

FIRST SEMESTER B.Sc. ZOOLOGY COMPLEMENTARY COURSE

Theory Course- I

ANIMAL DIVERSITY AND WILDLIFE CONSERVATION

Code: ZOL1C01T

[36 hrs] [2 hours/week] [3 credits]

COURSE OUTCOMES [COs]

COs	Course Outcome Statements
CO1	Describe the general characters of protists and salient features of phylum – Rhizopoda, Ciliophora, Dinoflagellata and Apicomplexa (2 hrs)
CO2	Enumerate the salient features and examples of Phylum – Porifera, Coelenterata, Platyhelminthes, Aschelminthes, Annelida, Arthropoda, Onychophora, Mollusca and Echinodermata, and the structural organization of <i>Peneaus</i> sp. (14 hrs)
CO3	Describe the characteristic features and classification of phylum Chordata with examples and, structural organization of <i>Oryctolagus cuniculus</i> (14 hrs)
CO4	Explain levels of biodiversity, threats to biodiversity, biodiversity hotspots, importance and strategies for conservation of wildlife and sustainable development (6 hrs)

Question paper pattern for external examination

[Module: 1 Short answer 2x2=4marks

Module: 2 Short answer 3x2 = 6marks, Paragraph 3x5=15 marks; Essay 1x10=10 marks

Module: 3 Short answer 3x2= 6 marks; Paragraph 3x5=15 marks; Essay 1x10=10 marks

Module: 4 Short answer 4x2=8 marks, Paragraph 1x5=5marks]

Section A: PROTISTA

MODULE 1. Kingdom Protista (2 hrs)

General characters.

Salient features of protozoans.

Phylum Dinoflagellata: e.g. Noctiluca

Phylum Ciliophora: e.g. Vorticella

Phylum Rhizopoda: e. g. Amoeba

Phylum Apicomplexa: e.g. Plasmodium (exclude life cycle)

[Short answers]

Section B: Animal Diversity

MODULE 2: Animal diversity-Part I Nonchordata (14 hrs)

Salient features of phyla, classification down to classes

(8 hrs)

Phylum Porifera: e.g. *Leucosolenia*

Phylum Coelenterata: e.g. *Obelia*, *Aurelia*, *Sea anemone*

Phylum Platyhelminthes: e.g: *Fasciola*, *Schistosoma*

Phylum Aschelminthes: e.g. *Ascaris*, *Enterobius*

Phylum Annelida: e.g: *Arenicola*, *Hirudinaria*, *Megascolex*

Phylum Arthropoda: e.g: *Limulus*, *Sacculina*, *Eupagurus*,

Phylum Onychophora: e.g: *Peripatus*

Phylum Mollusca: e.g. *Perna*, *Teredo*, *Sepia*, *Pinctada*

Phylum Echinodermata: e.g. *Asterias*, *Holothuria*, *Sea urchin*

Type: *Peneaus* sp. (Exclude details of larval stages)

(6 hrs)

[Short answers/Paragraphs/Essays]

MODULE 3. Animal diversity-Part II Chordata (14 hrs)

Phylum Chordata: Salient features, Mention classes **(6 hrs)**

Sub phylum Urochordata e.g. *Ascidia*

Subphylum Cephalochordata e.g. *Branchiostoma*

Subphylum Vertebrata:

Div I. Agnatha e.g. *Petromyzon, Myxine*

Div II: Gnathostomata

Super class: Pisces

Class: Chondrichthyes: e.g. *Narcine*

Class: Osteichthyes: e.g. *Echeneis, Hippocampus, Heteropneustes, Scomberomorus, Pomfret*

Super class: Tetrapoda

Class Amphibia: e.g. *Ichthyophis, Salamandra, Rhacophorus, Duttaphrynus*, Mention - *Nasikabatrachus sahyadrensis*

Class Reptilia: e.g. *Chamaeleo, Chelone, Naja, Bungarus, Daboia*

Class Aves e.g. *Columba*

Class Mammalia e.g. *Pteropus*

Type: *Oryctolagus cuniculus* **(8 hrs)**

External features, skeletal system, digestive system, respiratory system, circulatory system, sense organs and nervous system. [Exclude skin, skull bones, arterial system, venous system, lymphatic system, autonomous nervous system and endocrine system].

[Short answers/Paragraphs/Essays]

Section C: Conservation Biology

MODULE 4. Conservation Biology (6 hrs)

I. Biodiversity, Levels of biodiversity (brief), significance and uses of biodiversity, threats to biodiversity- (fragmentation, invasive species, over exploitation, poaching, climate change), extinction of species, concept of threatened species.

II Biodiversity hot spots, brief notes on hot spots that include Indian region (Western Ghats and Sri Lanka, Indo Burma, Himalayas and Sundaland); endemism.

III Wild life management and conservation- Importance of wild life, strategies of conservation (*Ex situ* and *In situ*), mention Protection Acts- The Wildlife Protection Act, 1972.

IV Sustainable development (concept)

V. Red Data Book, IUCN, WWF (Brief account)

[Short answers/Paragraphs]

Topics for Assignments/Seminars

(Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students)

1. Project Tiger
2. Project Elephant

3. Operation Rhino

4. Ramsar sites

REFERENCES

- Ahluwalia, V. K. and Sunitha Malhotra (2009) *Environmental Science*, ISBN 10: 8180522113, Ane Books
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- Ekambraanatha Ayyar, M. & Ananthakrishnan, T. N. (2009) *Manual of Zoology, Chordata, Vol. II (Part I)*, ISBN-10: 8187156384, S. Viswanathan, Madras.
- Jordan E.L. & Verma, P.S. (2010) *Chordate Zoology*, ASIN: B00QUYL0ZY, Kindle Edition, S. Chand & Co. 1092 pages
- Jordan E.L. & Verma, P.S. (2009) *Invertebrate Zoology*, 15th Edition, ISBN-10: 9788121903677, S. Chand & Co., 1127 pages
- Kotpal, R.L. (2014) *Modern Text Book of Zoology – Invertebrates*, ISBN, 10: 9350780402, Rastogi
- Rajesh Gopal (2011) *Fundamentals of Wild Life Management*; ISBN-10: 8181581628, Natraj Pub., 1288 pages
- Soper R., D.J. Taylor N.P.O. Green G.W. Stout (2005) *Biological Science 3rd Edn.*, ISBN-10: 9780521684170, Cambridge University Press.

SECOND SEMESTER B.Sc. ZOOLOGY COMPLEMENTARY COURSE

Theory Course- II

ECONOMIC ZOOLOGY

Code: ZOL2C02T

[36 hrs] [2 hours/week] [3 credits]

COURSE OUTCOMES [COs]

COs	Course Outcome Statements
CO1	Explain parasitism and the major protist, cestode, trematode and nematode parasites of man and major insect vectors of human diseases and their control (11 hrs)
CO2	Understand major beneficial and harmful insects, damages caused to host plants and their control measures (14 hrs)
CO3	Understand pisciculture, prawn, mussel and pearl culture (11 hrs)

Question paper pattern for external examination

[Module 1 Short answer 4x2=8 marks, Paragraph 3x5=15 marks

Module 2 Short answer 5x2 = 10 marks, Paragraph 2x5=10 marks; Essay 1x10=10 marks

Module 3 Short answer 3x2=6 marks; Paragraph 2x5=10 marks; Essay 1x10=10 marks]

MODULE 1: Parasitism in relation to man (11 hrs)

Introduction, classification of parasites and hosts (2 hrs)

Obligatory, facultative, external, internal, hyperparasites. Definitive, intermediate, carrier and reserve hosts. Infection and infestation - Mention Hyper infection and Auto infection. Modes of infection - Inoculative, contaminative, direct and retroinfection, zoonotic diseases

Human Parasites (5 hrs)

Parasitic Protists – *Plasmodium vivax*, *Entamoeba histolytica*

Cestodes – *Taenia solium*, mention *T. saginata* and *Echinococcus granulosus*

Trematodes (Flukes) – *Schistosoma haematobium*

Nematodes – *Ancylostoma duodenale*, *Wuchereria bancrofti* and *Enterobius vermicularis*

Vectors of human diseases (4 hrs)

Insect vectors of human diseases and their control. *Anophales*, *Culex*, *Aedes*, *Xenopsylla*, *Cimex*, *Pediculus* and *Pthirus* (Diseases like malaria, filariasis, yellow fever, typhus fever, dengue, plague, chikungunya, kala azar).

[Short answers/Paragraphs]

MODULE 2. Useful Insects, Insect Pests and their control (14 hrs)

Insect Pests (9 hrs)

Definition of Pests, Kinds of Pests, Causes of pest outbreak.

Nature of damage to host plants and control measures of the following pests. (Exclude structure and Life history of Pests).

- Spodoptera* sp. (rice swarming caterpillar)
- Leptocorisa* sp. (rice bug)
- Rhynchophorus* sp. (red palm weevil)
- Opisina* sp. (Black headed caterpillar, mention biological control)
- Aceria* sp. (Coconut mite)
- Helopeltis* sp. (tea bug)
- Cosmopolites* sp. (Banana rhizome weevil)
- Bactrocera* sp. (Fruit fly)

- i) *Batocera* sp. (mango stem borer)
- j) *Sitophilus* sp. (rice weevil)

Insect control (2 hrs)

Basic principles of chemical control and biological control. Integrated Pest Management (IPM) (Brief notes).

Useful Insects (3 hrs)

Apiculture, Sericulture & Lac culture: Economic importance. Predatory insects, insect parasitoids.

[Short answers/Paragraphs/Essays]

MODULE 3. Aquaculture and Fishery Biology (11 hrs)

Brief Introduction mentioning its scope in Kerala. (1 hr)

Pisciculture (5 hrs)

Egg collection and hatching, induced spawning. Nursery ponds, manuring, feeding and harvesting, Ornamental fish farming (brief account). Mention common species. Fish utilization

Prawn culture. (2 hrs)

Breeding and spawning of prawns, seed collection and culture, types of prawn farms, mention common species.

Mussel farming (2 hrs)

Seed collection, artificial collection of seeds, induced spawning, rearing of larvae, farming methods and harvesting.

Pearl Culture (1 hr)

Preparation of nuclei, preparation of host and graft tissue, implantation and nursing.

[Short answers/Paragraphs/Essays]

Topics for Assignments/Seminars

(Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students)

1. *Callosobruchus chinensis* (Pulse beetle).
2. *Eomenacanthus stramineus* (Chicken louse).
3. *Hippobosca maculata* (house fly).
4. *Tabanus striatus* (horse fly).
5. *Pediculus humanus* (head louse)

REFERENCES

- Atuar Rahman (2017) Bee Keeping In India, ISBN-10: 9788171641659, ICAR, India, 270p.
- Borajah, G. (1994) *Lecturers on Sericulture*, 2nd Edition, SBS Pub., Banglaore.
- David B and Ananthkrishnan T. (2004) *General and Applied Entomology*, 2nd Edition, ISBN-10: 9780070434356, McGraw Hill Education, 877 pages
- K K Nayar; T N Ananthkrishnan; B Vasantharaj David (1976) *General & Applied Entomology*, TMH., 589 pages
- Madan Mohan Rao M. (2019) *An Introduction to Sericulture*, 2nd Edition, ISBN-10: 9387593975, BS Publications, 201 pages
- Shukla, G.S. & Upadhyay, V.B.(2014) *Economic Zoology*, ISBN-10: 9350780461, Rastogi Pub
- Sougata Ghosh (2013) *Panicker's Textbook of Medical Parasitology*, 7th Edition, ISBN-10: 9350905345, Jaypee Brothers , 280 pages
- Srivastava, C.B.L. (2006) *Fishery Science and Indian Fisheries*, ISBN-10: 8122500293, Kitab Mahal.

THIRD SEMESTER B.Sc. ZOOLOGY COMPLEMENTARY COURSE

Theory Course- III

PHYSIOLOGY AND ETHOLOGY

Code: ZOL3C03T

[54 hrs] [3 hours/week] [2 credits]

COURSE OUTCOMES [COs]

COs	Course Outcome Statements
CO1	Describe the structure of plasma membrane and the various trans-membrane transport mechanisms (3 hrs)
CO2	Enumerate the constituents of normal diet and the mechanism of digestion and absorption of carbohydrates, proteins and lipids and the regulation of gastrointestinal function (4 hrs)
CO3	Explain the mechanism of transport of respiratory gases, control of respiration, respiratory problems and artificial ventilation (6 hrs)
CO4	Explain the structure and working of human heart and mechanism of regulation of heart beat; constituents of human blood and blood transfusion and cardiovascular problems (7 hrs)
CO5	Illustrate the structure of human kidney, the mechanism of urine formation, hormonal control of kidney function and kidney disorders; osmoregulation and urea cycle (6 hrs)
CO6	Enumerate the structure of myofibrils and myofilaments; muscle contractile and regulatory proteins and mechanism of muscle contraction (7 hrs)
CO7	Explain different types of nerve cells and glial cells, maintenance of resting membrane potential, generation and propagation of action potential and synaptic transmission (7 hrs)
CO8	Describe innate behavior, learned behavior, patterns of behavior and factors that affect behavior (8 hrs)
CO9	Enumerate biological rhythms, communication in animals and social organization in mammals (6 hrs)

Question paper pattern for external examination

[Module 1-7 Short answer 9x2=18 marks, Paragraph 6x5=30 marks, Essay 1x10=10 marks
Module 8-9 Short answer 3x2 = 6 marks, Paragraph 1x5=5 marks; Essay 1x10=10 marks]

Section A. PHYSIOLOGY (40 hrs)

MODULE 1. Trans-membrane transport mechanisms (3 hrs)

Structure of Plasma membrane. Fluid mosaic model. Trans-membrane transport - passive & active mechanisms, vesicular transport

[Short answers/Paragraphs]

MODULE 2. Nutrition (4 hrs)

Constituents of normal diet. Digestion of carbohydrates, proteins and lipids. Absorption of nutrients (brief account). Brief account on the neural and hormonal control of gastrointestinal function. BMR and obesity

[Short answers/Paragraphs]

MODULE 3. Respiration (6 hrs)

Gas exchange and transport. Respiratory pigment – haemoglobin – properties. Control of respiration – neural & chemical (brief account). Respiratory problems - hypoxia, asphyxia, CO poisoning. Respiratory problem of high altitudes. Physiological adaptive mechanisms of diving mammals. Artificial ventilation; heart lung machine.

[Short answers/Paragraphs/Essays]

MODULE 4. Body fluids and circulation (7 hrs)

Constituents of human blood. Agglutination, coagulation of blood and haemostasis
Haemolysis. Blood transfusion (short notes). Brief account on the structure and
working of human heart. Pacemaker and conducting system of heart. Cardiac cycle
and regulation of heart beat. Blood pressure and pulse. Cardiovascular problems
(brief account) - arteriosclerosis and atherosclerosis, myocardial infarction,
hypertension and thrombosis.

[Short answers/Paragraphs/Essays]

MODULE 5. Osmoregulation and Excretion (6 hrs)

Osmoconformers and osmoregulators. Water retention and conservation in desert
animals. Urea cycle. Ammonotelism, ureotelism and uricotelism. Hormonal control
of kidney function. Kidney disorders, renal hypertension, nephritis and renal
failure. Dialysis and kidney transplantation (short notes)

[Short answers/Paragraphs/Essays]

MODULE 6. Muscle Physiology (7 hrs)

EM structure of myofibrils and myofilament. Muscle - contractile proteins and
major regulatory proteins. Chemistry and mechanism of muscle contraction.
Energy for muscle contraction. Muscle twitch and muscle tetanus, isometric and
isotonic contraction. All-or-none law and summation of stimuli. Muscle fatigue and
rigor mortis.

[Short answers/Paragraphs/Essays]

MODULE 7. Nerve physiology (7 hrs)

Mention different types of nerve cells and glial cells. Maintenance of resting
membrane potential; generation and propagation of action potential. Threshold
stimulus, all or none response. Synapse, types of synapses, synaptic transmission
and neurotransmitters.

[Short answers/Paragraphs/Essays]

Section B. ETHOLOGY (14 hrs)**MODULE 8. Behaviour (8 hrs)****Innate behaviour**

Orientation, taxes and kinesis, simple reflexes and instincts, drive and motivation

Learned behaviour

Habituation, conditioned reflex, trial and error learning, latent learning, imprinting,
insight learning

Patterns of behaviour

Habitat selection, sexual selection, co-operation, territoriality, aggression,
courtship and agonistic behaviour.

Proximate factors

Neurological basis of behaviour, mention hormonal, biochemical, environmental
and genetic factors that influence behaviour.

[Short answers/Paragraphs/Essays]

MODULE 9: Biological clocks/rhythms (6 hrs)

Photoperiod, circadian rhythm, migration, navigation and homing instinct,
diapause, hibernation and aestivation. Communication in animals. Social
organization in mammals – Elephant as example

[Short answers/Paragraphs/Essays]

Topics for Assignments/Seminars

(Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students)

1. Role of enzymes in digestion of Carbohydrates, proteins and lipids.
2. Absorption of carbohydrates, proteins, and lipids.
3. Problems of Alcoholism
4. Common renal problems - Renal hypertension, nephritis, renal failure, edema, acidosis, uremia, haematuria and calculi.
5. Minamata disease

REFERENCES

- Aubrey Manning and Marian Stamp Dwakins (2012) *Animal Behaviour*, 6th Edition, ISBN-10: 0521165148, CUP, 467 pages
- Berry, A.K. (2008) *Text Book of Animal Physiology*, 8th Edition, ISBN-10: 8185712034, Emkay Publications, 686 pages
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- Kim E. Barret, Susan M.Barman, Scott Boittano and Heddwen L Brooks (2016) *Ganong's Review of Mwdical Physiology*, 25th Edition, ISBN-10: 9789339223281, McGraw Hill Education
- Mark Ridley (1995) *Animal Behaviour: An Introduction to Behavioural Mechanisms, Development and Ecology*, 2nd Edition, ISBN-10: 0865423903, Wiley Blackwell, 296 pages
- Purohit, S.S.and Rajiv Ranjan (2009) *Ecology, Environment and Pollution*, ISBN 10: 8177541692, Agrobios.
- Rastogi, S.C. (2019) *Essentials of Animal Physiology*, 4th Edition, ISBN-10: 8122420141, New Age International, 596 pages
- Reena Mather (2016) *Animal Behaviour*, ISBN-13-9789350780480, Rosthogi Pub.

FOURTH SEMESTER B.Sc. ZOOLOGY COMPLEMENTARY COURSE

Theory Course- IV

GENETICS AND IMMUNOLOGY

Code: ZOL4C04T

[54 hrs] [3 hours/week] [2 credits]

COURSE OUTCOMES [COs]

COs	Course Outcome statements
CO1	Describe human karyotype , chromosomal anomalies and polygenic inheritance (6 hrs)
CO2	Explain the mechanisms of sex determination (4 hrs)
CO3	Enumerate the concept of genes, gene expression, genetic code, transcription and translation (8 hrs)
CO4	Illustrate the mechanism of recombinant DNA technology and its practical applications (13 hrs)
CO5	Explain the types of cancer, causes of transformation and characteristics of transformed cells (5 hrs)
CO6	Identify the cells and organs of immune system, antigens and antibodies (7 hrs)
CO7	Enumerate antigen-antibody interaction, generation of B-cell and T-cell response and major immunotechniques (7 hrs)
CO8	Explain primary and secondary immunodeficiency diseases, autoimmune diseases, vaccination and vaccines (4 hrs)

Question paper pattern for external examination

[Module 1-5 Short answer 8x2=16 marks, Paragraph 5x5=25 marks, Essay 1x10=10 marks
Module 6-8 Short answer 4x4= 8 marks, Paragraph 2x5=10 marks; Essay 1x10=10 marks]

Section A: GENETICS (36 hrs)

MODULE 1. Human Genetics (6 hrs)

Normal human karyotype: Classification and grouping of human chromosomes (Patau's & Denver schemes). Chromosomal anomalies and disorders (short note only). Autosomal anomalies: Phenyl ketonuria & Sickle cell anemia. X-linked – Haemophilia and Colour blindness. Y-linked – Y-Chromosome infertility. Polygenic inheritance - Cleft palate or Cleft lip and diabetes mellitus. Prenatal diagnosis. Genetic counselling. Eugenics, Euthenics and Euphenics.

[Short answers/Paragraphs/Essays]

MODULE 2. Genetic Control of Sex (4 hrs)

Autosomes and sex chromosomes: Mention Barr body and its significance. Chromosomal mechanism of sex determination: genic balance theory. Control of sex; hormonal influence of sex determination; sex mosaics; gynandromorphism

[Short answers/Paragraphs]

MODULE 3. Genes and gene expression (8 hrs)

Modern concept of genes, split genes, pseudogenes, overlapping genes and transposons. Gene expression. Genetic code, transcription and translation (brief account)

[Short answers/Paragraphs/Essays]

MODULE 4. Genetic Engineering (13 hrs)

Brief account of recombinant DNA technology – role of enzymes (restriction endonucleases, exonucleases, DNA polymerase, DNA ligase, reverse transcriptase, alkaline phosphatase, polynucleotide kinase and terminal transferase). Cloning vectors – plasmid vectors (mention pBR322), phage vectors, cosmids, viruses and YAC vector. Construction of recombinant DNA (preparation of vector DNA and donor DNA, joining of vector and donor DNAs, introduction of recombinant DNA into the host cell and selection of transformants). Methods of gene transfer. Practical applications, advantages and potential hazards.

[Short answers/Paragraphs/Essays]

MODULE 5. Cytogenetics of Cancer (5 hrs)

Types of cancer: brief account of sarcomas, carcinomas, melanomas, leukemia, lymphomas and blastomas. Characteristics of cancer cells: uncontrolled multiplication, loss of contact inhibition, metastasis, reduced cellular adhesion, metaplasia, invasiveness, growth factor secretion, cell surface alterations, alterations in transcriptome and proteome and protease secretion. Origin of Cancer: Carcinogens, oncogenic viruses, polygenic basis, hereditary predisposition to cancer

[Short answers/Paragraphs]

Section B: IMMUNOLOGY (18 hrs)

(Brief account of the following topics)

MODULE 6. Cells and organs of immune system, antigens and antibodies (7 hrs)

Cells and organs of immune system

Innate and adaptive immunity. Cells of immune system- B cell, T cell, NK cell and Antigen Presenting Cells (dendritic cells, macrophage cells). Organs of the immune system- Primary lymphoid Organs (Thymus, Bone Marrow), Secondary lymphoid Organs (Spleen, lymph node, MALT)

Antigens

Antigenicity, Immunogenicity and Haptens. Factors influencing immunogenicity. Mention human immunoglobulin gene families – λ and κ light chain families and heavy chain family and major histocompatibility complex (MHC) group of genes.

Antibodies

Structure, different classes and Function. Monoclonal antibodies-Hybridoma technology and applications.

[Short answers/Paragraphs/Essays]

MODULE 7. Antigen-Antibody interaction & Generation of B-cell and T-cell response (7 hrs)

Antigen - antibody interaction

Strength of Antigen-Antibody interaction. Cross reactivity, Precipitation reactions, and Agglutination reactions. Immunotechniques – Detection of biomolecules using ELISA, RIA, and Western blot. Southern blot, Northern blot and DNA Fingerprinting (Brief)

Generation of B cell and T-cell response:

Humoral and cell-mediated response. Properties of B-cell and T-cell- epitopes. Activation and differentiation of B and T cells. Cytokines- brief

[Short answers/Paragraphs]

MODULE 8. Immunodeficiency diseases, vaccines & vaccination (4 hrs)

Immunodeficiency diseases

Primary (Bruton's disease, Di-George syndrome & SCID). Secondary types: AIDS- Mention Acute, Chronic and Crisis phase, Window period. Autoimmune disease- Mention Hashimoto's thyroiditis, Grave's disease, Myasthenia gravis and Systemic Lupus Erythematosus.

Vaccines and Vaccination

Principle of vaccination; mention Attenuated vaccines, Inactivated vaccines, Toxoid vaccines and DNA vaccines.

[Short answers/Paragraphs/Essays]

Topics for Assignments/Seminars

(Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students)

1. Human genome
2. DNA tumor viruses
3. Human genome project
4. Structure of immunoglobulins and T-cell receptors

REFERENCES

- Darla J. Wise (2002) *Immunology, A Comprehensive Review*, 8th Edition, ASIN: B000RG1FTW, Blackwell, 182 pages
- Eldon John Gardner, Michael J. Simmons and Peter Snustad (1991) *Principles of Genetics*, 8th Edn, ISBN-10: 0471533971, Wiley, 714 pages
- Gangane, S.D (2012) *Human Genetics*, 2nd Edition, ISBN-10: 8131230228, Elsevier, 312 pages
- Ivan Roitt (1994): *Essential Immunology*, 8th Edition, ISBN-10: 0632033134, Blackwell Science, 456 pages
- Jenni Punt, Sharon Stranford, Patricia Jones and Judith A Owen (2018) *Kuby Immunology*, 8th Edition, ISBN-10: 1319114709, W.H. Freeman, 944 pages
- Jogchand, S.N.(2016) *Gene Biotechnology*, ISBN-978-93-5262-087-6, Himalaya Publishing House, 447 pages
- John Playfair and Gregory Bancroft (2014) *Infection and Immunity*, 4th Edition, ISBN: 9780199609505, OUP., 400 pages
- Mange, E.J. & Mange, A.P. (1999) *Basic Human Genetics*, Rastogi Pubs.
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- Ricki, L.(2014) *Human Genetics: Concepts and Application*, 11th Edition, ISBN-10: 0076701654, McGraw Hill Education, 480 pages
- Scot F. Gilbert (2013) *Developmental Biology*, 10th Edition, ISBN-10: 0878939784, Sinauer Associates, 750 pages
- Twyman R M. (2001) *Instant notes in Developmental Biology*, Viva Books, 421 pages

**B.Sc. ZOOLOGY COMPLEMENTARY COURSE
PRACTICAL**

Code: ZOL4C05P

[Practical I*A+I*B+I*C+I*D] [4 Credits]

COURSE OUTCOMES [COs]

COs	Course Outcome statement
CO1	Identify the salient features of the phylum; taxonomic position, habit, habitat, adaptations/importance of selected protists, non-chordates and chordates (36 hrs)
CO2	Describe major human parasites and economically important insects, molluscs and fishes (36 hrs)
CO3	Perform detection of human blood groups and prepare human blood smear as per laboratory standards; mounting of specialized organs of selected non-chordates and chordates, and demonstrate the presence of biomolecules in samples by standard laboratory protocols (36 hrs)
CO4	Illustrate the normal and selected abnormal human karyotypes and mode of inheritance of selected human genetic disorders and perform the dissection of earthworm and sardine to demonstrate the alimentary canal and <i>Penaeus</i> to demonstrate the nervous system (36 hrs)

**FIRST SEMESTER COMPLEMENTARY COURSE [PRACTICAL I *A]
[36 hrs] [2 hrs/week]**

A. Animal Diversity

- Phylum Dinoflagellata : *Noctiluca*
 Ciliophora : *Vorticella*
 Porifera : *Leucosolenia*
 Coelenterata : *Obelia, Physalia, Rhizostoma* (Any 2).
 Platyhelminthes : *Fasciola*
 Aschelminthes : *Ascaris*
 Annelida : *Chaetopterus / Arenicola, Hirudinaria*.
 Arthropoda : *Eupagarus, Belostoma, Limulus, Sacculina* (Any 3).
 Onychophora : *Peripatus*
 Mollusca : *Chiton, Sepia/ Loligo, Octopus* (Any 2)
 Echinodermata : *Asterias, Holothuria*.
- Chordata
 Prochordates : *Ascidia/ Branchiostoma*.
 Cyclostomata : *Petromyzon*.
 Superclass: Pisces : *Narcine, Echeneis, Hippocampus, Heteropneustes, Anguilla, Pomfret* (Any 3)
 Class Amphibia : *Ichthyophis, Axolotl larva, Rhacophorus* (Any 2)
 Class Reptilia : *Chamaeleo, Daboia, Bungarus*
 Class Aves : *Columba*
 Class Mammalia : *Pteropus* or any other Bat.

B. Histology: Study of the T.S. of *Hydra*, *Ascaris*, Earth worm (through typhlosolic region).

C. Osteology: Dentition (Rabbit), Pectoral and Pelvic girdles, typical vertebra

REFERENCES

- Jordan E. L. and P S Verma (2013) *Chordate Zoology*, 14th Edition, ISBN-10: 8121916399, S. Chand Publishres, 1076 pages
- Jordan E. L. and P S Verma (2009) *Invertebrate Zoology*, 15th Edition, ISBN-10: 9788121903677, S. Chand Publishres
- Jayasurya; N.C. Nair; N. Soundara Pandian; N. Arumugam; S. Leelavathy and T. Murugan: *Saras Practical Zoology Vol.1: Invertebrata*; ISBN : 9789382459231, Saras Publication, 424 pages
- Ghose K. C. and B. Manna (2007) *Practical Zoology*, ISBN-8173811822, New Central Book Agency 481 pages
- S.S. Lal (2016) *Practical Zoology INVERTEBRATE*, ISBN-10: 9350780089, Rastogi Publications
- R.L. Kotpal R. L. (2014) *Modern Text Book of Zoology: Invertebrates*, ISBN-10: 9350780402, Rastogi Publications
- Verma P S (2010) *A Manual of Practical Zoology Invertebrates*, ISBN-10: 8121908299, S. Chand Publishers

SECOND SEMESTER COMPLEMENTARY COURSE [PRACTICAL I *B]

[36 hrs] [2 hrs/week]

Study of the following items

Parasites

Entamoeba, *Plasmodium*, *Schistosoma*, *Taenia*, *Ancylostoma*, *Enterobius*, *Wuchereria*, *Hirudinaria*, *Cimex* (Any 5).

Insect pests

Spodoptera, *Leptocorisa*, *Oryctes*, *Rhynchophorus*, *Opisina*; *Batocera*, Termite, *Sitophilus* (Any 5).

Useful insects

Apis (worker), *Bombyx* female (any one)

Ornamental fishes

Poecilia reticulata (guppy), *Poecilia sphenops* (Black molly), *Carassius auratus* (Gold fish), *Puntius denisonii*, *Pterophyllum scalare* (Angel fish), *Colisa* sp. (Gaurami), *Betta* sp. (Fighting fish), *Danio malabaricus* (Giant Danio) (Any three)

Culture fishes

Catla catla (*Catla*), *Labeo rohita* (*Rohu*), *Cirrhinus mrigala* (*Mrigal*), *Ctenopharyngodon idellus* (*Grass Carp*) (Any three)

Economically important items

Perna, *Pinctada*, *Teredo*, *Loligo*, *Penaeus*, *Scoliodon*, *Sardinella*, *Rastrelliger*, *Cybium* (Any 5).

REFERENCES

- Dhaliwal G.S., Ram Singh and Chhillar B.S. (2014) *Elements of Agricultural Entomology*, ISBN-10: 8127226300, Kalyani Publishers
- John O Donel Alexander (1984) *Arthropods and Human Skin*, ISBN 978-1-4471-1356-0, Springer.
- 'Living Jewels': A hand book on freshwater ornamental fish, The Marine Products Export Development Authority, Ministry of Commerce & Industry, Govt. of India.
- "Commercial Fin Fishes and Shell Fishes of India", The Marine Products Export Development Authority, Ministry of Commerce & Industry, Govt. of India.

**THIRD SEMESTER COMPLEMENTARY COURSE [PRACTICAL I *C]
[36 hrs] [2 hrs/week]**

Section A: Physiology

1. Blood smear preparation and study of RBC and different types of WBCs.
2. Human blood grouping – ABO and Rh systems.
3. Detection of monosaccharides, polysaccharides, proteins & lipids.

Section B: Mounting

1. Earth worm: Setae in situ (minor), Spermatheca (minor)
2. *Penaeus*: Appendages (minor)
3. Cockroach: Salivary apparatus (major).
4. Honeybee: Mouth parts (minor).
5. Shark: Placoid scales (minor).

REFERENCES

- Jayasurya; N.C. Nair; N. Soundara Pandian; N. Arumugam; S. Leelavathy and T. Murugan: *Saras Practical Zoology Vol.1: Invertebrata*; ISBN : 9789382459231, Saras Publication, 424 pages
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- Stuart Ira (2013) *Human Physiology Laboratory manual*, 13th Edition, ASIN: B00E6TJHAK, Mc Graw Hill Education
- William Lutterschmidt and Deborah Lutterschmidt (2008) *Laboratory Excercises in Human Physiology*, 2nd Edition, ISBN-10: 0077229738, Mc Graw Hill, 256 pages

**FOURTH SEMESTER COMPLEMENTARY COURSE [PRACTICAL I *D]
[36 hrs] [2 hrs/week]**

Section A: Dissections

Earthworm: Alimentary canal upto 25th segment (minor)
Penaeus: Nervous system (major)
Sardinella: Alimentary canal (major)

Section B: Genetics

Study of the following (use slides/ models / charts / photographs)

1. Study of sex linked inheritance (haemophilia, sickle cell anaemia, color blindness)
2. Study of normal human karyotype (male and female) and abnormal karyotypes – Down's syndrome, Klinefelter's syndrome, Turners syndrome, Edwards syndrome (Any two)

REFERENCES

- Jayasurya; N.C. Nair; N. Soundara Pandian; N. Arumugam; S. Leelavathy and T. Murugan: *Saras Practical Zoology Vol.1: Invertebrata*; ISBN : 9789382459231, Saras Publication, 424 pages
- Jayesh Sheth and Frenny Sheth (2014) *Genetics in Clinical Practice*, 1st Edition, ISBN-10: 9351521532, Jaypee Brothers
- K. C. Ghose and B. Manna (2015) *Practical Zoology*, ISBN-10: 8173819505, New Central Book Agency, 642 pages

- Robin L. Bennett (2010) *The Practical Guide to the Genetic Family History*, 2nd Edition, ISBN-10: 0470040726, Wiley Blackwell, 384 pages
- S.S. Lal (2015) *Practical Zoology VERTEBRATE*, ISBN-10: 935078016X, Rastogi Publications
- S.S. Lal (2016) *Practical Zoology INVERTEBRATE*, ISBN-10: 9350780089, Rastogi Publications