Dipleurula concept and the Echinoderm theory of origin of chordates
Advanced features of vertebrates over Protochordata

**Unit 4: Agnatha** **2**

General characteristics and classification of cyclostomes up to class

**Unit 5: Pisces** **8**

General characteristics of Chondrichthyes and Osteichthyes, Classification up to order Migration, Osmoregulation and Parental care in fishes

**Unit 6: Amphibia** **6**

Origin of *Tetrapoda* (Evolution of terrestrial ectotherms); General characteristics and classification up to order; Parental care in Amphibians

**Unit 7: Reptilia** **7**

General characteristics and classification up to order; Affinities of *Sphenodon*; Poison apparatus and Biting mechanism in snakes

**Unit 8: Aves** **8**

General characteristics and classification up to order *Archaeopteryx*-- a connecting link; Principles and aerodynamics of flight, Flight adaptations and Migration in birds

**Unit 9: Mammals** **8**

General characters and classification up to order; Affinities of Prototheria; Adaptive radiation with reference to locomotory appendages

**Unit 10: Zoogeography** **8**

Zoogeographical realms, Theories pertaining to distribution of animals, Plate tectonic and Continental drift theory, distribution of vertebrates in different realms

## DIVERSITY OF CHORDATA

**PRACTICAL** **(Credits 2)**

1. **Protochordata**
   *Balanoglossus, Herdmania, Branchiostoma,* Colonial Urochordata, Sections of *Balanoglossus* through proboscis and branchiogenital regions, Sections of *Amphioxus* through pharyngeal, intestinal and caudal regions. Permanent slide of *Herdmania* spicules

2. **Agnatha**
   *Petromyzon, Myxine*

3. **Fishes**
   *Scoliodon, Sphyrna, Pristis, Torpedo, Chimaera, Mystus, Heteropneustes, Labeo, Exocoetus, Echeneis, Anguilla, Hippocampus, Tetrodon/ Diodon, 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. Types of beaks and claws

7. **Mammalia**
   *Sorex,* Bat (Insectivorous and Frugivorous), *Funambulus, Loris, Herpestes, Erinaceous.*
   Mount of weberian ossicles of *Mystus,* 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)
   Classification from Young, J. Z. (2004) to be followed

**SUGGESTED READINGS**


- Young, J. Z. (2004). *The Life of Vertebrates*. III Edition. Oxford university press.
- Pough H. *Vertebrate life*, VIII Edition, Pearson International.
- Darlington P.J. *The Geographical Distribution of Animals*, R.E. Krieger Pub. Co.
- Hall B.K. and Hallgrimsson B. (2008). *Strickberger's Evolution*. IV Edition. Jones and Bartlett Publishers Inc.

## CORE COURSE VI

## ANIMAL PHYSIOLOGY: CONTROLLING AND COORDINATING SYSTEMS

**THEORY** **(Credits 4)**

**Unit 1: Tissues** **6**

Structure, location, classification and functions of epithelial tissue, connective tissue, muscular tissue and nervous tissue

**Unit 2: Bone and Cartilage** **4**

Structure and types of bones and cartilages, Ossification, bone growth and resorption

**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 - reflex arc; Physiology of hearing and vision.

**Unit 4: Muscle** **12**

Histology of different types of muscle; Ultra structure of skeletal muscle; Molecular and chemical basis of muscle contraction; Characteristics of muscle twitch; Motor unit, summation and tetanus

**Unit 5: Reproductive System** **10**

Histology of testis and ovary; Physiology of male and female reproduction; Puberty, Methods of contraception in male and female

**Unit 6: Endocrine System** **18**

Histology of endocrine glands - pineal, pituitary, thyroid, parathyroid, pancreas, adrenal; hormones secreted by them and their mechanism of action; Classification of hormones; Regulation of their secretion; Mode 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

## ANIMAL PHYSIOLOGY: CONTROLLING AND COORDINATING SYSTEMS

### PRACTICALS (Credits 2)

*1. Recording of simple muscle twitch with electrical stimulation (or Virtual)
2. Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee jerk reflex)
3. Preparation of temporary mounts: Squamous epithelium, Striated muscle fibres and nerve cells
4. Study of permanent slides of Mammalian skin, Cartilage, Bone, Spinal cord, Nerve cell, Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid
5. Microtomy: Preparation of permanent slide of any five mammalian (Goat/white rat) tissues

**(*Subject to UGC guidelines)**

### SUGGESTED BOOKS


- Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company.

- Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons

- Victor P. Eroschenko. (2008). diFiore's Atlas of Histology with Functional correlations. XII Edition.Lippincott W. & Wilkins.

- Arey, L.B. (1974). Human Histology. IV Edition. W.B. Saunders.

## CORE COURSE VII

## FUNDAMENTALS OF BIOCHEMISTRY

**THEORY** **(CREDITS 4)**

**Unit 1: Carbohydrates** **8**

Structure and Biological importance: Monosaccharides, Disaccharides, Polysaccharides and Glycoconjugates

**Unit 2: Lipids** **8**

Structure and Significance: Physiologically important saturated and unsaturated fatty acids, Tri-acylglycerols, Phospholipids, Glycolipids, Steroids

**Unit 3: Proteins** **14**

**Amino acids:** Structure, Classification and General properties of α-amino acids; Physiological importance of essential and non-essential α-amino acids

**Proteins:** Bonds stabilizing protein structure; Levels of organization in proteins; Denaturation; Introduction to simple and conjugate proteins

**Immunoglobulins:** Basic Structure, Classes and Function, Antigenic Determinants

**Unit 4: Nucleic Acids** **12**

Structure: Purines and pyrimidines, Nucleosides, Nucleotides, Nucleic acids
Cot Curves: Base pairing, Denaturation and Renaturation of DNA
Types of DNA and RNA, Complementarity of DNA, Hpyo-Hyperchromaticity of DNA

**Unit 5: Enzymes** **18**

Nomenclature and classification; Cofactors; Specificity of enzyme action; Isozymes; Mechanism of enzyme action; Enzyme kinetics; Factors affecting rate of enzyme-catalyzed reactions; Derivation of Michaelis-Menten equation, Concept of Km and Vmax, Lineweaver-Burk plot; Multi-substrate reactions; Enzyme inhibition; Allosteric enzymes and their kinetics; Regulation of enzyme action

## FUNDAMENTALS OF BIOCHEMISTRY

**PRACTICAL** **(CREDITS 2)**

1. Qualitative tests of functional groups in carbohydrates, proteins and lipids.
2. Paper chromatography of amino acids.
3. Action of salivary amylase under optimum conditions.
4. Effect of pH, temperature and inhibitors on the action of salivary amylase.
5. Demonstration of proteins separation by SDS-PAGE.

**SUGGESTED READING**


- Cox, M.M and Nelson, D.L. (2008). *Lehninger's Principles of Biochemistry*, V Edition, W.H. Freeman and Co., New York.
- Berg, J.M., Tymoczko, J.L. and Stryer, L. (2007). *Biochemistry*, VI Edition, W.H. Freeman and Co., New York.
- 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.
- Hames, B.D. and Hooper, N.M. (2000). *Instant Notes in Biochemistry*, II Edition, BIOS Scientific Publishers Ltd., U.K.
- 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.

## CORE COURSEVIII

## COMPARATIVE ANATOMY OFVERTEBRATES

**THEORY** **(CREDITS 4)**

**Unit 1: Integumentary System** **8**

Structure, functions and derivatives of integument

**Unit 2: Skeletal System** **8**

Overview of axial and appendicular skeleton, Jaw suspensorium, Visceral arches

**Unit 3: Digestive System** **8**

Alimentary canal and associated glands, dentition

**Unit 4: Respiratory System** **8**

Skin, gills, lungs and air sacs; Accessory respiratory organs

**Unit 5: Circulatory System** **8**

General plan of circulation, evolution 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** **8**

Comparative account of brain
Autonomic nervous system, Spinal cord, Cranial nerves in mammals

**Unit 8: Sense Organs** **6**

Classification of receptors
Brief account of visual and auditory receptors in man

## COMPARATIVE ANATOMY OFVERTEBRATES

**PRACTICAL** **(CREDITS 2)**

1. Study of placoid, cycloid and ctenoid scales through permanent slides/photographs
2. Disarticulated skeleton of Frog, *Varanus*, Fowl, Rabbit
3. Carapace and plastron of turtle /tortoise
4. Mammalian skulls: One herbivorous and one carnivorous animal
5. Dissection of rat to study arterial and urinogenital system(subject to permission)
6. Study of structure of any two organs (heart, lung, kidney, eye and ear) from video recording (may be included if dissection not permitted)
7. Project on skeletal modifications in vertebrates (may be included if dissection not permitted)

**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
- Weichert C.K and William Presch (1970). *Elements of Chordate Anatomy*, Tata McGraw Hills
- 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

## CORE COURSE IX

## ANIMAL PHYSIOLOGY:LIFE SUSTAINING SYSTEMS

**THEORY** **(Credits 4)**

**Unit 1: Physiology of Digestion** **14**

Structural organization and functions of gastrointestinal tract and associated glands; Mechanical and chemical digestion of food; Absorptions of carbohydrates, lipids, proteins, water, minerals and vitamins; Hormonal control of secretion of enzymes in Gastrointestinal tract.

**Unit 2: Physiology of Respiration** **12**

Histology of trachea and lung; Mechanism of respiration, Pulmonary ventilation; Respiratory volumes and capacities; Transport of oxygen and carbon dioxide in blood; Respiratory pigments, Dissociation curves and the factors influencing it; Carbon monoxide poisoning; Control of respiration

**Unit 3: Renal Physiology** **8**

Structure of kidney and its functional unit; Mechanism of urine formation; Regulation of water balance; Regulation of acid-base balance

**Unit 4: Blood** **14**

Components of blood and their functions; Structure and functions of haemoglobin
Haemostasis: Blood clotting system, Kallikrein-Kinninogen system, Complement system& Fibrinolytic system, Haemopoiesis
Blood groups: Rh factor, ABO and MN

**Unit 5: Physiology of Heart** **12**

Structure of mammalian heart; Coronary circulation; Structure and working of conducting myocardial fibers. Origin and conduction of cardiac impulses
Cardiac cycle; Cardiac output and its regulation, Frank-Starling Law of the heart, nervous and chemical regulation of heart rate. Electrocardiogram, Blood pressure and its regulation

## ANIMAL PHYSIOLOGY:LIFE SUSTAINING SYSTEMS

**PRACTICALS** **(CREDITS 2)**

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 frog's heart beat under *in situ* and perfused conditions*
6. Recording of blood pressure using a sphygmomanometer
7. Examination of sections of mammalian oesophagus, stomach, duodenum, ileum, rectum liver, trachea, lung, kidney

**(*Subject to UGC guidelines)**

**SUGGESTED READINGS**


- Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. W.B. Saunders Company.
- Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons,
- Victor P. Eroschenko. (2008). diFiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott W. & Wilkins.
- Arey, L.B. (1974). Human Histology. IV Edition. W.B. Saunders.
- Vander A, Sherman J. and Luciano D. (2014). Vander's Human Physiology: The Mechanism of Body Function. XIII Edition, Mcgraw Hills

## CORE COURSE X

## BIOCHEMISTRY OF METABOLIC PROCESSES

**THEORY** **(CREDITS 4)**

**Unit 1: Overview of Metabolism** **10**

Catabolism *vs* Anabolism, Stages of catabolism, 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: Carbohydrate Metabolism** **16**

Sequence of reactions and regulation of glycolysis, Citric acid cycle, Phosphate pentose pathway, Gluconeogenesis, Glycogenolysis and Glycogenesis

**Unit 3: Lipid Metabolism** **14**

β-oxidation and omega -oxidation of saturated fatty acids with even and odd number of carbon atoms; Biosynthesis of palmitic acid; Ketogenesis

U**nit 4: Protein Metabolism** **10**

Catabolism of amino acids: Transamination, Deamination, Urea cycle; Fate of C-skeleton of Glucogenic and Ketogenic amino acids

**Unit 5: Oxidative Phosphorylation** **10**

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

## BIOCHEMISTRY OF METABOLIC PROCESS

**PRACTICAL** **(CREDITS 2)**

1. Estimation of total protein in given solutions by Lowry's method.
2. Detection of SGOT and SGPT or GST and GSH in serum/ tissue
3. To study the enzymatic activity of Trypsin and Lipase.
4. Study of biological oxidation (SDH) [goat liver]
5. To perform the Acid and Alkaline phosphatase assay from serum/ tissue.
6. Dry Lab: To trace the labelled C atoms of Acetyl-CoA till they evolve as $CO_2$in the TCA cycle

**SUGGESTED READINGS**


- Cox, M.M and Nelson, D.L. (2008). *Lehninger Principles of Biochemistry*, V Edition, W.H. Freeman and Co., New York.
- Berg, J.M., Tymoczko, J.L. and Stryer, L. (2007). *Biochemistry*, VI Edition, W.H. Freeman and Co., New York.
- Murray, R.K., Bende*r, 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.
- Hames, B.D. and Hooper, N.M. (2000). *Instant Notes in Biochemistry*, II Edition, BIOS Scientific Publishers Ltd., U.K.

## CORE COURSE XI

## MOLECULAR BIOLOGY

**THEORY** **(CREDITS 4)**

**Unit 1: Nucleic Acids** **4**

Salient features of DNA and RNA
Watson and Crick model of DNA

**Unit 2: DNA Replication** **12**

DNA Replication in prokaryotes and eukaryotes, mechanism of DNA replication,Semi-conservative, bidirectional and semi-discontinuous replication, RNA priming, Replication of circular and linear *ds*-DNA, replication of telomeres

**Unit 3:Transcription** **10**

RNA polymerase and transcription Unit, mechanism of transcription in prokaryotes and eukaryotes, synthesis of rRNA and mRNA, transcription factors

**Unit 4:Translation** **12**

Genetic code, Degeneracy of the genetic code and Wobble Hypothesis; Process 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; Inhibitors of protein synthesis; Difference between prokaryotic and eukaryotic translation

**Unit 5: Post Transcriptional Modifications and Processing of Eukaryotic RNA** **6**

Structure of globin mRNA; Split genes: concept of introns and exons, splicing mechanism, alternative splicing, exon shuffling, and RNA editing, Processing of tRNA

**Unit 6: Gene Regulation** **10**

Transcription regulation in prokaryotes: Principles of transcriptional regulation with examples from *lac* operon and *trp* operon; Transcription regulation in eukaryotes: Activators, repressors, enhancers, silencer elements; Gene silencing, Genetic imprinting

**Unit 7: DNA Repair Mechanisms** **3**

Pyrimidine dimerization and mismatch repair

**Unit 8: Regulatory RNAs** **3**

Ribo-switches, RNA interference, miRNA, siRNA

## MOLECULAR BIOLOGY

**PRACTICAL** **(CREDITS 2)**

1. Study of Polytene chromosomes from Chironomous / Drosophila larvae
2. Preparation of liquid culture medium (LB) and raise culture of *E. coli*
3. Estimation of the growth kinetics of *E. coli* by turbidity method
4. Preparation of solid culture medium (LB) and growth of *E. coli* by spreading and streaking
5. Demonstration of antibiotic sensitivity/resistance of *E. coli* to antibiotic pressure and interpretation of results
6. Quantitative estimation of salmon sperm/calf thymus DNA using colorimeter (Diphenylamine reagent) or spectrophotometer (A260 measurement)
7. Quantitative estimation of RNA using Orcinol reaction
8. Study and interpretation of electron micrographs/ photograph showing
   (a) DNA replication
   (b) Transcription
   (c) Split genes

**SUGGESTED READINGS**


- Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). *The World of the Cell.* VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
- Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter: *Molecular Biology of the Cell*, IV Edition.
- Cooper G. M. and Robert E. Hausman R. E. *The Cell: A Molecular Approach***,** V Edition, ASM Press and Sinauer Associates.
- De Robertis, E.D.P. and De Robertis, E.M.F. (2006). *Cell and Molecular Biology*. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
- Karp, G. (2010) *Cell and Molecular Biology: Concepts and Experiments*. VI Edition. John Wiley and Sons. Inc.
- Lewin B. (2008). *Gene XI*, Jones and Bartlett
- McLennan A., Bates A., Turner, P. and White M. (2015). *Molecular Biology* IV Edition. GS, Taylor and Francis Group, New York and London.

## CORE COURSE XII

## PRINCIPLES OF GENETICS

**THEORY** **(CREDITS 4)**

**Unit 1: Mendelian Genetics and its Extension** **8**

Principles of inheritance, Incomplete dominance and co-dominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Sex-linked, sex-influenced and sex-limited characters inheritance.

**Unit 2: Linkage, Crossing Over and Chromosomal Mapping** **12**

Linkage and crossing over, Cytological basis of crossing over, Molecular mechanisms of crossing over including models of recombination, Recombination frequency as a measure of linkage intensity, Two factor and three factor crosses, Interference and coincidence, Somatic cell hybridization.

**Unit 3: Mutations** **10**

Types of gene mutations (Classification), Types of chromosomal aberrations (Classification, figures and with one suitable example of each), Molecular basis of mutations in relation to UV light and chemical mutagens; Detection of mutations: CLB method, attached *X* method.

**Unit 4: Sex Determination** **4**

Chromosomal mechanisms of sex determination in Drosophila and Man

**Unit 5: Extra-chromosomal Inheritance** **6**

Criteria for extra-chromosomal inheritance, Antibiotic resistance in *Chlamydomonas*, Mitochondrial mutations in *Saccharomyces,* Infective heredity in *Paramecium* and Maternal effects

**Unit 6: Polygenic Inheritance** **3**

Polygenic inheritance with suitable examples; simple numericals based on it.

**Unit 7: Recombination in Bacteria and Viruses** **9**

Conjugation, Transformation, Transduction, Complementation test in Bacteriophage

**Unit 8: Transposable Genetic Elements** **8**

Transposons in bacteria, Ac-Ds elements in maize and P elements in *Drosophila*, Transposons in humans

## PRINCIPLES OF GENETICS

**PRACTICALS** **(CREDITS 2)**

1. To study the Mendelian laws and gene interactions.
2. Chi-square analyses using seeds/beads/*Drosophila*.
3. Linkage maps based on data from conjugation, transformation and transduction.
4. Linkage maps based on data from *Drosophila* crosses.
5. Study of human karyotype (normal and abnormal).
6. Pedigree analysis of some human inherited traits.

**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
- Fletcher H. and Hickey I. (2015). *Genetics.* IV Edition. GS, Taylor and Francis Group, New York and London.

## CORE COURSE XIII

## DEVELOPMENTAL BIOLOGY

**THEORY** **(CREDITS 2)**

**Unit 1: Introduction** **4**

Historical perspective and basic concepts: Phases of development, Cell-Cell interaction, Pattern formation, Differentiation and growth, Differential gene expression, Cytoplasmic determinants and asymmetric cell division

**Unit 2: Early Embryonic Development** **28**

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**

Metamorphosis: Changes, hormonal regulations in amphibians and insects; Regeneration: Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each); Ageing: Concepts and Theories

**Unit 5: Implications of Developmental Biology** **8**

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

# DEVELOPMENTAL BIOLOGY

## PRACTICAL (CREDITS 2)

1. Study of whole mounts and sections of developmental stages of frog through permanent slides: Cleavage stages, blastula, gastrula, neurula, tail-bud stage, tadpole (external and internal gill stages)
2. 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)
3. Study of the developmental stages and life cycle of *Drosophila* from stock culture
4. Study of different sections of placenta (photomicropgraph/ slides)
5. Project report on *Drosophila* culture/chick embryo development

## SUGGESTED READINGS


- Gilbert, S. F. (2010). Developmental Biology, IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA
- Balinsky B. I. and Fabian B. C. (1981). An Introduction to Embryology, V Edition, International Thompson Computer Press
- Carlson, R. F. Patten's Foundations of Embryology
- Kalthoff (2008). Analysis of Biological Development, II Edition, McGraw-Hill Publishers
- Lewis Wolpert (2002). Principles of Development. II Edition, Oxford University Press

## CORE COURSE XIV

## EVOLUTIONARY BIOLOGY

**THEORY** **(CREDITS 4)**

**Unit 1:** **7**
Life's Beginnings: Chemogeny, RNA world, Biogeny, Origin of photosynthesis, Evolution of eukaryotes

**Unit 2:** **4**
Historical review of evolutionary concept: Lamarckism, Darwinism, Neo-Darwinism

**Unit 3:** **10**
Evidences of Evolution: Fossil record (types of fossils, transitional forms, geological time scale, evolution of horse, Molecular (universality of genetic code and protein synthesising machinery, three domains of life, neutral theory of molecular evolution, molecular clock ,example of globin gene family, rRNA/cyt c

**Unit 4:** **8**
Sources of variations: Heritable variations and their role in evolution

**Unit 5:** **13**
Population genetics: Hardy-Weinberg Law (statement and derivation of equation, application of law to human Population);Evolutionary forces upsetting H-W equilibrium. Natural selection (concept of fitness, selection coefficient, derivation of one unit of selection for a dominant allele, genetic load, mechanism of working, types of selection, density-dependent selection, heterozygous superiority, kin selection, adaptive resemblances, sexual selection. Genetic Drift (mechanism, founder's effect, bottleneck phenomenon; Role of Migration and Mutation in changing allele frequencies

**Unit 6:** **7**
Product of evolution: Micro evolutionary changes (inter-population variations, clines, races, Species concept, Isolating mechanisms, modes of speciation—allopatric, sympatric, Adaptive radiation / macroevolution (exemplified by Galapagos finches

**Unit 7:** **2**
Extinctions, Back ground and mass extinctions (causes and effects), detailed example of K-T extinction

**Unit 8:** **6**
Origin and evolution of man, Unique hominin characteristics contrasted with primate characteristics, primate phylogeny from *Dryopithecus* leading to *Homo sapiens*, molecular analysis of human origin

**Unit 9:** 2
Phylogenetic trees, Multiple sequence alignment, construction of phylogenetic trees, interpretation of trees

## EVOLUTIONARY BIOLOGY

**PRACTICAL** **(CREDITS 2)**

1. Study of fossils from models/ pictures
2. Study of homology and analogy from suitable specimens
3. Study and verification of Hardy-Weinberg Law by chi square analysis
4. Demonstration of role of natural selection and genetic drift in changing allele frequencies using simulation studies
5. Graphical representation and interpretation of data of height/ weight of a sample of 100 humans in relation to their age and sex.
6. Construction of phylogenetic trees with the help of bioinformatics tools (Clustal X, Phylip, NJ) and its interpretation.

**SUGGESTED READINGS**


- Ridley,M (2004) Evolution III Edition Blackwell publishing
- Hall, B.K. and Hallgrimson, B (2008). Evolution IV Edition. Jones and Barlett Publishers.
- Campbell, N.A. and Reece J.B (2011). Biology. IX Edition. Pearson, Benjamin, Cummings.
- Douglas, J. Futuyma (1997).Evolutionary Biology. Sinauer Associates.
- Snustad. S Principles of Genetics.
- Pevsner, J (2009). Bioinformatics and Functional Genomics. II Edition Wiley-Blackwell
- Minkoff, E. (1983). Evolutionary Biology. Addison-Wesley

# DISCIPLINE CENTRIC ELECTIVE COURSES

**DSE 1**

**ANIMAL BEHAVIOUR AND CHRONOBIOLOGY**

**THEORY** **(Credits 4)**

## Unit 1: Introduction to Animal Behaviour

Origin and history of Ethology; Brief profiles of Karl Von Frish, Ivan Pavlov, Konrad Lorenz, Niko Tinbergen, Proximate and ultimate causes of behaviour, Methods and recording of a behaviour

## Unit 2: Patterns of Behaviour

Stereotyped Behaviours (Orientation, Reflexes); Individual Behavioural patterns; Instinct vs. Learnt Behaviour; Associative learning, classical and operant conditioning, Habituation, Imprinting.

### Unit 3: Social and Sexual Behaviour

Social Behaviour: Concept of Society; Communication and the senses; Altruism; Insects' society with Honey bee as example; Foraging in honey bee and advantages of the waggle dance.

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

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

## Unit 5: Biological Rhythm

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

## Unit 8: Biological Clocks

Relevance of biological clocks; Chronopharmacology, Chronomedicine, Chronotherapy.

## ANIMAL BEHAVIOUR AND CHRONOBIOLOGY

**PRACTICAL** **(Credits 2)**

1. To study nests and nesting habits of the birds and social insects.
2. To study the behavioural responses of wood lice to dry and humid conditions.
3. To study geotaxis behaviour in earthworm.
4. To study the phototaxis behaviour in insect larvae.
5. Visit to Forest/ Wild life Sanctuary/Biodiversity Park/Zoological Park 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).

**SUGGESTED READINGS**


- David McFarland, Animal Behaviour, Pitman Publishing Limited, London, UK.
- Manning, A. and Dawkins, M. S, An Introduction to Animal Behaviour, Cambridge,University Press, UK.
- John Alcock, Animal Behaviour, Sinauer Associate Inc., USA.
- Paul W. Sherman and John Alcock, Exploring Animal Behaviour, Sinauer Associate Inc., Massachusetts, USA.
- Chronobiology Biological Timekeeping: Jay. C. Dunlap, Jennifer. J. Loros, Patricia J. DeCoursey (ed). 2004, Sinauer Associates, Inc. Publishers, Sunderland, MA, USA
- Insect Clocks D.S. Saunders, C.G.H. Steel, X., Afopoulou (ed.)R.D. Lewis. (3rd Ed) 2002 Barens and Noble Inc. New York, USA
- The Clock that times us. 1982. Moore Ed et al.
- Biological Rhythms: Vinod Kumar (2002) Narosa Publishing House, Delhi/ Springer-Verlag, Germany.

**DSE 2**

## BASICS OF NEUROSCIENCE

**THEORY** **(Credits 4)**

**Unit 1: Introduction to Neuroscience** **6**

Origins of Neuroscience; Neuroanatomy, Neurophysiology, and Systems Neurobiology

**UNIT 2: The Nervous system-An Introduction** **14**

Introduction to the structure and function of the nervous system: Cellular components: Neurons; Neuroglia; Neuron doctrine; The prototypical neuron – axons and dendrites as unique structural components of neurons. The ionic bases of resting membrane potential; The action potential- its generation and properties; The action potential conduction.

**UNIT 3: Cellular and Molecular Neurobiology** **14**

Molecular and cellular approaches used to study the CNS at the level of single molecules, Synapse: Synaptic transmission, Types of synapses; synaptic function; Principles of chemical synaptic transmission; Principles of synaptic integration; EPSPs and IPSPs. Ion channels, Neural transmission,

**Unit 4. Neurotransmitters** **10**

Different types of neurotranmitters– catecholamines, amino acidergic and peptidergic neurotransmitters; Transmitter gated channels; G-protein coupled receptors and effectors, neurotransmitter receptors; Ionotropic and metabotropic receptors.

**UNIT 5: Neurobiology and Neuropharmacology of Behaviour** **16**

The principles of signal transduction and information processing in the vertebrate central nervous system, and the relationship of functional properties of neural systems with perception and behavior; sensory systems, molecular basis of behavior including learning and memory. Molecular pathogenesis of pain and neurodegenerative diseases such as Parkinson's, Alzheimer's, psychological disorders, addiction, etc.

## BASICS OF NEUROSCIENCE

**PRACTICAL** **(CREDITS 2)**

1. Dissection and study of Drosophila nervous system using GFP reporter.
2. Observation and quantitation of Drosophila photoreceptor neurons in healthy and diseased condition.
3. Nerve Cell preparation from the spinal cord.
4. Study of neurons and/ or myelin by Nissl, Giemsa or Luxol Fast Blue staining.
5. Study of olfaction in Drosophila.
6. Study of novelty, anxiety and spatial learning in mice.

**SUGGESTED READINGS**


- Neuroscience: Exploring the brain by Mark F. Baer; Barry W. Connors. 2015
- From Molecules to Networks: An Introduction to Cellular and Molecular Neuroscience by John H. Byrne. Ruth Heidelberg and M. Neal Waxham
- Neuroscience-Eds. Dale Purves et. al. (3rd Edn)-Sinauer Associates, Inc.-2004
- Principles of Neural Science-4th Edn-Eds. Kandel, Schwartz and Jessell- McGraw-Hill Companies-2000
- Nerve Cells and Animal Behaviour-2nd Edn-Peter J Simmons and David Young-CUP-2003
- Essential Psychopharamacology-Neuroscientific Basis and Practical Applications-2nd Edn.-Stephan M. Stahl-CUP-2000
- Phantoms in the Brain - Vilayanur S. Ramachandran and Sandra Blakeslee-1998
- The Human Brain Book - Rita Carter-2009

**DSE 3**

# 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, knock out 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. 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. Northern Blotting
    c. Western Blotting
    d. DNA Sequencing (Sanger's Method)
    e. PCR
    f. 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.

**DSE 4**

# BIOLOGY OF INSECTA

**THEORY** **(Credits 4)**

**Unit I: Introduction** **4**

General Features of Insects

Distribution and Success of Insects on the Earth

**Unit II: Insect Taxonomy** **4**

Basis of insect classification; Classification of insects up to orders

**Unit III: General Morphology of Insects** **8**

External Features; Head – Eyes, Types of antennae, Mouth parts w.r.t. feeding habits

Thorax: Wings and wing articulation, Types of Legs adapted to diverse habitat

Abdominal appendages and genitalia

**Unit IV: Physiology of Insects** **28**

Structure and physiology of Insect body systems - Integumentary, digestive, excretory, circulatory, respiratory, endocrine, reproductive, and nervous system

Sensory receptors

Growth and metamorphosis

**Unit IV: Insect Society** **6**

Group of social insects and their social life

Social organization and social behaviour (w.r.t. any one example)

**Unit V: Insect Plant Interaction** **4**

Theory of co-evolution, role of allelochemicals in host plant mediation

Host-plant selection by phytophagous insects, Insects as plant pests

**Unit VI: Insects as Vectors** **6**

Insects as mechanical and Biological vectors, Brief discussion on houseflies and mosquitoes as important insect vectors

**BIOLOGY OF INSECTA**

**PRACTICAL** **(CREDITS 2)**

1. Study of one specimen from each insect order
2. Study of different kinds of antennae, legs and mouth parts of insects
3. Study of head and sclerites of any one insect
4. Study of insect wings and their venation.
5. Study of insect spiracles
6. Methodology of collection, preservation and identification of insects.
7. Morphological studies of various castes of *Apis, Camponotus* and *Odontotermes*
8. Study of any three insect pests and their damages
9. Study of any three beneficial insects and their products

**Field study of insects and submission of a project report on the insect diversity**

**SUGGESTED READINGS**


- A general text book of entomology, Imms , A. D., Chapman & Hall, UK
- The Insects: Structure and function, Chapman, R. F., Cambridge University Press, UK
- 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
- The Insects, An outline of Entomology, Gullan, P. J. , and Cranston, P. S., Wiley Blackwell, UK
- Insect Physiology and Biochemistry, Nation, J. L., CRC Press, USA

**DSE 5**

# COMPUTATIONAL BIOLOGY

**THEORY** **(Credits 4)**

**Unit 1: Introduction to Bioinformatics** **5**

Importance, Goal, Scope; Genomics, Transcriptomics, Systems Biology, Functional Genomics, Metabolomics, Molecular Phylogeny; Applications and Limitations of Bioinformatics

**Unit 2: Biological Databases** **10**

Introduction to biological databases; Primary, secondary and composite databases; Nucleic acid databases (GenBank, DDBJ, EMBL and NDB); Protein databases (PIR, SWISS-PROT, TrEMBL, PDB); Metabolic pathway database (KEGG, EcoCyc, and MetaCyc); Small molecule databases (PubChem, Drug Bank, ZINC, CSD)

**Unit 3: Data Generation and Data Retrieval** **14**

Generation of data (Gene sequencing, Protein sequencing, Mass spectrometry, Microarray), Sequence submission tools (BankIt, Sequin, Webin); Sequence file format (flat file, FASTA, GCG, EMBL, Clustal, Phylip, Swiss-Prot); Sequence annotation; Data retrieval systems (SRS, Entrez)

**Unit 3: Basic Concepts of Sequence Alignment** **14**

Scoring Matrices (PAM, BLOSUM), Methods of Alignment (Dot matrix, Dynamic Programming, BLAST and FASTA); Local and global alignment, pair wise and multiple sequence alignments; Similarity, identity and homology of sequences.

**Unit 4: Applications of Bioinformatics** **7**

Structural Bioinformatics (3-D protein, PDB), Functional genomics (genome-wide and high throughput approaches to gene and protein function), Drug discovery method (Basic concepts)

**Unit 5:Biostatistics** **10**

Introduction, calculation of standard deviation, standard error, Co-efficient of Variance, Chi-square test, Z test, t-Test

# COMPUTATIONAL BIOLOGY

## PRACTICAL (Credits 2)

1. Accessing biological databases
2. Retrieval of nucleotide and protein sequences from the databases.
3. To perform pair-wise alignment of sequences (BLAST) and interpret the output
4. Translate a nucleotide sequence and select the correct reading frame of the polypeptide from the output sequences
5. Predict the structure of protein from its amino acid sequence.
6. To perform a "two-sample t- test" for a given set of data
7. To learn graphical representations of statistical data with the help of computers (e.g. MS Excel).

## SUGGESTED READINGS


- Ghosh Z and Mallick B. (2008). Bioinformatics: *Principles and Applications*, Oxford University Press.
- Pevsner J. (2009). *Bioinformatics and Functional Genomic*s, II Edition, Wiley Blackwell.
- Zvelebil, Marketa and Baum O. Jeremy (2008). *Understanding Bioinformatics*, Garland Science, Taylor and Francis Group, USA.
- Zar, Jerrold H. (1999). *Biostatistical Analysis*, IV Edition, Pearson Education Inc and Dorling Kindersley Publishing Inc. USA
- Antonisamy, B., Christopher S. and Samuel, P. P. (2010). *Biostatistics: Principles and Practice*. Tata McGraw Hill Education Private Limited, India.
- Pagana, M. and Gavreau, K. (2000). *Principles of Biostatistics*, Duxberry Press, USA

**DSE 6**

# PARASITOLOGY

**THEORY** **(CREDITS 4)**

**Unit I: Introduction to Parasitology** **3**

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

**Unit II: Parasitic Protists** **15**

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

**Unit III: Parasitic Platyhelminthes** **15**

Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Fasciolopsis buski, Schistosoma haematobium,Taenia solium* and *Hymenolepis nana*

**Unit IV: 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 IV: Parasitic Arthropoda** **10**

Biology, importance and control of ticks, mites, *Pediculus humanus* (head and body louse), *Xenopsylla cheopis* and *Cimex lectularius*

**Unit V: Parasitic Vertebrates** **2**

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

## PARASITOLOGY

**PRACTICAL** **(Credits2)**

- 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 *Fasciolopsis buski, 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]

**Submission of a brief report on parasitic vertebrates**

**SUGGESTED READINGS**


- Arora, D. R and Arora, B. (2001) *Medical Parasitology*. II Edition. CBS Publications and Distributors
- E.R. Noble and G.A. Noble (1982) Parasitology: The biology of animal parasites. V Edition, Lea & Febiger
- Ahmed, N., Dawson, M., Smith, C. and Wood, Ed. (2007) *Biology of Disease.* Taylor and Francis Group
- 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
- Meyer, Olsen & Schmidt's Essentials of Parasitology, Murray, D. Dailey, W.C. Brown Publishers
- Thomas C. Cheng (1986). *General Parasitology*, II Edition, Academic Press Inc
- K. D. Chatterjee (2009). Parasitology: Protozoology and Helminthology. XIII Edition, CBS ***Publishers*** & Distributors (P) Ltd.

# ENDOCRINOLOGY

**THEORY** **(Credits 4)**

**Unit 1**: **Introduction to Endocrinology** **12**

History of endocrinology, Classification, Characteristic and Transport of Hormones, Neurosecretions and Neurohormones

**Unit 2: Epiphysis, Hypothalamo-hypophysial Axis** **15**

Structure of pineal gland, Secretions and their functions inbiological rhythms and reproduction.

Structure of hypothalamus, Hypothalamic nuclei and their functions, 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** **18**

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** **15**

Hormone action at Cellular level: Hormone receptors, transduction and regulation
Hormone action at Molecular level: Molecular mediators, Genetic control of hormone action

# ENDOCRINOLOGY

## PRACTICAL (Credits 2)

1.Dissect and display of Endocrine glands in laboratory bred rat*
2.Study of the permanent slides of all the endocrine glands
3.Compensatory ovarian/ adrenal hypertrophy*in vivo* bioassay in laboratory bred rat*
4.Demonstration of Castration/ ovariectomy in laboratory bred rat*
5.Estimation of plasma level of any hormone using ELISA
6.Designing of primers of any hormone

## SUGGESTED READINGS


- General Endocrinology C. Donnell Turner Pub- SaundersToppan
- Endocrinology: An Integrated Approach; Stephen Nussey and Saffron Whitehead.
- Oxford: BIOS Scientific Publishers; 2001.
- Hadley, M.E. and Levine J.E. 2007. Endocrinology, 6th Edition. Pearson Prentice-Hall, Pearson Education Inc., New Jersey.
- A textbook of comparative endocrinology, Aubrey Gorbman, Howard Alan Bern, 1962, Medical.
- Vertebrate Endocrinology by David O. Norris,

**DSE 8**

# FISH AND FISHERIES

**THEORY** **(Credits 4)**

**UNIT 1: Introduction and Classification:** **6**

General description of fish; Account of systematic classification of fishes (upto classes); Classification based on feeding habit, habitat and manner of reproduction.

**UNIT 2: Morphology and Physiology:** **18**

Types of fins and their modifications; Locomotion in fishes; 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 fishes); Electric organs; Bioluminiscience; Mechanoreceptors; Schooling; Parental care; Migration

**UNIT 3: Fisheries** **12**

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 fisheries resources; Application of remote sensing and GIS in fisheries; Fisheries law and regulations

**Unit 4: Aquaculture** **20**

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** **4**

Transgenic fish, Zebrafish as a model organism in research

## FISH AND FISHERIES

**PRACTICAL** **(Credits 2)**

1. Study of *Petromyzon, Myxine, Pristis, Chimaera, Exocoetus, Hippocampus, Gambusia, Labeo, Heteropneustes, Anabas*
2. Study of different types of scales (through permanent slides/ photographs).
3. Study of crafts and gears used in Fisheries
4. Water quality criteria for Aquaculture: Assessment of pH, conductivity, Total solids, Total dissolved solids
5. Study of air breathing organs in *Channa, Heteropneustes, Anabas* and *Clarias*
6. Demonstration of induced breeding in Fishes (video)
7. Demonstration of parental care in fishes (video)
8. Project Report on a visit to any fish farm/ pisciculture unit/Zebrafish rearing Lab.

**SUGGESTED READINGS**


- Q Bone and R Moore, Biology of Fishes, Talyor and Francis Group, CRC Press, U.K.
- D. H. Evans and J. D. Claiborne, The Physiology of Fishes, Taylor and Francis Group, CRC Press, UK 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

**DSE 9**

# IMMUNOLOGY

**THEORY** **(Credits 4)**

**Unit 1: Overview of Immune System** 10

Historical perspective of Immunology, Early theories of Immunology, Cells and organs of the Immune system

**Unit 2: Innate and Adaptive Immunity** 10

Anatomical barriers, Inflammation, Cell and molecules involved in innate immunity, Adaptive immunity (Cell mediated and humoral), Passive: Artificial and natural Immunity, Active: Artificial and natural Immunity, Immune dysfunctions (brief account of autoimmunity with reference to Rheumatoid Arthritis and tolerance, AIDS).

**Unit 3: Antigens** 8

Antigenicity and immunogenicity, Immunogens, Adjuvants and haptens, Factors influencing immunogenicity, B and T-Cell epitopes

**Unit 4: Immunoglobulins** 10

Structure and functions of different classes of immunoglobulins, Antigen-antibody interactions, Immunoassays (ELISA and RIA), Polyclonal sera, Hybridoma technology: Monoclonal antibodies in therapeutics and diagnosis

**Unit 5: Major Histocompatibility Complex** 6

Structure and functions of MHC molecules. Endogenous and exogenous pathways of antigen processing and presentation

**Unit 6: Cytokines** 4

Properties and functions of cytokines, Therapeutics Cytokines

**Unit 7: Complement System** 4

Components and pathways of complement activation.

**Unit 8: Hypersensitivity** 3

Gell and Coombs' classification and brief description of various types of hypersensitivities

**Unit 9: Vaccines** 5

Various types of vaccines.

**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*. Cell counting and viability test from splenocytes of farm bred animals/cell lines.

7. Demonstration of

   a. ELISA

   b. Immunoelectrophoresis

* The experiments can be performed depending upon usage of animals in UG courses.

**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.

**DSE 10**

# REPRODUCTIVE BIOLOGY

**THEORY** **(CREDITS 4)**

## Unit 1: Reproductive Endocrinology

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

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

## Unit 3: Functional anatomy of female reproduction

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; Hormonal control of implantation; Hormonal regulation of gestation, pregnancy diagnosis, foeto – maternal relationship; Mechanism of parturition and its hormonal regulation; Lactation and its regulation

## Unit 4: Reproductive Health

Infertility in male and female: causes, diagnosis and management; 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

## 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.
2. Examination of vaginal smear rats from live animals.
3. Surgical techniques: principles of surgery in endocrinology. Ovarectomy, hysterectorny, castration and vasectomy in rats.
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. Human vaginal exfoliate cytology.
6. Sperm count and sperm motility in rat
7. 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.

**DSE 11**

**WILD LIFE CONSERVATION AND MANAGEMENT**

**THEORY** **(CREDITS 4)**

## Unit 1: Introduction to Wild Life

Values of wild life - positive and negative; Conservation ethics; Importance of conservation; Causes of depletion; World conservation strategies.

## Unit 2: Evaluation and management of wild life

Habitat analysis, Physical parameters: Topography, Geology, Soil and water;
Biological Parameters: food, cover, forage, browse and cover estimation;
Standard evaluation procedures: remote sensing and GIS.

## Unit 3:Management of habitats

Setting back succession; Grazing logging; Mechanical treatment; Advancing the successional process; Cover construction; Preservation of general genetic diversity.

## Unit 4:Population estimation

Population density, Natality, Birth rate, Mortality, fertility schedules and sex ratio computation; Faecal analysis of ungulates and carnivores: Faecal samples, slide preparation, Hair identification, Pug marks and census method.

## Unit 5:Management planning of wild life in protected areas

Estimation of carrying capacity; Eco tourism / wild life tourism in forests; Concept of climax persistence; Ecology of perturbence.

## Unit 7:Management of excess population

Bio- telemetry; Care of injured and diseased animal; Quarantine; Common diseases of wild animal

## Unit 8: Protected areas

National parks & sanctuaries, Community reserve; Important features of protected areas in India; Tiger conservation - Tiger reserves in India; Management challenges in Tiger reserve.

## PRACTICALS

1. Identification of flora, mammalian fauna, avian fauna, herpeto-fauna
2. Demonstration of basic equipment needed in wildlife studies use, care and maintenance (Compass, Binoculars, Spotting scope, 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. PCQ, Ten tree method, Circular, Square & rectangular plots, Parker's 2 Step and other methods for ground cover assessment, Tree canopy cover assessment, Shrub cover assessment.
6. Trail / transect monitoring for abundance and diversity estimation of mammals and bird (direct and indirect evidences)

## SUGGESTED READINGS


- Caughley, G., and Sinclair, A.R.E. (1994). *Wildlife Ecology and Management*. Blackwell Science.

- Woodroffe R., Thirgood, S. and Rabinowitz, A. (2005). *People and Wildlife, Conflict or Co-existence*? Cambridge University.

- Bookhout, T.A. (1996). *Research and Management Techniques for Wildlife and Habitats*, 5 th edition. The Wildlife Society, Allen Press.

- Sutherland, W.J. (2000). *The Conservation Handbook: Research, Management and Policy*. Blackwell Sciences

- Hunter M.L., Gibbs, J.B. and Sterling, E.J. (2008). *Problem-Solving in Conservation Biology and Wildlife Management: Exercises for Class, Field, and Laboratory*. Blackwell Publishing.

# GENERIC ELECTIVE COURSES

## GE 1
## ANIMAL CELL BIOTECHNOLOGY

**THEORY** **(CREDITS 4)**

**UNIT 1: Introduction** **5**

Concept and Scope of Biotechnology

**UNIT2:Techniques in Gene manipulation** **15**

Outline process of genetic engineering and recombinant DNA technology, Isolation of genes, Concept of restriction and modification: Restriction endonucleases, DNA modifying enzymes

Cloning Vectors: Plasmids, Phage vectors, Cosmids, Phagemids, BAC, YAC, HAC. Shuttle and Expression Vectors**.**

Construction of Genomic libraries and cDNA libraries

Transformation techniques: microbial, plants and animals: Cloning in mammalian cells, Integration of DNA into mammalian genome- Electroporation and Calcium Phosphate Precipitation method.

**UNIT 3: Animal cell Culture** **12**

Basic techniques in animal cell culture and organ culture, Primary Culture and Cell lines, Culture media- Natural and Synthetic, Stem cells, Cryopreservation of cultures.

Agarose and Polyacrylamide Gel Electrophoresis, Southern, Northern and Western blotting, DNA sequencing: Sanger method, Polymerase chain reaction, DNA Fingerprinting and DNA microarrays.

**UNIT 4:Fermentation** **8**

Different types of Fermentation :Submerged & Solid state; batch, Fed batch &Continuous; Stirred tank, Air Lift, Fixed Bed and Fluidized.

Downstream Processing :filtration, centrifugation, extraction, chromatography, spray drying and lyophilization.

**UNIT 5: Transgenic Animal Technology**

Production of transgenic animals: nuclear transplantation, Retroviral method, DNA microinjection method, Dolly and Polly.

**UNIT6: Application in Health** **8**

Development of recombinant Vaccines, Hybridoma technology, Gene Therapy.

Production of recombinant Proteins: Insulin and growth hormones.

**UNIT 7:** Bio safety Physical and Biological containment. 4

**PRACTICAL** **(CREDITS 2)**

1. Packing and sterilization of glass and plastic wares for cell culture.
2. Preparation of culture media.
3. Preparation of genomic DNA from *E. coli*/animals/ human.
4. Plasmid DNA isolation (pUC 18/19) and DNA quantitation using agarose gel electrophoresis (by using lambda DNA as standard).
5. Restriction digestion of lambda (λ) DNA using EcoR1 and Hind III.
6. Preparation of competent cells and Transformation of *E. coli* with plasmid DNA using $CaCl_2$, Selection of transformants on X-gal and IPTG (Optional).
7. Techniques: Western Blot, Southern Hybridization, DNA Fingerprinting, PCR, DNA Microarrays

**SUGGESTED READINGS**


- Animal Cells Culture and Media, D.C. Darling and S.J. Morgan, 1994. BIOS Scientific Publishers Limited.
- Methods in Cell Biology, Volume 57, Jennie P. Mathur and David Barnes, 1998. Animal Cell Culture Methods Academic Press.
- P.K. Gupta: Biotechnology and Genomics, Rastogi publishers (2003).
- B.D. Singh: Biotechnology, Kalyani publishers, 1998 (Reprint 2001).
- T.A. Brown: Gene cloning and DNA analysis: An Introduction, Blackwell Science (2001).
- Bernard R. Click & Jack J. Pasternak: Molecular Biotechnology, ASM Press, Washington (1998).
- Methods in Gene Biotechnology, W. Wu, M.J. Welsh, P.B. Kaufman & H.H. Zhang, 1997, CRC Press, New York
- 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 & Co., N.Y., USA

## GE 2

## ANIMAL DIVERSITY

**THEORY** **(CREDITS 4)**

**Unit 1. Protista** **4**
General characters of Protozoa; Life cycle of Plasmodium

**Unit 2. Porifera** **3**
General characters and canal system in Porifera

**Unit 3. Radiata** **3**
General characters of Cnidarians and polymorphism

**Unit 4. Aceolomates** **3**
General characters of Helminthes; Life cycle of Taenia solium

**Unit 5. Pseudocoelomates** **3**
General characters of Nemethehelminthes; Parasitic adaptations

**Unit 6. Coelomate Protostomes** **3**
General characters of Annelida ; Metamerism.

**Unit 7. Arthropoda** **4**
General characters. Social life in insects.

**Unit 8. Mollusca** **3**
General characters of mollusca; Pearl Formation

**Unit 9. Coelomate Deuterostomes** **3**
General characters of Echinodermata, Water Vascular system in Starfish.

**Unit 10. Protochordata** **2**
Salient features

**Unit 11. Pisces** **4**
Osmoregulation, Migration of Fishes

**Unit 12. Amphibia** **4**
General characters,Adaptations for terrestrial life,parental care in Amphibia.

**Unit 13.** **5**
Amniotes; Origin of reptiles.Terrestrial adaptations in reptiles.

**Unit 14. Aves:** **5**
The origin of birds; Flight adaptations

**Unit 15. Mammalia** **6**
Early evolution of mammals; Primates;Dentition in mammals.

**PRACTICAL** **(CREDITS 2)**

1. Study of following specimens:
   **Non Chordates:** *Euglena, Noctiluca, Paramecium, Sycon, , Physalia, Tubipora, Metridium, Taenia, Ascaris, Nereis, Aphrodite, Leech, Peripatus, Limulus, ,* Hermitcrab*, Daphnia,* Millipede, Centipede,Beetle, *Chiton, Dentalium, Octopus, Asterias, and Antedon.*
   **Chordates***: Balanoglossus, Amphioxus, Petromyzon, Pristis, Hippocampus, Labeo, Icthyophis/Uraeotyphlus, Salamander, Rhacophorus Draco, Uromastix, Naja, Viper, model of Archaeopteryx,* any three common birds-*(Crow, duck, Owl),* Squirrel and Bat.
2. Study of following Permanent Slides:
   Cross section of Sycon, Sea anemone and *Ascaris(*male and female*).* T. S. of Earthworm passing through pharynx, gizzard, and typhlosolar intestine. Bipinnaria and Pluteus larva.

3. Temporary mounts of
   - Septal & pharyngeal nephridia of earthworm.
   - Unstained mounts of Placoid ,cycloid and ctenoid scales.

4. Dissections of
   - Digestive and nervous system of Cockroach.
   - Urinogenital system of Rat

**SUGGESTED BOOKS**


- Barnes, R.D. (1992). Invertebrate Zoology. Saunders College Pub. USA.
- Ruppert, Fox and Barnes (2006) Invertebrate Zoology. A functional Evolutionary Approach 7th Edition, Thomson Books/Cole
- Campbell & Reece (2005). Biology, Pearson Education, (Singapore) Pvt. Ltd.
- Kardong, K. V. (2002). Vertebrates Comparative Anatomy. Function and Evolution. Tata McGraw Hill Publishing Company. New Delhi.
- Raven, P. H. and Johnson, G. B. (2004). Biology, 6th edition, Tata McGraw Hill Publications. New Delhi.

## GE 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 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.

**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

## GE 4

## ENVIRONMENT AND PUBLIC HEALTH

**THEORY** **(Credits 4 )**

### UNIT I: Introduction

Sources of Environmental hazards, hazard identification and accounting, fate of toxic and persistent substances in the environment, dose Response Evaluation, exposure Assessment.

### UNIT II Climate Change

Greenhouse gases and global warming, Acid rain, Ozone layer destruction, Effect of climate change on public health

### Unit III Pollution

Air, water, noise pollution sources and effects, Pollution control

### Unit IV 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, Case histories on Bhopal gas tragedy, Chernobyl disaster, Seveso disaster and Three Mile Island accident and their aftermath.

### Unit 5 Diseases

Causes, symptoms and control of tuberculosis, Asthma, Cholera, Minamata disease, typhoid

## ENVIRONMENT AND PUBLIC HEALTH

**PRACTICAL** **(Credits 2)**

1. To determine pH, Cl, $SO_4$, $NO_3$ in soil and water samples from different locations.

**SUGGESTED BOOKS**


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

**GE 5**

## EXPLORING THE BRAIN: STRUCTURE AND FUNCTION

**THEORY** **(Credits 4 )**

**Unit 1: Introduction:** Early and Nineteenth century views of the Brain; Neuroscience today; Evolution of brain in vertebrates

**Unit 2: Neurons and Glia:**Neurons – Soma, Axon, Dendrite; Classification of Neurons; Glia – Astrocytes, Myelinating Glia, Non-nueornal cells

**Unit 3: Evolution and Adaptation of Brain:**Brain evolution and behavioral adaptation; Theories of brain evolution – involving addition of structure or areas, involving new formation and reorganization of circuits.

**Unit 4: Organization of the Brain:** Anatomical references, Cerebrum, cerebellum, brain stem, spinal cord; Cranial nerves, Meninges, ventricular system; CT and MRI imaging of the brain

**Unit 5: Understanding Brain Structure through Development:** Formation of neural tube, Primary brain vesicles; Differentiation of forebrain, midbrain and hindbrain. Cerebral cortex – neocortical evolution and structure-function relationship

**Unit 6: Chemical Control of Brain and Behaviour:** Structure and connection of the secretory hypothalamus; Diffuse modulatory systems of the brain – noradrenergic, serotonergic, dominergic and cholinergic system; Drugs and diffuse modulatory systems.

**Unit 7: Rhythms of the Brain:** Electroencephalogram; Sleep – why do we sleep, Non-REM and REM sleep, neural mechanisms of sleep; Circadian rhythms.

**Unit 8: Mental illness and the Brain:** Psychosocial and biological approaches to mental illness; Anxiety disorders; Mood disorders; Schizophrenia.

## EXPLORING THE BRAIN: STRUCTURE AND FUNCTION

**PRACTICAL** **(CREDITS 2)**

1. Dissection and study of Drosophila nervous system using GFP reporter.
2. Observation and quantitation of Drosophila photoreceptor neurons in healthy and diseased condition.

**SUGGESTED READINGS**

1. Neuroscience: Exploring the Brain by Mark F. Bear, Barry W. Connors and Michael A. Paradiso.
2. Comparative vertebrate Neuroanatomy by Ann B. Butler and William Hoods.

Project work/ Home assignment

## GE 6
## FOOD, NUTRITION AND HEALTH

**THEORY** **(Credits 4 )**

**Unit 1: Basic concept of food and nutrition** **10**

Food Components and food-nutrients

Concept of a balanced diet, nutrient needs and dietary pattern for various groups- adults, pregnant and nursing mothers, infants, school children, adolescents and elderly

**Unit 2: Nutritional Biochemistry**: **20**

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** **15**

Introduction to health- Definition and concept of health

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

**Unit 4: Food hygiene**: **15**

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; **Parasitic infection**: taeniasis and ascariasis their transmission, causative agent, sources of infection, symptoms and prevention

Brief account of food spoilage: Causes of food spoilage and their preventive measures

**PRACTICAL** **(Credits 2)**

1. To detect adulteration in a) Ghee b) Sugars c) Tea leaves and d) Turmeric
3. Estimation of Lactose in milk
4. Ascorbic acid estimation in food by titrimetry

5. Estimation of Calcium in foods by titrimetry
6. Study of the stored grain pests from slides/ photograph (*Sitophilus oryzae*, *Trogoderma granarium*, *Callosobruchus chinensis* and *Tribolium castaneum*): their identification, habitat and food sources, damage caused and control. Preparation of temporary mounts of the above stored grain pests.
7. Project- Undertake computer aided diet analysis and nutrition counseling for different age groups.

   OR

   Identify nutrient rich sources of foods **(fruits and vegetables),** their seasonal availability and price

   OR

   Study of nutrition labeling on selected foods

**SUGGESTED BOOKS**


- Mudambi, SR and Rajagopal, MV. Fundamentals of Foods, Nutrition and Diet Therapy; Fifth Ed; 2007; New Age International Publishers
- Srilakshmi B. Nutrition Science; 2002; New Age International (P) Ltd.
- Srilakshmi B. Food Science; Fourth Ed; 2007; New Age International (P) Ltd.
- Swaminathan M. Handbook of Foods and Nutrition; Fifth Ed; 1986; BAPPCO.
- Bamji MS, Rao NP, and Reddy V. Text Book of Human Nutrition; 2009; Oxford & IBH Publishing Co. Pvt Ltd.
- Wardlaw GM, Hampl JS. Perspectives in Nutrition; Seventh Ed; 2007; McGraw Hill.
- Lakra P, Singh MD. Textbook of Nutrition and Health; First Ed; 2008; Academic Excellence.
- Manay MS, Shadaksharaswamy. Food-Facts and Principles; 1998; New Age International (P) Ltd.
- Gibney et al. Public Health Nutrition; 2004; Blackwell Publishing

## GE 7

## HUMAN PHYSIOLOGY

**THEORY** **(CREDITS 4)**

**Unit 1: Digestion and Absorption of Food** **12**

Structure and function of digestive glands; Digestion and absorption of carbohydrates, fats and proteins; Nervous and hormonal control of digestion (*in brief*)

**Unit 2: Functioning of Excitable Tissue (Nerve and Muscle)** **10**

Structure of neuron, Propagation of nerve impulse (myelinated and non-myelinated nerve fibre); Structure of skeletal muscle, Mechanism of muscle contraction (Sliding filament theory), Neuromuscular junction

**Unit 3: Respiratory Physiology** **6**

Ventilation, External and internal Respiration, Transport of oxygen and carbon dioxide in blood, Factors affecting transport of gases.

**Unit 4: Renal Physiology** **8**

Functional anatomy of kidney, Mechanism and regulation of urine formation,

**Unit 5: Cardiovascular Physiology** **10**

Structure of heart, Coordination of heartbeat, Cardiac cycle, ECG

**Unit 6: Endocrine and Reproductive Physiology** **14**

Structure and function of endocrine glands (pituitary, thyroid, parathyroid, pancreas, adrenal, ovaries, and testes), Brief account of spermatogenesis and oogenesis, Menstrual cycle

## HUMAN PHYSIOLOGY

**PRACTICAL** **(CREDITS 2)**

1. Preparation of temporary mounts: Neurons and Blood film.
2. Preparation of haemin and haemochromogen crystals.
3. Estimation of haemoglobin using Sahli's haemoglobinometer.
4. Examination of permanent histological sections of mammalian oesophagus, stomach, duodenum, rectum, lung, kidney, thyroid, pancreas, adrenal, testis, ovary.

**SUGGESTED READINGS**


- Tortora, G.J. and Derrickson, B.H. (2009). *Principles of Anatomy and Physiology*, XII Edition, John Wiley and 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.
- Marieb, E. (1998). *Human Anatomy and Physiology*, IV Edition, Addison-Wesley.
- Kesar, S. and Vashisht, N. (2007). *Experimental Physiology*, Heritage Publishers.
- Prakash, G. (2012). *Lab Manual on Blood Analysis and Medical Diagnostics*, S. Chand and Company Ltd.

## GE 8
## 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: Hempitera 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 vectorsthrough permanent slides/ photographs: *Aedes, Culex,Anopheles, Pediculus humanus capitis, Pediculus humanus corporis, Phithirus 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 1

### 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 2**

## AQUARIUM FISH KEEPING

**(CREDITS 2)**

**Unit1: Introduction to Aquarium Fish Keeping**

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

**Unit 2: Biology of Aquarium Fishes**

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**

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

**Unit 4: Fish Transportation**

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

**Unit 5: Maintenance of Aquarium**

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

## SEC 3
## MEDICAL DIAGNOSTICS

**THEORY** **(Credits 2)**

**Unit 1:Introduction to Medical Diagnostics and its Importance 2**

**Unit 2: Diagnostics Methods Used for Analysis of Blood 10**

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**

Urine Analysis: Physical characteristics; Abnormal constituents

**Unit 4:Non-infectious Diseases 6**

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

**Unit 5:Infectious Diseases 3**

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

**Unit 6:Tumours 3**

Types (Benign/Malignant), Detection and metastasis; Medical imaging: X-Ray of Bone fracture, PET, 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. T*extbook of Medical Physiology*, Saunders
- Robbins and Cortan, *Pathologic Basis of Disease*, VIIIEdition, Saunders
- Prakash, G. (2012), *Lab Manual on Blood Analysis and Medical Diagnostics*, S. Chand and Co. Ltd.


## 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**


- Manual on Sericulture; Food and Agriculture Organisation, Rome 1976
- Handbook of Practical Sericulture: S.R. Ullal and M.N. Narasimhanna CSB, Bangalore
- Silkworm Rearing and Disease of Silkworm, 1956, Ptd. By Director of Ptg., Stn. & Pub. Govt. Press, 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, Japan1972.
- 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.

# SCHEME AND SYLLABUS UNDER CHOICE BASED CREDIT SYSTEM FOR B.Sc. PROGRAMME WITH LIFE SCIENCE

# SCHEME AND SYLLABUS UNDER

# CHOICE BASED CREDIT SYSTEM

# FOR B.Sc. PROGRAMME LIFE SCIENCES

| | **CORE COURSE (12)** | **Ability Enhancement Compulsory Courses AEC (2)** | **Skill Enhancement Courses SEC (4)** | **Discipline Specific Elective DSE (4)** |
|---|---|---|---|---|
| I | CC- Botany I<br>CC- Zoology I<br>CC- Chemistry I | English Communication | | |
| II | CC- Botany II<br>CC-Zoology II<br>CC- Chemistry II | Environmental Science | | |
| III | CC- Botany III<br>CC-Zoology III<br>CC- Chemistry III | | SEC-I | |
| IV | CC- Botany IV<br>CC-Zoology IV<br>CC- Chemistry IV | | SEC-II | |
| V | | | SEC-III | DSE-Botany I<br>DSE-Zoology I<br>DSE-Chemistry I |
| VI | | | SEC-IV | DSE-Botany II<br>DSE-Zoology II<br>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. Immunology
5. Reproductive Biology
6. Insect,Vector and Diseases

## Skill Enhancement Courses: Zoology

1. Apiculture
2. Aquarium Fish Keeping
3. Aquatic Biology
4. Medical Diagonistics
5. Public Health and Hygiene
5. Sericulture

# 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 Nemathelminthes** **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


- Barnes, R.D. (1982). *Invertebrate Zoology*, V 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
- Barrington, E.J.W. (1979). *Invertebrate Structure and Functions*. II Edition, E.L.B.S. and Nelson
- 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** **4**
Derivatives of integument w.r.t. glands and digital tips

**Unit 2: Skeletal System** **3**
Evolution of visceral arches

**Unit 3: Digestive System** **4**
Brief account of alimentary canal and digestive glands

**Unit 4: Respiratory System** **5**
Brief account of Gills, lungs, air sacs and swim bladder

**Unit 5: Circulatory System** **4**
Evolution of heart and aortic arches

**Unit 6: Urinogenital System** **4**
Succession of kidney, Evolution of urinogenital ducts

**Unit 7: Nervous System** **3**
Comparative account of brain

**Unit 8: Sense Organs** **3**
Types of receptors

**Unit 9: Early Embryonic Development** **12**
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**
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**

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. Study of placental development in humans by ultrasound scans.

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.
- Weichert C.K and William Presch (1970). *Elements of Chordate Anatomy*, Tata McGraw Hills
- 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 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). T*extbook 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)

7. Genomic DNA isolation from *E. coli*
8. Plasmid DNA isolation (pUC 18/19) from *E. coli*
9. Restriction digestion of plasmid DNA.
10. Construction of circular and linear restriction map from the data provided.
11. Calculation of transformation efficiency from the data provided.
12. 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
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.

## 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 Approache*s. CABI publications, U.K.
- Pedigo, L.P. (2002). *Entomology and Pest Management*, Prentice Hall.

## 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)**

6. Determine the area of a lake using graphimetric and gravimetric method.
7. Identify the important macrophytes, phytoplanktons and zooplanktons present in a lake ecosystem.
8. Determine the amount of Turbidity/transparency, Dissolved Oxygen, Free Carbon dioxide, Alkalinity (carbonates & bicarbonates) in water collected from a nearby lake/ water body.
9. Instruments used in limnology (Secchi disc, Van Dorn Bottle, Conductivity meter, Turbidity meter, PONAR grab sampler) and their significance.
10. 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**

**IMMUNOLOGY**

**THEORY** **(CREDITS 4)**

**Unit 1**: **Overview of the Immune System** **10**

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**

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

**Unit 3: Antigens** **8**

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,

**Unit 7: Vaccines** **4**

General introduction to vaccines, Various types of vaccines

## 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*. Cell counting and viability test from splenocytes of farm bred animals/cell lines.
7. Demonstration of
   a) ELISA
   b) Immunoelectrophoresis

**(*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.

**DSE 5**

# REPRODUCTIVE BIOLOGY

**THEORY** **(CREDITS 4)**

## Unit 1: Reproductive Endocrinology

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

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

## Unit 3: Functional anatomy of female reproduction

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; Hormonal control of implantation; Hormonal regulation of gestation, pregnancy diagnosis, foeto – maternal relationship; Mechanism of parturition and its hormonal regulation; Lactation and its regulation

## Unit 4: Reproductive Health

Infertility in male and female: causes, diagnosis and management; 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

## REPRODUCTIVE BIOLOGY

**PRACTICAL** **(CREDITS 2)**

8. Study of animal house: set up and maintenance of animal house, breeding techniques, care of normal and experimental animals.
9. Examination of vaginal smear rats from live animals.
10. Surgical techniques: principles of surgery in endocrinology. Ovarectomy, hysterectorny, castration and vasectomy in rats.
11. 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.
12. Human vaginal exfoliate cytology.
13. Sperm count and sperm motility in rat
14. 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.

## GE 6

## 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: Hempitera 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)**

10. Study of different kinds of mouth parts of insects

*11.* Study of following insect vectors through permanent slides/ photographs: *Aedes, Culex, Anopheles, Pediculus humanus capitis, Pediculus humanus corporis, Phithirus pubis, Xenopsylla cheopis, Cimex lectularius, Phlebotomus argentipes, Musca domestica,* through permanent slides/ photographs

*12.* 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 1

## 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 2

## AQUARIUM FISH KEEPING

**(CREDITS 2)**

**Unit1: Introduction to Aquarium Fish Keeping**

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

**Unit 2: Biology of Aquarium Fishes**

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**

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

**Unit 4: Fish Transportation**

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

**Unit 5: Maintenance of Aquarium**

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

**SEC - 2**
**MEDICAL DIAGNOSTICS**

**THEORY** **(Credits 2)**

**Unit 1: Introduction to Medical Diagnostics and its Importance** **2**

**Unit 2: Diagnostics Methods Used for Analysis of Blood** **10**
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**
Urine Analysis: Physical characteristics; Abnormal constituents

**Unit 4: Non-infectious Diseases** **6**
Causes, types, symptoms, complications, diagnosis and prevention of Diabetes (Type I and Type II), Hypertension (Primary and secondary), Testing of blood glucose using Glucometer/Kit

**Unit 5: Infectious Diseases** **3**
Causes, types, symptoms, diagnosis and prevention of Tuberculosis and Hepatitis

**Unit 6: Tumours** **3**
Types (Benign/Malignant), Detection and metastasis; Medical imaging: X-Ray of Bone fracture, PET, 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. T*extbook 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 3**

## PUBLIC HEALTH AND HYGIENE

**(CREDITS 2)**

**Unit 1: Introduction to Public health and Hygiene** **6**

Significance of Public health and Hygiene, Nutrition and health, classification of foods, Major nutritional Deficiency diseases- Protein Energy Malnutrition (kwashiorkor and marasmus), Vitamin deficiency disorders, Iron deficiency disorders, Iodine deficiency disorders

**Unit 2: Environment and Health hazards** **5**

Environmental degradation, Environmental Pollution – Air, water, soil and noise; Associated health hazards

**Unit 3: Communicable diseases** **5**

Different types of communicable diseases and their control measures – Tuberculosis, Measles, Dengue, Leprosy

**Unit 4: Life Style related Non-Communicable diseases** **5**

Different types of Life style related non-communicable diseases - Hypertension, Coronary Heart diseases, Stroke, Diabetes mellitus, Obesity and Mental ill-health - their causes and prevention through dietary and lifestyle modifications

**Unit 5: Social health problems** **4**

Smoking, alcoholism, drug dependence and Acquired Immuno-Deficiency Syndrome (AIDS) - their causes, treatment and prevention

# 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


- Manual on Sericulture; Food and Agriculture Organisation, Rome 1976
- Handbook of Practical Sericulture: S.R. Ullal and M.N. Narasimhanna CSB, Bangalore
- Silkworm Rearing and Disease of Silkworm, 1956, Ptd. By Director of Ptg., Stn. & Pub. Govt. Press, 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, Japan1972.
- 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.