Structure and Syllabus of Zoology Honours for B.Sc. Undergraduate Programme

Based on:

U.G.C. Choice Based Credit System (CBCS) Model Curriculum

(Effective from academic session July, 2016)
B.Sc. (Honours) Zoology

GENERAL INSTRUCTIONS/GUIDELINES FOR EXECUTION OF CURRICULUM

I. The B.Sc. (Honours) Zoology will be of three years duration semester-based Choice Based Credit System (CBCS) course.

II. There will be broadly three types of courses for B.Sc. (Honours) Zoology degree program.

1. The Core Courses (14 courses for honours; and 4 discipline specific papers) will be of 6- credits each including 2 credits assigned to the practical component. Thus a candidate will have to pass 14 courses for earning 14 X 6 = 84 credits during six semesters. Each of the 6-credits courses will carry 100 marks. These 100 marks will be split into marks assigned for Theory [TH]: 40 marks; Practical [P]: 30 marks and Internal Assessment [IA]: 30. The Internal Assessment [30 marks] will include one Multi Choice Questions (MCQ)-based examination of 25 marks each [25 or 50 questions of 1.0 or 0.5 mark each as the case may be]; and Classroom Attendance Incentive marks (5 marks). The Lab-based practical will be of 2-hours [One credit]. A total of 14 X 6 = 84 credits could be accumulated under these courses during the Honours degree program.

2. The Elective Courses will 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. The Elective Courses will include:

   Discipline Specific Elective [DSE] Courses: A total of 4 courses offered under the main discipline/subject of study is referred to as Discipline Specific Elective. These courses are discipline related and/or interdisciplinary in nature. A total of 4 X 6 = 24 credits could be accumulated under DSE courses during the Honours degree program.
Generic Elective [GE] Courses: A total of 4 courses of 6-credits each including 2 credits assigned for the practical component of each of these courses i.e. one course per 1st to 4th semester will be studied by the candidates. An elective course chosen from an unrelated discipline/ subject, with an intention to seek exposure beyond discipline(s) of choice is called Generic Elective Course. The purpose of this category of papers is to offer the students the option to explore disciplines of interest beyond the choices they make in Core and Discipline Specific Elective papers. Further, a 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 Course. A total of 4 X 6 = 24 credits could be accumulated under GE courses during the Honours degree program.

3. Ability Enhancement Compulsory Courses [AECC]: Ability Enhancement Courses are of two types; Ability Enhancement Compulsory Courses [AECC] and Skill Enhancement Courses [SEC]. A total of 4 X 4 = 16 credits could be accumulated under these courses during the Honours degree program i.e. 4 X 2 = 8 credits for AECC, and 4 X 2 = 8 credits for SEC courses.

The AECC courses are the mandatory courses based upon the content that leads to knowledge enhancement; i. Environment Science and ii. English/ Hindi/ MIL Communication. All these are mandatory courses for obtaining a B.Sc. (Honours) degree in the concerned subject. These courses are mandatory for all disciplines. SEC courses are value-based and/ or skill-based and are aimed at providing hands-on-training, competencies, skills etc. A minimum of two such courses for obtaining an Honours degree are selected amongst the courses designed to provide value-based and/ or skill-based knowledge and may contain both theory and lab/ hands-on training. The main purpose of these courses is to provide students life-skills in hands-on mode so as to increase their employability.

III. Practical [P] component has been included in every core and discipline/ generic specific elective paper. The list of practicals to be conducted by the candidates has been provided alongside each of such courses. The marks (30 marks) for the practical examination will be split as follows;

- Write up of Practical I: 5 marks
- Write up of Practical II: 5 marks
- Performance of any one of these practicals: 7 marks
- Practical record/ notebook: 5 marks
- Viva voce: 8 marks
IV. **Classroom Attendance Incentive:** Those candidates who have greater than 75% attendance (for those participating in Co-curricular activities, 25% will be added to per cent attendance) will be awarded CCA marks as follows:

- \( \geq 75\% \) but < 80\% : 1 marks
- \( \geq 80\% \) but < 85\% : 2 marks
- \( \geq 85\% \) but < 90\% : 3 marks
- \( \geq 90\% \) but < 95\% : 4 marks
- \( \geq 95\% \) TO 100\% : 5 marks

V. The admission to B.Sc. (Honours) Zoology programme of Himachal Pradesh University will be as per guidelines of Himachal Pradesh University, Shimla from time to time.

i. The candidate should have passed 10+2 (class XII) Examination or its equivalent from a recognized Board/University with any of the three subjects out of Physics, Chemistry and Biology or any other science subjects with 50\% or equivalent grade (for SC/ST candidates marks of eligibility will be 45\% or equivalent grade).

ii. In case of candidates who are studying in University/ Board/ College/ Schools in any of the foreign countries the eligibility/ Qualifying marks will be the same as recognized/equivalent to 10+2 by the University or the association of the Indian University with 50\% marks of equivalent grade (for SC/ST candidates, eligibility will be 45\% marks or equivalent grade).

iii. The candidate who has appeared in the qualifying examination but whose result has so far not been declared can also apply but his/her eligibility for the entrance test will be purely provisional subject to the condition that he/she has to produced a passing certificate scoring at least the minimum percentage of marks as prescribed for the qualifying examination on the day and the specified time of counseling.

iv. The candidate shall not be more than 22 years of age as on 01st July of the year of admission. Date of birth as recorded in the Secondary Education Board/ University Certificate Only will be considered as authentic.
### Scheme and Syllabus for Choice Based Credit System

#### For B.Sc. Honours (Zoology)

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### CORE COURSES

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<td>OR</td>
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<tr>
<td>DSE 11</td>
<td>Reproductive Biology ZOOL (H) 604B- TH, ZOOL (H) 604 B-PR</td>
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<td>DSE 12</td>
<td>Wild Life Conservation and Management ZOOL(H) 604 C-TH, ZOOL(H)604C-PR</td>
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</table>
### GENERIC ELECTIVE COURSES

<table>
<thead>
<tr>
<th>GE</th>
<th>Course</th>
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<tr>
<td>GE 1</td>
<td>Animal Cell Biotechnology ZOOL(H)103A-TH, ZOOL(H) 103A- PR</td>
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<td>Animal Diversity ZOOL(H) 103B-TH, ZOOL (H) 103B-PR</td>
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<td>Aquatic Biology ZOOL(H) 203A-TH, ZOOL(H) 203A-PR</td>
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<td>GE 5</td>
<td>Exploring the Brain: Structure and Function ZOOL(H) 305A-TH, ZOOL(H) 305A-PR</td>
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<td>GE 6</td>
<td>Food, Nutrition and Health ZOOL(H) 305B-TH, ZOOL(H) 305B-PR</td>
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<td>GE 8</td>
<td>Insect Vectors and Diseases ZOOL(H) 405B-TH, ZOOL(H)405B-TH</td>
<td>ZOOL(H) 405B-TH, ZOOL 405B-TH</td>
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### SKILL ENHANCEMENT COURSES

<table>
<thead>
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<td>Apiculture ZOOL(H) 304A-TH, ZOOL(H) 304A-PR</td>
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<td>SEC 2</td>
<td>Aquarium Fish Keeping ZOOL(H) 304B-TH, ZOOL(H) 304B-PR</td>
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<td>Medical Diagnostics ZOOL(H) 404A-TH, ZOOL (H) 404 A-PR</td>
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<td>SEC 5</td>
<td>Sericulture ZOOL(H) 404C-TH, ZOOL (H) 404C-PR</td>
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</tbody>
</table>
CORE COURSE I
NON-CHORDATES I: PROTISTS TO PSEUDOCOELOMATES
ZOOL(H) 101 TH

THEORY (Credits 4)

Unit 1: Protista, Parazoa and Metazoa
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
General characteristics and Classification up to classes
Canal system and spicules in sponges

Unit 3: Cnidaria
General characteristics and Classification up to classes
Metagenesis in *Obelia*
Polymorphism in Cnidaria
Corals and coral reefs

Unit 4: Ctenophora
General characteristics and Evolutionary significance

Unit 5: Platyhelminthes
General characteristics and Classification up to classes
Life cycle and pathogenicity of *Fasciola hepatica* and *Taenia solium*

Unit 6: Nemathelminthes
General characteristics and Classification up to classes
Life cycle, and pathogenicity of *Ascaris lumbricoides* and *Wuchereria bancrofti*
Parasitic adaptations in helminthes

PRACTICALS (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)


**SUGGESTED READINGS**

# CORE COURSE II
## PRINCIPLES OF ECOLOGY
### ZOOL(H) 102 TH

<table>
<thead>
<tr>
<th>Theory</th>
<th>(Credits 4)</th>
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</thead>
<tbody>
<tr>
<td><strong>Unit 1: Introduction to Ecology</strong></td>
<td>6</td>
</tr>
<tr>
<td>History of ecology, Autecology and synecology, Levels of organization, Laws of limiting factors, Study of physical factors</td>
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<tr>
<td><strong>Unit 2: Population</strong></td>
<td>24</td>
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<tr>
<td>Unitary and Modular populations</td>
<td></td>
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<tr>
<td>Unique and group attributes of population: Density, natality, mortality, life tables, fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion</td>
<td></td>
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<tr>
<td>Exponential and logistic growth, equation and patterns, r and K strategies</td>
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<tr>
<td>Population regulation - density-dependent and independent factors</td>
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<tr>
<td>Population interactions, Gause’s Principle with laboratory and field examples, Lotka-Volterra equation for competition and Predation, functional and numerical responses</td>
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<tr>
<td><strong>Unit 3: Community</strong></td>
<td>12</td>
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<tr>
<td>Community characteristics: species richness, dominance, diversity, abundance, vertical stratification, Ecotone and edge effect; Ecological succession with one example</td>
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<tr>
<td>Theories pertaining to climax community</td>
<td></td>
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<tr>
<td><strong>Unit 4: Ecosystem</strong></td>
<td>14</td>
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<tr>
<td>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</td>
<td></td>
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<tr>
<td>Nutrient and biogeochemical cycle with one example of Nitrogen cycle Human modified ecosystem</td>
<td></td>
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<tr>
<td><strong>Unit 5: Applied Ecology</strong></td>
<td>4</td>
</tr>
<tr>
<td>Ecology in Wildlife Conservation and Management</td>
<td></td>
</tr>
</tbody>
</table>
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 CO₂
4. Report on a visit to National Park/Biodiversity Park/Wild life sanctuary

SUGGESTED READINGS

- Robert Leo Smith Ecology and field biology Harper and Row publisher
THEORY (Credits 4)

Unit 1: Introduction to Coelomates
Evolution of coelom and metamerism

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

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

Unit 4: Onychophora
General characteristics and Evolutionary significance

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

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

PRACTICAL (Credits 2)

1. Study of following specimens:
   - 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)


SUGGESTED READINGS

# Theory (Credits 4)

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

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

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

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

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

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

## Unit 7: Cell Division
Mitosis, Meiosis, Cell cycle and its regulation

## Unit 8: Cell Signaling
GPCR and Role of second messenger (cAMP)
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

CORE COURSE V
DIVERSITY OF CHORDATA
ZOOL(H) 301 TH

THEORY

(Credits 4)

Unit 1: Introduction to Chordates
General characteristics and outline classification

Unit 2: Protochordata
General characteristics of Hemichordata, Urochordata and Cephalochordata;
Study of larval forms in protochordates; Retrogressive metamorphosis in Urochordata

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

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

Unit 5: Pisces
General characteristics of Chondrichthyes and Osteichthyes, classification up to order Migrations, Osmoregulation and Parental care in fishes

Unit 6: Amphibia
Origin of Tetrapoda (Evolution of terrestrial ectotherms); General characteristics and classification up to order; Parental care in Amphibians

Unit 7: Reptilia
General characteristics and classification up to order; Affinities of Sphenodon; Poison apparatus and Biting mechanism in snakes

Unit 8: Aves
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
General characters and classification up to order; Affinities of Prototheria; Adaptive radiation with reference to locomotory appendages

Unit 10: Zoogeography
Zoogeographical realms, Theories pertaining to distribution of animals, Plate tectonic and Continental drift theory, distribution of vertebrates in different realms
DIVERSITY OF CHORDATA
ZOOL(H) 301 PR

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, Sphyra, 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

CORE COURSE VI
ANIMAL PHYSIOLOGY: CONTROLLING AND COORDINATING SYSTEMS
ZOOL(H) 302 TH

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

ZOOL(H) 302 PR

PRACTICALS

*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


CORE COURSE VII  
FUNDAMENTALS OF BIOCHEMISTRY  
ZOOL(H) 303 TH

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 $\alpha$-amino acids; Physiological importance of essential and non-essential $\alpha$-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, Hypo-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
PRACTICAL

1. Qualitative tests of functional groups in carbohydrates, proteins and lipids.
3. Action of salivary amylase under optimum conditions.
5. Demonstration of proteins separation by SDS-PAGE.

SUGGESTED READING

<table>
<thead>
<tr>
<th>Unit</th>
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<tr>
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<td>Integumentary System</td>
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<td>Structure, functions and derivatives of</td>
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<td>Skeletal System</td>
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<td>Overview of axial and appendicular</td>
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<td>skeleton, Jaw suspensorium, Visceral</td>
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<td>Digestive System</td>
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<td>Alimentary canal and associated glands,</td>
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<td>4</td>
<td>Respiratory System</td>
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<td>Skin, gills, lungs and air sacs; Accessory</td>
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<td>Circulatory System</td>
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<td>General plan of circulation, evolution</td>
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<td>Urinogenital System</td>
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<td>urinogenital ducts, Types of mammalian</td>
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<td>7</td>
<td>Nervous System</td>
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<td>Comparative account of brain</td>
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<td>Autonomic nervous system, Spinal cord,</td>
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<td>Cranial nerves in mammals</td>
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<td>8</td>
<td>Sense Organs</td>
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<td>Classification of receptors</td>
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<td>Brief account of visual and auditory</td>
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<td>receptors in man</td>
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PRACTICAL

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

- 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
ZOOL(H) 402 TH

THEORY (Credits 4)

Unit 1: Physiology of Digestion
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
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
Structure of kidney and its functional unit; Mechanism of urine formation; Regulation of water balance; Regulation of acid-base balance

Unit 4: Blood
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
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

ZOOL(H) 402 PR

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 haematin 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

CORE COURSE X
BIOCHEMISTRY OF METABOLIC PROCESSES
ZOOL(H) 403 TH

THEORY (CREDITS 4)

Unit 1: Overview of Metabolism

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

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

Unit 3: Lipid Metabolism

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

Unit 4: Protein Metabolism

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

Unit 5: Oxidative Phosphorylation

Redox systems; Review of mitochondrial respiratory chain, Inhibitors and un-couplers of Electron Transport System
PRACTICALS (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 CO₂ in the TCA cycle

SUGGESTED READINGS

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
ZOOL(H) 501 PR

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

THEORY

Unit 1: Mendelian Genetics and its Extension
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
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
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
Chromosomal mechanisms of sex determination in Drosophila and Man

Unit 5: Extra-chromosomal Inheritance
Criteria for extra-chromosomal inheritance, Antibiotic resistance in Chlamydomonas, Mitochondrial mutations in Saccharomyces, Infective heredity in Paramecium and Maternal effects

Unit 6: Polygenic Inheritance
Polygenic inheritance with suitable examples; simple numericals based on it.

Unit 7: Recombination in Bacteria and Viruses
Conjugation, Transformation, Transduction, Complementation test in Bacteriophage

Unit 8: Transposable Genetic Elements
Transposons in bacteria, Ac-Ds elements in maize and P elements in Drosophila, Transposons in humans

(CREDITS 4)
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

# CORE COURSE XIII
## DEVELOPMENTAL BIOLOGY
### ZOOL(H) 601 TH

### THEORY  
(CREDITS 2)

<table>
<thead>
<tr>
<th>Unit 1: Introduction</th>
<th>4</th>
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</thead>
<tbody>
<tr>
<td>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</td>
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<table>
<thead>
<tr>
<th>Unit 2: Early Embryonic Development</th>
<th>28</th>
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<tbody>
<tr>
<td>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</td>
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<tr>
<th>Unit 3: Late Embryonic Development</th>
<th>8</th>
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<tbody>
<tr>
<td>Fate of Germ Layers; Extra-embryonic membranes in birds; Implantation of embryo in humans, Placenta (Structure, types and functions of placenta)</td>
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<tr>
<th>Unit 4: Post Embryonic Development</th>
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<tbody>
<tr>
<td>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</td>
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<tr>
<th>Unit 5: Implications of Developmental Biology</th>
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<tr>
<td>Teratogenesis: Teratogenic agents and their effects on embryonic development; <em>In vitro</em> fertilization, Stem cell (ESC), Amniocentesis</td>
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</table>
PRACTICALS

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 (photomicrograph/slides)
5. Project report on *Drosophila* culture/chick embryo development

SUGGESTED READINGS

- Carlson, R. F. Patten's Foundations of Embryology
The document provides a detailed outline of a course titled "Evolutionary Biology," focusing on various aspects of biological evolution. The course is divided into nine units, each covering specific topics in evolutionary theory and history.

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

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

**Unit 3:**
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:**
Sources of variations: Heritable variations and their role in evolution

**Unit 5:**
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:**
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:**
Extinctions, Background and mass extinctions (causes and effects), detailed example of K-T extinction

**Unit 8:**
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:**
Phylogenetic trees, Multiple sequence alignment, construction of phylogenetic trees, interpretation of trees

Additionally, there are credits allocated for each unit, ranging from 7 to 10 credits, indicating the course's comprehensive coverage of evolutionary biology.
PRACTICALS

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

- Snustad, S Principles of Genetics.
**DISCIPLINE CENTRIC ELECTIVE COURSES**

**DSE 1**

**ANIMAL BEHAVIOUR AND CHRONOBIOLOGY**  
**ZOOL(H) 503 B TH**

**THEORY (Credits 4)**

**Unit 1: Introduction to Animal Behaviour**  
10
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**  
10
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**  
16
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**  
8
Historical developments in chronobiology; Biological oscillation: the concept of Average, amplitude, phase and period. Adaptive significance of biological clocks.

**Unit 5: Biological Rhythm**  
12
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**  
4
Relevance of biological clocks; Chronopharmacology, Chronomedicine, Chronotherapy.
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/Wildlife 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

- John Alcock, Animal Behaviour, Sinauer Associate Inc., USA.
- Paul W. Sherman and John Alcock, Exploring Animal Behaviour, Sinauer Associate Inc., Massachusetts, USA.
- Insect Clocks D.S. Saunders, C.G.H. Steel, X., Afopoulou (ed.)R.D. Lewis. (3rd Ed) 2002 Baren and Noble Inc. New York, USA
DSE 2
ANIMAL BIOTECHNOLOGY
ZOOL(H) 503CTH

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

ZOOL(H) 503C PR

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

DSE 3
BASICS OF NEUROSCIENCE
ZOO(H) 504A TH

THEORY (Credits 4)

Unit 1: Introduction to Neuroscience
Origins of Neuroscience; Neuroanatomy, Neurophysiology, and Systems Neurobiology

UNIT 2: The Nervous system-An Introduction
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
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
Different types of neurotransmitters– 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
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.
PRACTICAL

1. Dissection and study of Drosophila nervous system using GFP reporter.
2. Observation and quantitation of Drosophila photoreceptor neurons in healthy and diseased condition.
4. Study of neurons and/or myelin by Nissl, Giemsa or Luxol Fast Blue staining.
5. Study of olfaction in Drosophila.

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
- Nerve Cells and Animal Behaviour-2nd Edn-Peter J Simmons and David Young-CUP-2003
- Phantoms in the Brain - Vilayanur S. Ramachandran and Sandra Blakeslee-1998
- The Human Brain Book - Rita Carter-2009
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
ZOO(1) 504B PR

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
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**

**ZOOL(H) 504C TH**

<table>
<thead>
<tr>
<th>UNIT</th>
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<tbody>
<tr>
<td><strong>THEORY</strong> (Credits 4)</td>
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<tr>
<td><strong>Unit 1: Introduction to Bioinformatics</strong></td>
</tr>
<tr>
<td>Importance, Goal, Scope; Genomics, Transcriptomics, Systems Biology, Functional Genomics, Metabolomics, Molecular Phylogeny; Applications and Limitations of Bioinformatics</td>
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<tr>
<td><strong>Unit 2: Biological Databases</strong></td>
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<tr>
<td>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)</td>
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<tr>
<td><strong>Unit 3: Data Generation and Data Retrieval</strong></td>
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<tr>
<td>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)</td>
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<tr>
<td><strong>Unit 3: Basic Concepts of Sequence Alignment</strong></td>
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<tr>
<td>Scoring Matrices (PAM, BLOSUM), Methods of Alignment (Dot matrix, Dynamic Programming, BLAST and FASTA); Local and global alignment, pairwise and multiple sequence alignments; Similarity, identity and homology of sequences.</td>
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<tr>
<td><strong>Unit 4: Applications of Bioinformatics</strong></td>
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<tr>
<td>Structural Bioinformatics (3-D protein, PDB), Functional genomics (genome-wide and high throughput approaches to gene and protein function), Drug discovery method (Basic concepts)</td>
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<tr>
<td><strong>Unit 5: Biostatistics</strong></td>
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<tr>
<td>Introduction, calculation of standard deviation, standard error, Co-efficient of Variance, Chi-square test, Z test, t-Test</td>
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</table>
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

DSE 6
ENDOCRINOLOGY
ZOOL(H) 603A TH

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 in biological 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

ZOOL(H) 603A PR

PRACTICAL

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- Saunders Toppan
- Endocrinology: An Integrated Approach; Stephen Nussey and Saffron Whitehead.
- Vertebrate Endocrinology by David O. Norris,
UNIT 1: Introduction and Classification:
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:
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; Bioluminiscence; Mechanoreceptors; Schooling; Parental care; Migration

UNIT 3: Fisheries
Inland Fisheries; Marine Fisheries; Environmental factors influencing the seasonal variations in fish catches in the Arabian Sea and the Bay of Bengal; Fishing crafts and Gears; Depletion of fisheries resources; Application of remote sensing and GIS in fisheries; Fisheries law and regulations

Unit 4: Aquaculture
Sustainable Aquaculture; Extensive, semi-intensive and intensive culture of fish; Pen and cage culture; Polyculture; Composite fish culture; Brood stock management; Induced breeding of fish; Management of finfish hatcheries; Preparation and maintenance of fish aquarium; Preparation of compound diets for fish; Role of water quality in aquaculture; Fish diseases: Bacterial, viral and parasitic; Preservation and processing of harvested fish, Fishery by-products

UNIT 5: Fish in research
Transgenic fish, Zebrafish as a model organism in research
FISH AND FISHERIES
ZOOL(H) 603B PR

PRACTICAL

1. Morphometric and meristic characters of fishes
2. Study of Petromyzon, Myxine, Pristis, Chimaera, Exocoetus, Hippocampus, Gambusia, Labeo, Heteropneustes, Anabas
3. Study of different types of scales (through permanent slides/photographs).
4. Study of crafts and gears used in Fisheries
5. Water quality criteria for Aquaculture: Assessment of pH, conductivity, Total solids, Total dissolved solids
6. Study of air breathing organs in Channa, Heteropneustes, Anabas and Clarias
7. Demonstration of induced breeding in Fishes (video)
8. Demonstration of parental care in fishes (video)

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
- 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
<table>
<thead>
<tr>
<th>Unit</th>
<th>Topic</th>
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<tbody>
<tr>
<td>1</td>
<td>Overview of Immune System</td>
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<tr>
<td>2</td>
<td>Innate and Adaptive Immunity</td>
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<td>3</td>
<td>Antigens</td>
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<td>4</td>
<td>Immunoglobulins</td>
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<td>5</td>
<td>Major Histocompatibility Complex</td>
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<td>Cytokines</td>
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<td>7</td>
<td>Complement System</td>
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<td>8</td>
<td>Hypersensitivity</td>
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<td>9</td>
<td>Vaccines</td>
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**THEORY**

(Credits 4)

Unit 1: **Overview of Immune System**

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

Unit 2: **Innate and Adaptive Immunity**


Unit 3: **Antigens**

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

Unit 4: **Immunoglobulins**

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**

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

Unit 6: **Cytokines**

Properties and functions of cytokines, Therapeutics Cytokines

Unit 7: **Complement System**

Components and pathways of complement activation.

Unit 8: **Hypersensitivity**

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

Unit 9: **Vaccines**

Various types of vaccines.
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.


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


THEORY (CREDITS 4)

Unit I: Introduction to Parasitology
Brief introduction of Parasitism, Parasite, Parasitoid and Vectors (mechanical and biological vector) Host parasite relationship

Unit II: Parasitic Protists
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
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
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), *Pratylenchus* (lesion nematode)

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

Unit V: Parasitic Vertebrates
A brief account of parasitic vertebrates; Cookicutter Shark, Candiru, Hood Mockingbird and Vampire bat
PRACTICAL

- 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


THEORY (CREDITS 4)

Unit 1: Reproductive Endocrinology 15


Unit 2: Functional anatomy of male reproduction 15

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 20

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 10

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
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.
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

- Knobil, E. et al. (eds). The Physiology of Reproduction. Raven Press Ltd.
# DSE 11

**WILD LIFE CONSERVATION AND MANAGEMENT**  
ZOOL(H) 604C TH

## THEORY  
(CREDITS 4)

<table>
<thead>
<tr>
<th>Unit</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>1</td>
<td>Introduction to Wild Life</td>
<td>10</td>
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<tr>
<td></td>
<td>Values of wild life - positive and negative; Conservation ethics; Importance of conservation; Causes of depletion; World conservation strategies.</td>
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<td>2</td>
<td>Evaluation and management of wild life</td>
<td>12</td>
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<tr>
<td></td>
<td>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.</td>
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<td>3</td>
<td>Management of habitats</td>
<td>10</td>
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<td>Setting back succession; Grazing logging; Mechanical treatment; Advancing the successional process; Cover construction; Preservation of general genetic diversity; Restoration of degraded habitats</td>
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<td>4</td>
<td>Population estimation</td>
<td>14</td>
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<td></td>
<td>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.</td>
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<td>5</td>
<td>Management planning of wild life in protected areas</td>
<td>5</td>
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<td></td>
<td>Estimation of carrying capacity; Eco tourism / wild life tourism in forests; Concept of climax persistence; Ecology of perturbation.</td>
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<td>7</td>
<td>Management of excess population</td>
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<tr>
<td></td>
<td>Bio- telemetry; Care of injured and diseased animal; Quarantine; Common diseases of wild animal</td>
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<tr>
<td>8</td>
<td>Protected areas</td>
<td>5</td>
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<tr>
<td></td>
<td>National parks &amp; sanctuaries, Community reserve; Important features of protected areas in India; Tiger conservation - Tiger reserves in India; Management challenges in Tiger reserve.</td>
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</tbody>
</table>
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

# GENERIC ELECTIVE COURSES

## GE 1

### ANIMAL CELL BIOTECHNOLOGY

**ZOOl(H) 103A TH**

<table>
<thead>
<tr>
<th>UNIT</th>
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<tbody>
<tr>
<td>UNIT 1: Introduction</td>
<td>5</td>
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<tr>
<td>Concept and Scope of Biotechnology</td>
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</tbody>
</table>

**UNIT 2: Techniques in Gene manipulation**

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**

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**

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.

**UNIT 6: Application in Health**

Development of recombinant Vaccines, Hybridoma technology, Gene Therapy.

Production of recombinant Proteins: Insulin and growth hormones.

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

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 CaCl2, Selection of transformants on X-gal and IPTG (Optional).
7. Techniques: Western Blot, Southern Hybridization, DNA Fingerprinting, PCR, DNA Microarrays

**SUGGESTED READINGS**

THEORY

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

Unit 2. Porifera
General characters and canal system in Porifera

Unit 3. Radiata
General characters of Cnidarians and polymorphism

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

Unit 5. Pseudocoelomates
General characters of Nemetehelminthes; Parasitic adaptations

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

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

Unit 8. Mollusca
General characters of mollusca; Pearl Formation

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

Unit 10. Protochordata
Salient features

Unit 11. Pisces
Osmoregulation, Migration of Fishes

Unit 12. Amphibia
General characters, Adaptations for terrestrial life, Parental care in Amphibia.

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

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

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

1. Study of following specimens:
   **Non Chordates:** *Euglena, Noctiluca, Paramecium, Sycon,* , *Physalia, Tubipora, Metridium, Taenia, Ascaris, Nereis, Aphrodite, Leech, Peripatus, Limulus,* , *Hermit crab, Daphnia, Millipede, Centipede, Beetle, Chiton, Dentalium, Octopus, Asterias, and Anactonia.*
   **Chordates:** *Balanoglossus, Amphioxus, Petromyzon, Pristis, Hippocampus, Labeo, Ichthyophis/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:

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

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


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

ZOOL(H)203 A PR

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
- 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
THEORY

(Credits 4)

UNIT I: Introduction  15
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  8
Greenhouse gases and global warming, Acid rain, Ozone layer destruction, Effect of climate change on public health

UNIT III Pollution  5
Air, water, noise pollution sources and effects, Pollution control

UNIT IV Waste Management Technologies  26
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  6
Causes, symptoms and control of tuberculosis, Asthma, Cholera, Minamata disease, typhoid
PRACTICAL

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

SUGGESTED BOOKS


THEORY

Unit 1: Introduction: 6
Early and Nineteenth century views of the Brain; Neuroscience today; Evolution of brain in vertebrates

Unit 2: Neurons and Glia: 6
Neurons – Soma, Axon, Dendrite; Classification of Neurons; Glia – Astrocytes, Myelinating Glia, Non-neuronal cells

Unit 3: Evolution and Adaptation of Brain: 8
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: 8
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: 10
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: 10
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: 6
Electroencephalogram; Sleep – why do we sleep, Non-REM and REM sleep, neural mechanisms of sleep; Circadian rhythms.

Unit 8: Mental illness and the Brain: 6
Psychosocial and biological approaches to mental illness; Anxiety disorders; Mood disorders; Schizophrenia.
EXPLORING THE BRAIN: STRUCTURE AND FUNCTION

ZOOL(H) 305A PR

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


Project work/ Home assignment
GE 6

FOOD, NUTRITION AND HEALTH

ZOOL(H) 305B TH

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

ZOOL(H) 305B PR

1. To detect adulteration in a) Ghee b) Sugars c) Tea leaves and d) Turmeric
2. Estimation of Lactose in milk
3. Ascorbic acid estimation in food by titrimetry
4. Estimation of Calcium in foods by titrimetry
5. 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.
6. 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.
- Wardlaw GM, Hampel JS. Perspectives in Nutrition; Seventh Ed; 2007; McGraw Hill.
- Manay MS, Shadaksharaswamy. Food-Facts and Principles; 1998; New Age International (P) Ltd.
- Gibney et al. Public Health Nutrition; 2004; Blackwell Publishing
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<tr>
<th>Unit</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>1</td>
<td><strong>Unit 1: Digestion and Absorption of Food</strong></td>
<td>12</td>
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<tr>
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<td>Structure and function of digestive glands; Digestion and absorption</td>
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<td>of carbohydrates, fats and proteins; Nervous and hormonal control</td>
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<td>of digestion (<em>in brief</em>)</td>
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<td><strong>Unit 2: Functioning of Excitable Tissue (Nerve and Muscle)</strong></td>
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<td>Structure of neuron, Propagation of nerve impulse (myelinated and</td>
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<td>non-myelinated nerve fibre); Structure of skeletal muscle, Mechanism</td>
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<td>of muscle contraction (Sliding filament theory), Neuromuscular</td>
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<td>junction</td>
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<td>3</td>
<td><strong>Unit 3: Respiratory Physiology</strong></td>
<td>6</td>
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<tr>
<td></td>
<td>Ventilation, External and internal Respiration, Transport of oxygen</td>
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<td>and carbon dioxide in blood, Factors affecting transport of gases.</td>
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<td>4</td>
<td><strong>Unit 4: Renal Physiology</strong></td>
<td>8</td>
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<td>Functional anatomy of kidney, Mechanism and regulation of urine</td>
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<td>formation,</td>
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<td>5</td>
<td><strong>Unit 5: Cardiovascular Physiology</strong></td>
<td>10</td>
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<td>Structure of heart, Coordination of heartbeat, Cardiac cycle, ECG</td>
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<td>6</td>
<td><strong>Unit 6: Endocrine and Reproductive Physiology</strong></td>
<td>14</td>
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<td>Structure and function of endocrine glands (pituitary, thyroid,</td>
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<td></td>
<td>parathyroid, pancreas, adrenal, ovaries, and testes), Brief account</td>
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<td>of spermatogenesis and oogenesis, Menstrual cycle</td>
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PRACTICAL

(CREDITS 2)

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

GE 8
INSECT VECTORS AND DISEASES
ZOOL(H) 405B TH

THEORY

(Credits 4)

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

Unit II: Concept of Vectors
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
Classification of insects up to orders, detailed features of orders with insects as vectors – Diptera, Siphonaptera, Siphunculata, Hemiptera

Unit IV: Dipteran as Disease Vectors
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
Fleas as important insect vectors; Host-specificity, Study of Flea-borne diseases – Plague, Typhus fever; Control of fleas

Unit V: Siphunculata as Disease Vectors
Human louse (Head, Body and Pubic louse) as important insect vectors; Study of louse-borne diseases – Typhus fever, Relapsing fever, Trench fever, Vagabond’s disease, Phthiriasis; Control of human louse

Unit VI: Hemiptera as Disease Vectors
Bugs as insect vectors; Blood-sucking bugs; Chagas disease, Bed bugs as mechanical vectors, Control and prevention measures
INSECT VECTORS AND DISEASES
ZOOL(H) 405B PR

PRACTICAL (CREDITS 2)

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

Submission of a project report on any one of the insect vectors and disease transmitted

SUGGESTED READINGS

SKILL ENHANCEMENT COURSES

SEC 1

APICULTURE

ZOOL(H) 304ATH  

(CREDITS 4)  

(3+1)

Unit 1: Biology of Bees  
History, Classification and Biology of Honey  
Bees Social Organization of Bee Colony  

Unit 2: Rearing of Bees  
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  
Bee Diseases and Enemies  
Control and Preventive measures  

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

Unit 5: Entrepreneurship in Apiculture  
Bee Keeping Industry – Recent Efforts, Modern Methods in employing artificial Beehives for cross pollination in horticultural gardens  

SUGGESTED READINGS


• Singh S., *Beekeeping in India*, Indian council of Agricultural Research, New Delhi.  

Tutorial – 01 Credit
Unit 1: 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

SUGGESTED READINGS

- Mills, Dick; Keeping Aquarium Fish (Teach Yourself General) Publisher: Teach Yourself

Tutorial – 01 Credit
SEC 3
MEDICAL DIAGNOSTICS
ZOOL(H) 404A TH

THEORY

(Credits 4)
(3+01)

Unit 1: Introduction to Medical Diagnostics and its Importance 2

Unit 2: Diagnostics Methods Used for Analysis of Blood 15
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 10
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 6
Causes, types, symptoms, diagnosis and prevention of Tuberculosis and Hepatitis

Unit 6: Tumours 6
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
- Cheesbrough M., A Laboratory Manual for Rural Tropical Hospitals, A Basis for Training Courses
- Guyton A.C. and Hall J.E. Textbook of Medical Physiology, Saunders
- Robbins and Cortan, Pathologic Basis of Disease, VIII Edition, Saunders
- Prakash, G. (2012), Lab Manual on Blood Analysis and Medical Diagnostics, S. Chand and Co. Ltd.

Tutorial – 01 Credit
Unit 1: Foundations of Research
Meaning, Objectives, Motivation: Research Methods vs Methodology, Types of Research: Analytical vs Descriptive, Quantitative vs Qualitative, Basic vs Applied

Unit 2: Research Design
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
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
Intellectual property Rights, Commercialization, Copy Right, Royalty, Patent law, Plagiarism, Citation, Acknowledgement

SUGGESTED READINGS
- 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

Tutorial – 01 Credit
Unit 1: Introduction
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
Life cycle of *Bombyx mori*
Structure of silk gland and secretion of silk

Unit 3: Rearing of Silkworms
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
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
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.
- Improved Method of Rearing Young age silkworm; S. Krishnaswamy, reprinted CSB, Bangalore, 1986.

Tutorial – 01 Credit
END SEMESTER EXAMINATION (ESE) OF ZOOLOGY HONOURS IN B.Sc. PROGRAMME
THEORY EXAMINATION

SCHEME OF EXAMINATION

1. English shall be the medium of instruction and examination.
2. Examinations shall be conducted at the end of each semester as per the Academic Calendar notified by Himachal Pradesh University.
3. Each course will carry **100 marks** and will have following components

1. **Theory Paper End-Semester examination**  50 marks
2. **Practicals**  30 marks
3. **Internal Assessment**  20 Marks

Theory Paper + Practicals + Internal Assessment  (50+30+ 20) =100 marks

Scheme of Examination for every course (Core Course, Discipline Specific Elective Course, Generic Elective Course):

End Semester Examination  50 marks  Time 3 hrs
Practical for every course  30 marks  Time 3 hrs
Internal Assessment  20 Marks

**Skill Enhancement Course & Ability Enhancement Compulsory Course:**

Theory Paper End Semester Examination  100 marks