Annexure- B

H.P. University, Summerhill, Shimla

Structure and Syllabus

of

Zoology Honours

for

B.Sc. Undergraduate Programme

Based on:

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

(Effective from academic session July, 2018)

HIMACHAL PRADESH UNIVERSITY
SUMMER-HILL, SHIMLA-171005
GENERAL INSTRUCTIONS/ GUIDELINES FOR EXECUTION OF CURRICULUM

1. The B.Sc. (Honours) Zoology will be of three years duration annually-based Choice Based Credit System [CBCS] course.

1. 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]: 50 marks; Practical [P]: 20 marks and Internal Assessment [IA]: 30.

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.
2. **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 $4 \times 4 = 16$ credits could be accumulated under these courses during the Honours degree program i.e. $4 \times 2 = 8$ credits for AECC, and $4 \times 2 = 8$ credits for SEC courses.

The AECC courses are the mandatory courses based upon the content that leads to knowledge enhancement; i.e. 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.

II. **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 (20 marks) for the practical examination will be split as follows;

- Write up of Practical I: 4 marks
- Write up of Practical II: 4 marks
- Performance of any one of these practicals: 4 marks
- Practical record/ notebook: 4 marks
- Viva voce: 4 marks

III. **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:

- □ 75% but < 80% 1 marks
- □ 80% but <85% 2 marks
- □ 85 but <90% 3 marks
- □ 90% but < 95% 4 marks
- □ 95% TO 100% 5 marks
IV. 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.
<table>
<thead>
<tr>
<th>Discipline Specific Course (14)</th>
<th>Ability Enhancement</th>
<th>Skill Enhancement Compulsory Course (2)</th>
<th>Discipline Specific Course SEC</th>
<th>Generic Elective DCE (4)</th>
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<tr>
<td>Non-chordates I: Protista to Pseudocoelomates ZOOL(H) 101 TH; ZOOL(H) 101 PR</td>
<td>i. Environment Science ENVS1AECC 02 ii. English ENGL 103/Hindi/SKT</td>
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| DSC II | Principles of Ecology  
ZOOL(H) 102 TH; ZOOL(H) 102 PR |
| DSC III | Non-chordates II: Coelomates  
ZOOL(H) 103 TH; ZOOL(H) 103 PR |
| DSC IV | Cell Biology  
ZOOL(H) 104 TH; ZOOL(H) 104 PR |
| DSC V | Diversity of Chordates  
ZOOL(H) 201 TH; ZOOL(H) 201 PR |
| DSC VI | Physiology: Controlling and Coordinating Systems  
ZOOL(H) 202 TH; ZOOL(H) 202 PR |
| DSC VII | Fundamentals of Biochemistry  
ZOOL(H) 203 TH; ZOOL(H) 203 PR |
| DSC VIII | Comparative Anatomy of Vertebrates  
ZOOL(H) 204 TH; ZOOL(H) 204 PR |
| DSC IX | Physiology: Life Sustaining Systems  
ZOOL(H) 205 TH; ZOOL(H) 205 PR |
| DSC X | Biochemistry of Metabolic Processes  
ZOOL(H) 206 TH; ZOOL(H) 206 PR |
| DSC XI | Molecular Biology  
ZOOL(H) 301 TH; ZOOL(H) 301 PR |
| DSC XII | Principles of Genetics  
ZOOL(H) 302 TH; ZOOL(H) 302 PR |
| DSC XIII | Developmental Biology  
ZOOL(H) 303 TH; ZOOL(H) 303 PR |
| DSC XIV | Evolutionary Biology  
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<th>Animal Behavior and Chronobiology ZOOL(H) 305A-TH, ZOOL(H)305 B- PR</th>
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### GENERIC ELECTIVE COURSE COURSES

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<th>Animal Cell Biotechnology ZOOL(H) 105A-TH, ZOOL(H)105 B- PR</th>
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<td>Environment And Public Health  ZOOL(H) 106 B-TH, ZOOL(H) 106 B-PR</td>
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<td>Exploring the brain : Structure and Function ZOOL(H) 107 A - TH, ZOOL(H) 107 A- PR</td>
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<td>Insect Vectors and Disease ZOOL (H) 108 B- TH, ZOOL (H) 108 B-PR</td>
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### SKILL ENHANCEMENT COURSES

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<td>Sericulture ZOOL(H) 208 C-TH</td>
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B.Sc. I Year

CORE COURSE I NON-CHORDATES I: PROTISTS TO PSEUDOCELOMATES 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

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/microphotographs)
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>
</tr>
</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>
<td></td>
</tr>
<tr>
<td><strong>Unit 2: Population</strong></td>
<td>24</td>
</tr>
<tr>
<td>Unitary and Modular populations</td>
<td></td>
</tr>
<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>
</tr>
<tr>
<td>Exponential and logistic growth, equation and patterns, r and K strategies</td>
<td></td>
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<tr>
<td>Population regulation - density-dependent and independent factors</td>
<td></td>
</tr>
<tr>
<td>Population interactions, Gause’s Principle with laboratory and field examples, Lotka-Volterra equation for competition and Predation, functional and numerical responses</td>
<td></td>
</tr>
<tr>
<td><strong>Unit 3: Community</strong></td>
<td>12</td>
</tr>
<tr>
<td>Community characteristics: species richness, dominance, diversity, abundance, vertical stratification, Ecotone and edge effect; Ecological succession with one example</td>
<td></td>
</tr>
<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>
</tr>
<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>
</tr>
<tr>
<td>Nutrient and biogeochemical cycle with one example of Nitrogen cycle Human modified ecosystem</td>
<td></td>
</tr>
<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>
PRACTICALS

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


CORE COURSE III
NON-CHORDATES II: COELOMATES ZOOL(H) 103 TH

THEORY

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 trophophore larva

Unit 6: Echinodermata

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

NON-CHORDATES II: COELOMATES

ZOOL(H) 103 PR

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

CORE COURSE IV
CELL BIOLOGY ZOOL(H) 104 TH

THEORY (Credits 4)
Unit 1: Overview of Cells 3
Prokaryotic and Eukaryotic cells, Virus, Viroids, Mycoplasma, Prions

Unit 2: Plasma Membrane 7
Various models of plasma membrane structure
Transport across membranes: Active and Passive transport, Facilitated transport
Cell junctions: Tight junctions, Desmosomes, Gap junctions

Unit 3: Endomembrane System 10
Structure and Functions: Endoplasmic Reticulum, Golgi Apparatus, Lysosomes

Unit 4: Mitochondria and Peroxisomes 8
Mitochondria: Structure, Semi-autonomous nature, Endosymbiotic hypothesis
Mitochondrial Respiratory Chain, Chemi-osmotic hypothesis
Peroxisomes

Unit 5: Cytoskeleton 8
Structure and Functions: Microtubules, Microfilaments and Intermediate filaments

Unit 6: Nucleus 12
Structure of Nucleus: Nuclear envelope, Nuclear pore complex, Nucleolus
Chromatin: Euchromatin and Heterochromatin and packaging (nucleosome)

Unit 7: Cell Division 8
Mitosis, Meiosis, Cell cycle and its regulation

Unit 8: Cell Signaling 4
GPCR and Role of second messenger (cAMP)
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

B.Sc. IIInd Year
CORE COURSE V
DIVERSITY OF CHORDATA
ZOOL(H) 201 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 Migration, 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;
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) 201 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

1. Agnatha
   *Petromyzon, Myxine*

2. Fishes
   *Scoliodon, Sphyrna, Pristis, Torpedo, Chimaera, Mystus, Heteropneustes, Labeo, Exocoetus, Echeneis, Anguilla, Hippocampus, Tetrodon/ Diodon, Anabas*, Flat fish

3. Amphibia
   *Ichthyophis/Ureotyphlus, Necturus, Bufo, Hyla, Alytes, Salamandra*

4. Reptilia
   *Chelone, Trionyx, Hemidactylus, Varanus, Uromastix, Chamaeleon, Ophiosaurus, Draco, Bungarus, Vipera, Naja, Hydrophis, Zamenis, Crocodylus*
   Key for Identification of poisonous and non-poisonous snakes

5. Aves
   Study of six common birds from different orders. Types of beaks and claws

6. 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

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

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 nonsteroidal 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) 202 PR

PRACTICALS

(Credits 2)

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

(*Subject to UGC guidelines)

SUGGESTED BOOKS

CORE COURSE VII

FUNDAMENTALS OF BIOCHEMISTRY

ZOOL(H) 203 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 α-amino acids; Physiological importance of essential and non-essential α-amino acids
Proteins: Bonds stabilizing protein structure; Levels of organization in proteins; Denaturation; Introduction to simple and conjugate proteins
Immunoglobulins: Basic Structure, Classes and Function, Antigenic Determinants

Unit 4: Nucleic Acids 12
Structure: Purines and pyrimidines, Nucleosides, Nucleotides, Nucleic acids
Cot Curves: Base pairing, Denaturation and Renaturation of DNA
Types of DNA and RNA, Complementarity of DNA, 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; Multisubstrate reactions; Enzyme inhibition; Allosteric enzymes and their kinetics; Regulation of enzyme action

26
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

THEORY

(CREDITS 4)

Unit 1: Integumentary System 8
Structure, functions and derivatives of integument

Unit 2: Skeletal System 8
Overview of axial and appendicular skeleton, Jaw suspensorium, Visceral arches

Unit 3: Digestive System 8
Alimentary canal and associated glands, dentition

Unit 4: Respiratory System 8
Skin, gills, lungs and air sacs; Accessory respiratory organs

Unit 5: Circulatory System 8
General plan of circulation, evolution of heart and aortic arches

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

Unit 7: Nervous System 8
Comparative account of brain
Autonomic nervous system, Spinal cord, Cranial nerves in mammals

Unit 8: Sense Organs 6
Classification of receptors
Brief account of visual and auditory receptors in man
COMPARATIVE ANATOMY OF VERTEBRATES
ZOOL(H) 204 PR

PRACTICAL (CREDITS 2)

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

SUGGESTED READINGS

- 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
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-Kininogen 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) 205 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 haemin and haemochromogen crystals
5. Recording of frog’s heart beat under in situ and perfused conditions*
6. Recording of blood pressure using a sphygmomanometer
7. Examination of sections of mammalian oesophagus, stomach, duodenum, ileum, rectum liver, trachea, lung, kidney

(*Subject to UGC guidelines)

SUGGESTED READINGS

THEORY

(CREDITS 4)

Unit 1: Overview of Metabolism 10

Catabolism vs Anabolism, Stages of catabolism, Compartmentalization of metabolic pathways, Shuttle systems and membrane transporters; ATP as "Energy Currency of cell"; coupled reactions; Use of reducing equivalents and cofactors; Intermediary metabolism and regulatory mechanisms

Unit 2: Carbohydrate Metabolism 16

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

Unit 3: Lipid Metabolism 14 β-oxidation and omega-oxidation of saturated fatty acids with even and odd number of carbon atoms; Biosynthesis of palmitic acid; Ketogenesis

Unit 4: Protein Metabolism 10

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

Unit 5: Oxidative Phosphorylation 10

Redox systems; Review of mitochondrial respiratory chain, Inhibitors and uncouplers of Electron Transport System
PRACTICALS

1. Estimation of total protein in given solutions by Lowry’s method.
2. Detection of SGOT and SGPT or GST and GSH in serum/tissue
3. To study the enzymatic activity of Trypsin and Lipase.
4. Study of biological oxidation (SDH) [goat liver]
5. To perform the Acid and Alkaline phosphatase assay from serum/tissue.
6. Dry Lab: To trace the labelled C atoms of Acetyl-CoA till they evolve as CO$_2$ in the TCA cycle

SUGGESTED READINGS

THEORY (CREDITS 4)

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

Unit 2: DNA Replication
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
RNA polymerase and transcription Unit, mechanism of transcription in prokaryotes and eukaryotes, synthesis of rRNA and mRNA, transcription factors

Unit 4: Translation
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
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
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

34
Unit 7: DNA Repair Mechanisms
Pyrimidine dimerization and mismatch repair

Unit 8: Regulatory RNAs
Ribo-switches, RNA interference, miRNA, siRNA

MOLECULAR BIOLOGY
ZOOL(H) 301 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

CORE COURSE XII
PRINCIPLES OF GENETICS
ZOOL(H) 302 TH

THEORY (CREDITS 4)

Unit 1: Mendelian Genetics and its Extension 8
Principles of inheritance, Incomplete dominance and co-dominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Sex-linked, sex-influenced and sex-limited characters inheritance.

Unit 2: Linkage, Crossing Over and Chromosomal Mapping 12
Linkage and crossing over, Cytological basis of crossing over, Molecular mechanisms of crossing over including models of recombination, Recombination frequency as a measure of linkage intensity, Two factor and three factor crosses, Interference and coincidence, Somatic cell hybridization.

Unit 3: Mutations 10
Types of gene mutations (Classification), Types of chromosomal aberrations (Classification, figures and with one suitable example of each), Molecular basis of mutations in relation to UV light and chemical mutagens; Detection of mutations: CLB method, attached X method.

Unit 4: Sex Determination 4
Chromosomal mechanisms of sex determination in Drosophila and Man

Unit 5: Extra-chromosomal Inheritance 6
Criteria for extra-chromosomal inheritance, Antibiotic resistance in Chlamydomonas, Mitochondrial mutations in Saccharomyces, Infective heredity in Paramecium and Maternal effects

Unit 6: Polygenic Inheritance 3
Polygenic inheritance with suitable examples; simple numericals based on it.
Unit 7: Recombination in Bacteria and Viruses
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

PRINCIPLES OF GENETICS
ZOOI(H) 302 PR

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) 303 TH

THEORY (CREDITS 2)

Unit 1: Introduction
Historical perspective and basic concepts: Phases of development, Cell-Cell interaction, Pattern formation, Differentiation and growth, Differential gene expression, Cytoplasmic determinants and asymmetric cell division

Unit 2: Early Embryonic Development
Gametogenesis, Spermatogenesis, Oogenesis; Types of eggs, Egg membranes; Fertilization (External and Internal): Changes in gametes, Blocks to polyspermy; Planes and patterns of cleavage; Types of Blastula; Fate maps (including Techniques); Early development of frog and chick up to gastrulation; Embryonic induction and organizers

Unit 3: Late Embryonic Development
Fate of Germ Layers; Extra-embryonic membranes in birds; Implantation of embryo in humans, Placenta (Structure, types and functions of placenta)

Unit 4: Post Embryonic Development
Metamorphosis: Changes, hormonal regulations in amphibians and insects; Regeneration: Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each); Ageing: Concepts and Theories

Unit 5: Implications of Developmental Biology
Teratogenesis: Teratogenic agents and their effects on embryonic development; In vitro fertilization, Stem cell (ESC), Amniocentesis

PRACTICALS (CREDITS 2)

1. Study of whole mounts and sections of developmental stages of frog through permanent slides: Cleavage stages, blastula, gastrula, neurula, tail-bud stage, tadpole (external and internal gill stages)
2. Study of whole mounts of developmental stages of chick through permanent slides: Primitive streak (13 and 18 hours), 21, 24, 28, 33, 36, 48, 72, and 96 hours of incubation (Hamilton and Hamburger stages)
3. Study of the developmental stages and life cycle of *Drosophila* from stock culture
4. Study of different sections of placenta (photomicrograph/slides)
5. Project report on *Drosophila* culture/chick embryo development

SUGGESTED READINGS

- Carlson, R. F. Patten's Foundations of Embryology

**CORE COURSE XIV**
**EVOLUTIONARY BIOLOGY**

**ZOOL(H) 304 TH**

**THEORY** (CREDITS 4)

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

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

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

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

**Unit 5:** 14 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, Back ground 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

**EVOLUTIONARY BIOLOGY**

**ZOOL(H) 304 PR**

**PRACTICALS**  
(CREDITS 2)

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

**SUGGESTED READINGS**


• Snustad. S Principles of Genetics.


**DISCIPLINE CENTRIC ELECTIVE COURSES**

**DSE 1**

**ANIMAL BEHAVIOUR AND CHRONOBIOLOGY**

ZOOL(H) 305A 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

Relevance of biological clocks; Chronopharmacology, Chronomedicine, Chronotherapy.

ANIMAL BEHAVIOUR AND CHRONOBIOLOGY
ZOOL(H) 305 A PR

PRACTICAL (Credits 2)

1. To study nests and nesting habits of the birds and social insects.

2. To study the behavioural responses of wood lice to dry and humid conditions.

3. To study geotaxis behaviour in earthworm.

4. To study the phototaxis behaviour in insect larvae.

5. Visit to Forest/ Wild life Sanctuary/Biodiversity Park/Zoological Park to study behavioural activities of animals and prepare a short report.

6. Study and actogram construction of locomotor activity of suitable animal models.

7. Study of circadian functions in humans (daily eating, sleep and temperature patterns).

SUGGESTED READINGS


• John Alcock, Animal Behaviour, Sinauer Associate Inc., USA.

• Paul W. Sherman and John Alcock, Exploring Animal Behaviour, Sinauer Associate Inc., Massachusetts, USA.
DSE 1
ANIMAL BIOTECHNOLOGY
ZOOL(H) 305BTH

THEORY 
(Credits 4)

Unit 1. Introduction
Concept and scope of biotechnology

Unit 2. Molecular Techniques in Gene manipulation
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
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**

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)**

**305B 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.
4. Calculation of transformation efficiency from the data provided.
5. To study following techniques through photographs
   a. Southern Blotting
   b. Northern Blotting
   c. Western Blotting
   d. DNA Sequencing (Sanger's Method)
   e. PCR
   f. DNA fingerprinting
6. Project report on animal cell culture
SUGGESTED READINGS


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; Ionotrophic 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.
BASICS OF NEUROSCIENCE  
ZOOL(H) 306A 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.  
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
General Features of Insects
Distribution and Success of Insects on the Earth

Unit II: Insect Taxonomy
Basis of insect classification; Classification of insects up to orders

Unit III: General Morphology of Insects
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
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
Group of social insects and their social life
Social organization and social behaviour (w.r.t. any one example)

Unit V: Insect Plant Interaction
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
Insects as mechanical and Biological vectors, Brief discussion on houseflies and mosquitoes as important insect vectors
BIOLOGY OF INSECTA ZOOL(H) 306B PR

(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 2**
**COMPUTATIONAL BIOLOGY ZOOL(H) 306C TH**

**THEORY**

*(Credits 4)*

**Unit 1: Introduction to Bioinformatics**

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

<table>
<thead>
<tr>
<th><strong>Unit 2: Biological Databases</strong></th>
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<tbody>
<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>
</tbody>
</table>

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

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

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

Scoring Matrices (PAM, BLOSUM), Methods of Alignment (Dot matrix, Dynamic Programming, BLAST and FASTA); Local and global alignment, pair wise and multiple sequence alignments; Similarity, identity and homology of sequences.
Unit 4: Applications of Bioinformatics

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

Unit 5: Biostatistics

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

COMPUTATIONAL BIOLOGY ZOOL(H)

306C PR

(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
54
7. To learn graphical representations of statistical data with the help of computers (e.g. MS Excel).

SUGGESTED READINGS

• Zvelebil, Marketa and Baum O. Jeremy (2008). Understanding
DSE 3  
ENDOCRINOLOGY  
ZOOL(H) 307 A TH

**THEORY**  
(Credits 4)

<table>
<thead>
<tr>
<th>Unit</th>
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<td>Introduction to Endocrinology</td>
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<td>Epiphysis, Hypothalamo-hypophysial Axis</td>
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<td>Peripheral Endocrine Glands</td>
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<td>4</td>
<td>Regulation of Hormone Action</td>
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</tr>
</tbody>
</table>

**Unit 1: Introduction to Endocrinology**

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

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

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**

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**

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) 307A PR

Credits 2)

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

SUGGESTED READINGS

- General Endocrinology C. Donnell Turner Pub- Saunders Toppan
- Endocrinology: An Integrated Approach; Stephen Nussey and Saffron Whitehead.
- Vertebrate Endocrinology by David O. Norris.
DSE 3
FISH AND FISHERIES ZOOL(H) 307 B TH

THEORY

(Credits 4)

UNIT 1: Introduction and Classification:  6
General description of fish; Account of systematic classification of fishes (upto classes); Classification based on feeding habit, habitat and manner of reproduction.

UNIT 2: Morphology and Physiology:  18
Types of fins and their modifications; Locomotion in fishes; Hydrodynamics; Types of Scales, Use of scales in Classification and determination of age of fish; Gills and gas exchange; Swim Bladder: Types and role in Respiration, buoyancy; Osmoregulation in Elasmobranchs; Reproductive strategies (special reference to Indian fishes); Electric organs; Bioluminiscence; Me chanoreceptors; Schooling; Parental care; Migration

UNIT 3: Fisheries  12
Inland Fisheries; Marine Fisheries; Environmental factors influencing the seasonal variations in fish catches in the Arabian Sea and the Bay of Bengal; Fishing crafts and Gears; Depletion of fisheries resources; Application of remote sensing and GIS in fisheries; Fisheries law and regulations

Unit 4: Aquaculture  20
Sustainable Aquaculture; Extensive, semi-intensive and intensive culture of fish; Pen and cage culture; Polyculture; Composite fish culture; Brood stock management; Induced breeding of fish; Management of finfish hatcheries; Preparation and maintenance of fish aquarium; Preparation of compound diets for fish; Role of water quality in aquaculture; Fish diseases: Bacterial, viral and parasitic; Preservation and processing of harvested fish, Fishery by-products

UNIT 5: Fish in research  4
Transgenic fish, Zebrafish as a model organism in research
FISH AND FISHERIES
ZOOL(H) 307B PR

(Credits 2)

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.
- 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>Title</th>
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<tbody>
<tr>
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<td>Overview of Immune System</td>
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<td>Innate and Adaptive Immunity</td>
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<td>Immunoglobulins</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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</tbody>
</table>

**THEORY**

**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.

IMMUNOLOGY
ZOOL(H) 307 C PR

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

DSE 4
PARASITOLOGY ZOOL(H) 308A TH

THEORY (CREDITS 4)

Unit I: Introduction to Parasitology 3
Brief introduction of Parasitism, Parasite, Parasitoid and Vectors (mechanical and biological vector) Host parasite relationship

Unit II: Parasitic Protists 15
Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of Entamoeba histolytica, Giardia intestinalis, Trypanosoma gambiense, Leishmania donovani, Plasmodium vivax

Unit III: Parasitic Platyhelminthes 15
Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of Fasciolopsis buski, Schistosoma haematobium, Taenia solium and Hymenolepis nana

Unit IV: Parasitic Nematodes 15
Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of Ascaris lumbricoides, Ancylostoma duodenale, Wuchereria bancrofti and Trichinella spiralis. Study of structure, life cycle and importance of Meloidogyne (root knot nematode), Pratylenchus (lesion nematode)

Unit IV: Parasitic Arthropoda 10
Biology, importance and control of ticks, mites, Pediculus humanus (head and body louse), Xenopsylla cheopis and Cimex lectularius

Unit V: Parasitic Vertebrates 2
A brief account of parasitic vertebrates; Cookicutter Shark, Candiru, Hood Mockingbird and Vampire bat
PARASITOLOGY
ZOOLO(H) 308A PR

PRACTICAL (Credits 2)

• 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

  Publications and Distributors □

DSE 10
REPRODUCTIVE BIOLOGY
ZOOL(H) 308B TH

THEORY (CREDITS 4)

Unit 1: Reproductive Endocrinology 15

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

Unit 2: Functional anatomy of male reproduction 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
REPRODUCTIVE BIOLOGY ZOOL(H) 308B PR 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 4
WILD LIFE CONSERVATION AND MANAGEMENT
ZOOL(H) 308 C TH THEORY (CREDITS 4)

Unit 1: Introduction to Wild Life
Values of wild life - positive and negative; Conservation ethics; Importance of conservation; Causes of depletion; World conservation strategies.
Unit 2: Evaluation and management of wild life
Habitat analysis, Physical parameters: Topography, Geology, Soil and water; Biological Parameters: food, cover, forage, browse and cover estimation; Standard evaluation procedures: remote sensing and GIS.

Unit 3: Management of habitats
Setting back succession; Grazing logging; Mechanical treatment; Advancing the successional process; Cover construction; Preservation of general genetic diversity; Restoration of degraded habitats

Unit 4: Population estimation
Population density, Natality, Birth rate, Mortality, fertility schedules and sex ratio computation; Faecal analysis of ungulates and carnivores: Faecal samples, slide preparation, Hair identification, Pug marks and census method.

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

Unit 7: Management of excess population
Bio- telemetry; Care of injured and diseased animal; Quarantine; Common diseases of wild animal

Unit 8: Protected areas
National parks & sanctuaries, Community reserve; Important features of protected areas in India; Tiger conservation - Tiger reserves in India; Management challenges in Tiger reserve.
GENERIC ELECTIVE COURSES
GENERIC ELECTIVE COURSES
GE 1
ANIMAL CELL BIOTECHNOLOGY
ZOOL(H) 105A TH

THEORY (CREDITS 4)

UNIT 1: Introduction
5
Concept and Scope of Biotechnology

UNIT 2: Techniques in Gene manipulation
20
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
15
Basic techniques in animal cell culture and organ culture, Primary Culture and Cell lines, Culture media- Natural and Synthetic, Stem cells, Cryopreservation of cultures.
Agarose and Polyacrylamide Gel Electrophoresis, Southern, Northern and Western blotting, DNA sequencing: Sanger method, Polymerase chain reaction, DNA Fingerprinting and DNA microarrays.

UNIT 4: Fermentation
8
Different types of Fermentation: Submerged & Solid state; batch, Fed batch &Continuous; Stirred tank, Air Lift, Fixed Bed and Fluidized.
Downstream Processing: Filtration, centrifugation, extraction, chromatography, spray drying and lyophilization.

UNIT 5: Transgenic Animal Technology
5
Production of transgenic animals: nuclear transplantation, Retroviral method, DNA microinjection method, Dolly and Polly.

UNIT 6: Application in Health
5
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
ANIMAL CELL BIOTECHNOLOGY
ZOOL(H) 105 PR

PRACTICAL

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

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<td><strong>Unit 1. Protista</strong></td>
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<tr>
<td>General characters of Protozoa; Life cycle of Plasmodium</td>
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<td><strong>Unit 2. Porifera</strong></td>
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<tr>
<td>General characters and canal system in Porifera</td>
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<td><strong>Unit 3. Radiata</strong></td>
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<td>General characters of Cnidarians and polymorphism</td>
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<td>General characters of Helminthes; Life cycle of <em>Taenia solium</em></td>
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<td>General characters of mollusca; Pearl Formation</td>
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<td><strong>Unit 9. Coelomate Deuterostomes</strong></td>
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<td>General characters of Echinodermata, Water Vascular system in Starfish.</td>
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<td>4</td>
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<tr>
<td>Osmoregulation, Migration of Fishes</td>
<td></td>
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<tr>
<td><strong>Unit 12. Amphibia</strong></td>
<td>5</td>
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<tr>
<td>General characters, Adaptations for terrestrial life, Parental care in Amphibia.</td>
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<tr>
<td><strong>Unit 13. Amniotes</strong></td>
<td>6</td>
</tr>
<tr>
<td>Origin of reptiles. Terrestrial adaptations in reptiles</td>
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</tr>
</tbody>
</table>
Unit 14. Aves:
The origin of birds; Flight adaptations

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

ZOOL(H) 105B PR
PRACTICAL (CREDITS 2)

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


70
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 (Credits 2)

ZOOL(H)106A 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 bioreserve/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 □
GE 2
ENVIRONMENT AND PUBLIC HEALTH ZOOL(H) 106B TH

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

ENVIRONMENT AND PUBLIC HEALTH ZOOL(H) 106B PR

PRACTICAL (Credits 2)

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

SUGGESTED BOOKS
70
GE 3

EXPLORING THE BRAIN: STRUCTURE AND FUNCTION
ZOOL(H) 107A TH

THEORY  (Credits 4 )

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

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

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

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

Unit 5: Understanding Brain Structure through Development:  
Formation of neural tube, Primary brain vesicles; Differentiation of forebrain, midbrain and hindbrain. Cerebral cortex – neocortical evolution and structure-function relationship
Unit 6: Chemical Control of Brain and Behaviour: 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) 107A 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 3

FOOD, NUTRITION AND HEALTH
ZOOL(H) 107B 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

72
Unit 2: Nutritional Biochemistry:

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

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 Immune Deficiency Syndrome (AIDS) - their causes, treatment and prevention

Common ailments- cold, cough, and fevers, their causes and treatment

Unit 4: Food hygiene:

Potable water- sources and methods of purification at domestic level

Food and Water borne infections: Bacterial infection: Cholera, typhoid fever, dysentery; Viral infection: Hepatitis, Poliomyelitis, Protozoan infection: amoebiasis, giardiasis; Parasitic infection: taeniasis and ascariasis their transmission, causative agent, sources of infection, symptoms and prevention

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

PRACTICAL (Credits 2)

ZOOL(H) 107B PR

1. To detect adulteration in a) Ghee b) Sugars c) Tea leaves and d) Turmeric

3. Estimation of Lactose in milk

4. Ascorbic acid estimation in food by titrimetry

5. Estimation of Calcium in foods by titrimetry
6. Study of the stored grain pests from slides/photograph (*Sitophilus oryzae, Trogoderma granarium, Callosobruchus chinensis* and *Tribolium castaneum*): their identification, habitat and food sources, damage caused and control. Preparation of temporary mounts of the above stored grain pests.

76

7. Project- Undertake computer aided diet analysis and nutrition counseling for different age groups.

OR

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

OR

Study of nutrition labeling on selected foods

SUGGESTED BOOKS

- Mudambi, SR and Rajagopal, MV. Fundamentals of Foods, Nutrition and Diet Therapy; Fifth Ed; 2007; New Age International Publishers
- Srilakshmi B. Nutrition Science; 2002; New Age International (P) Ltd.
- Srilakshmi B. Food Science; Fourth Ed; 2007; New Age International (P) Ltd.
- Swaminathan M. Handbook of Foods and Nutrition; Fifth Ed; 1986; BAPPCO.
- Wardlaw GM, Hampfl 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
GE 4
HUMAN PHYSIOLOGY ZOOL(H) 108A TH

THEORY

(CREDITS 4)

Unit 1: Digestion and Absorption of Food 12
Structure and function of digestive glands; Digestion and absorption of carbohydrates, fats and proteins; Nervous and hormonal control of digestion (in brief)

Unit 2: Functioning of Excitable Tissue (Nerve and Muscle) 10
Structure of neuron, Propagation of nerve impulse (myelinated and non-myelinated nerve fibre); Structure of skeletal muscle, Mechanism of muscle contraction (Sliding filament theory), Neuromuscular junction

Unit 3: Respiratory Physiology 6
Ventilation, External and internal Respiration, Transport of oxygen and carbon dioxide in blood, Factors affecting transport of gases.

Unit 4: Renal Physiology 8
Functional anatomy of kidney, Mechanism and regulation of urine formation,

Unit 5: Cardiovascular Physiology 10
Structure of heart, Coordination of heartbeat, Cardiac cycle, ECG

Unit 6: Endocrine and Reproductive Physiology 14
Structure and function of endocrine glands (pituitary, thyroid, parathyroid, pancreas, adrenal, ovaries, and testes), Brief account of spermatogenesis and oogenesis, Menstrual cycle

HUMAN PHYSIOLOGY
ZOOL(H) 108A PR

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 4

INSECT VECTORS AND DISEASES ZOOL(H) 108 B 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

6

**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

6

**Unit III: Insects as Vectors**

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

8

**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

24

76
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) 108B 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


77
SKILL ENHANCEMENT COURSES
SEC 1
APICULTURE ZOOL(H) 207ATH

(CREDITS 4) (3+1)

Unit 1: Biology of Bees (10)
History, Classification and Biology of Honey
Bees Social Organization of Bee Colony

Unit 2: Rearing of Bees (15)
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 (8)
Bee Diseases and Enemies
Control and Preventive measures

Unit 4: Bee Economy (6)
Products of Apiculture Industry and its Uses (Honey, Bees Wax, Propolis), Pollen etc

Unit 5: Entrepreneurship in Apiculture (6)
Bee Keeping Industry – Recent Efforts, Modern Methods in employing artificial
Beehives for cross pollination in horticultural gardens

SUGGESTED READINGS

• Bisht D.S., Apiculture, ICAR Publication.
• Singh S., Beekeeping in India, Indian council of Agricultural Research, NewDelhi.

Tutorial – 01 Credit
AQUARIUM FISH KEEPING ZOOL(H) 207 B TH

(CREDITS 4)

(3+01)

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

• Mary Bailey, Gina Sandford; The Complete Guide to Aquarium Fish Keeping (Practical Handbook) Publishers: Lorenz Books

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

Tutorial – 01 Credit
SEC 2
MEDICAL DIAGNOSTICS ZOOL(H) 208A TH

(Credits 4)
THEORY (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, VIIIEdition, Saunders
• Prakash, G. (2012), Lab Manual on Blood Analysis and Medical Diagnostics, S. Chand and Co. Ltd.

Tutorial – 01 Credit

SEC 2
RESEARCH METHODOLOGY ZOOL(H) 208 B TH

CREDITS 4
(3+01)

Unit 1: Foundations of Research 8

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

Unit 2: Research Design 15

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 15

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 7

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

SEC 2
SERICULTURE
ZOOL(H) 208C TH

(CREDITS 4)

(3+01)

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.


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

• Improved Method of Rearing Young age silkworm; S. Krishnaswamy, reprinted CSB, Bangalore, 1986.
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** 20 marks
3. **Internal Assessment** 30 Marks

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

Distribution of Internal Assessment /CCA

(i) Class Attendance = 5 Marks
(ii) Class test to be taken on completion of 40% syllabus by the class teacher = 5 Marks
(iii) House test to be taken on completion of 75 % of Syllabus = 10 Marks
(iv) Assignments, Tutorials, general behavior of Students = 10 Marks

**Marks for Class attendance**

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<thead>
<tr>
<th>Percentage</th>
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<tr>
<td>75 % but &lt; 80 %</td>
<td>1</td>
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<tr>
<td>80 % but &lt; 85 %</td>
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<td>85 % but &lt; 90 %</td>
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<td>90 % but &lt; 95 %</td>
<td>4</td>
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<td>95 % to 100 %</td>
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**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 20 Marks Time 3 hrs
Internal Assessment 30 Marks

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

Skill Enhancement Course 100 Marks (Theory 70 + CCA 30)

Ability Enhancement Compulsory Course: 1. Environment Science = 100 Marks

2 English/Hindi/SKT = 100 Marks (Theory 70 + CCA 30)