

DEPARTMENT OF ZOOLOGY
HEMVATI NANDAN BAHUGUNA GARHWAL UNIVERSITY
SRINAGAR (GARHWAL), UTTARAKHAND



COURSE CONTENT AND SYLLABUS
OF
B.Sc. ZOOLOGY (CBCS)
w.e.f. 2015-16

B.Sc. ZOOLOGY (CBCS)

COURSE CONTENT

Core Courses: Zoology

1. Animal Diversity (1st semester)
2. Comparative Anatomy and Developmental Biology (2nd semester)
3. Physiology and Biochemistry (3rd semester)
4. Genetics and Evolutionary Biology (4th semester)

Ability Enhancement Compulsory Courses (AECC)

1. English/MIL Communication (1st semester)
2. Environmental Science (2nd semester)

Skill Enhancement Courses: Zoology (Any four) (One each in 3rd, 4th, 5th and 6th semester, if opted from Zoology)

1. Public Health and Hygiene
2. Aquarium Fish Keeping
3. Pisciculture
4. Poultry Farming
5. Sericulture
6. Apiculture

Discipline Specific Electives: Zoology (Any two) – One each in 5th and 6th semester

1. Reproductive Biology
2. Wild Life Conservation and Management
3. Molecular Biology
4. Immunology
5. Applied Zoology
6. Animal behaviour and Ecology

SYLLABUS OF 1st SEMESTER (Zoology)

Core Course: Zoology I

ANIMAL DIVERSITY

(Credits: Theory-4, Practicals-2)

THEORY

Lectures: 60

Unit 1. Kingdom Protista: General characters and classification up to classes; Locomotory Organelles and locomotion in Protozoa

Unit 2. Phylum Porifera: General characters and classification up to classes; Canal System in *Sycon*

Unit 3. Phylum Cnidaria: General characters and classification up to classes; Polymorphism in Hydrozoa

Unit 4. Phylum Platyhelminthes: General characters and classification up to classes; Life history of *Taenia solium*

Unit 5. Phylum Nematelminthes: General characters and classification up to classes; Life history of *Ascaris lumbricoides* and its parasitic adaptations

Unit 6. Phylum Annelida: General characters and classification up to classes; Metamerism in Annelida

Unit 7. Phylum Arthropoda: General characters and classification up to classes; Vision in Arthropoda, Metamorphosis in Insects

Unit 8. Phylum Mollusca: General characters and classification up to classes; Torsion in gastropods

Unit 9. Phylum Echinodermata: General characters and classification up to classes Water-vascular system in Asteroidea

Unit 10. Protochordates: General features and Phylogeny of Protochordata

Unit 11. Agnatha: General features of Agnatha and classification of cyclostomes up to classes

Unit 12. Pisces: General features and Classification up to orders; Osmoregulation

Unit 13. Amphibia: General features and Classification up to orders; Parental care

Unit 14. Reptiles: General features and Classification up to orders; Poisonous and non- poisonous snakes, Biting mechanism in snakes

Unit 15. Aves: General features and Classification up to orders; Flight adaptations

Unit 16 Mammals: Classification up to orders; Origin of mammals

SUGGESTED READINGS

1. Barnes, R.D. (1982). Invertebrate Zoology, V Edition. Holt Saunders International Edition.
2. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science
3. Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson
4. Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press.
5. Pough H. Vertebrate life, VIII Edition, Pearson International.
6. Hall B.K. and Hallgrimsson B. (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.
7. Kotpal, Agrawal & Khetrapal: Modern Text-book of Zoology, Invertebrates. Rastogi, 1976.

PRACTICALS

Kingdom Protista: *Amoeba*, *Euglena*, *Plasmodium*, *Paramecium*

Phylum Porifera: *Sycon* (including T.S. and L.S.), *Hyalonema* and *Euplectella*

Phylum Cnidaria: *Obelia*, *Physalia*, *Aurelia*, *Tubipora*, *Metridium*

Phylum Platyhelminthes: *Taenia solium* and study of its life history stages

Phylum Nematelminthes: Male and female *Ascaris lumbricoides*

Phylum Annelida: *Aphrodite*, *Nereis*, *Pheretima*, *Hirudinaria*

Phylum Arthropoda: *Palaemon*, *Cancer* *Limulus*, *Palamnaeus*, *Scolopendra*, *Julus*, *Periplaneta*, *Apis*

Phylum Mollusca: *Chiton*, *Dentalium*, *Pila*, *Unio*, *Loligo*, *Sepia*, *Octopus*

Phylum Echinodermata: *Pentaceros*, *Ophiura*, *Echinus*, *Cucumaria* and *Antedon*

Protochordata: *Balanoglossus*, *Herdmania*, *Branchiostoma*, Agnatha: *Petromyzon*

Pisces: *Sphyrna, Pristis, Torpedo, Labeo, Exocoetus, Anguilla,*

Amphibia: *Ichthyophis/ Ureotyphlus, Salamandra, Bufo, Hyla*

Reptilia: *Chelone, Hemidactylus, Chamaeleon, Draco, Vipera, Naja, Crocodylus, Gavialis;* Key for Identification of poisonous and non-poisonous snakes

Aves: Study of six common birds from different orders

Mammalia: *Sorex, Bat, Funambulus, Loris,* An "animal album" containing photographs, cut outs, with appropriate write up about the above mentioned taxa. Different taxa/ topics may be given to different sets of students for this purpose. These need not be repeated as drawings by the album maker.

SYLLABUS OF 2nd SEMESTER (Zoology)

Core Course: Zoology II

COMPARATIVE ANATOMY AND DEVELOPMENTAL BIOLOGY OF VERTEBRATES)

(Credits: Theory-4, Practicals 2)

THEORY

Lectures: 60

A. COMPARATIVE ANATOMY

Unit 1: Integumentary System: Derivatives of integument w.r.t. glands and digital tips

Unit 2: Skeletal System: Evolution of visceral arches

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

Unit 4: Respiratory System: Gills, lungs, air sacs and swim bladder

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

Unit 6: Urinogenital System: Succession of kidney, Evolution of urino-genital ducts

Unit 7: Nervous System: Comparative account of brain

Unit 8: Sense Organs: Types of receptors

SUGGESTED READINGS

1. Kardong, K.V. (2005) *Vertebrates' Comparative Anatomy, Function and Evolution*. IV Edition. McGraw-Hill Higher Education.
2. Kent, G.C. and Carr R.K. (2000). *Comparative Anatomy of the Vertebrates*. IX Edition. The McGraw-Hill Companies.
3. Weichert C.K and William Presch (1970). *Elements of Chordate Anatomy*, Tata McGraw Hills
4. Hilderbrand, M and Gaslow G.E. *Analysis of Vertebrate Structure*, John Wiley and Sons.
5. Walter, H.E. and Sayles, L.P; *Biology of Vertebrates*, Khosla Publishing House.

B. DEVELOPMENTAL BIOLOGY

Unit 1: Early embryonic development

Gametogenesis: Spermatogenesis and oogenesis in mammals, vitellogenesis in birds;

Fertilization: external (amphibians), internal (mammals), blocks to polyspermy; Early development of frog and humans (structure of mature egg and its membranes, patterns of cleavage, fate map, up to formation of gastrula); types of morphogenetic movements; Fate of germ layers; Neurulation in frog embryo.

Unit 2: Late embryonic development

Implantation of embryo in humans, Formation of human placenta and functions, other types of placenta on the basis of histology; Metamorphic events in frog life cycle and its hormonal regulation.

Unit 3: Control of Development

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

SUGGESTED READINGS

1. Gilbert, S.F. (2006). Developmental Biology, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
2. Balinsky, B.I. (2008). An introduction to Embryology, International Thomson Computer Press.
3. Carlson, Bruce M (1996). Patten's Foundations of Embryology, McGraw Hill, Inc.

PRACTICALS

A. COMPARATIVE ANATOMY

1. Osteology:

- a. Disarticulated skeleton of fowl and rabbit
- b. Carapace and plastron of turtle/tortoise
- c. Mammalian skulls: One herbivorous and one carnivorous animal.

B. DEVELOPMENTAL BIOLOGY

2. Frog - Study of developmental stages - whole mounts and sections through permanent slides – cleavage stages, blastula, gastrula, neurula, tail bud stage, tadpole external and internal gill stages.
 3. Study of the different types of placentae- histological sections through permanent slides or photomicrographs.
 4. Study of placental development in humans by ultrasound scans.
 5. Examination of gametes - frog/rat - sperm and ova through permanent slides or photomicrographs.
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SYLLABUS OF 3rd SEMESTER (Zoology)

Core Course: Zoology III

Physiology and Biochemistry (Credits: Theory-4, Practicals-2)

THEORY

Lectures: 60

A. PHYSIOLOGY

Unit 1. Nerve and muscle: Structure of a neuron, Resting membrane potential, Graded potential, Origin of Action potential and its propagation in myelinated and non-myelinated nerve fibres, Ultrastructure of skeletal muscle, Molecular and chemical basis of muscle contraction

Unit 2. Digestion: Digestion in different segments of the alimentary canal; Absorption of carbohydrates, proteins, lipids

Unit 3. Respiration: Pulmonary ventilation, Respiratory volumes and capacities, Transport of Oxygen and carbon dioxide in blood.

Unit 4. Excretion: Structure of nephron, mechanism of Urine formation

Unit 5. Cardiovascular system: Blood: Composition, Hemostasis, Heart structure, Origin and conduction of the cardiac impulse, cardiac cycle

Unit 6. Reproduction and Endocrine Glands: Physiology of male reproduction: hormonal control of spermatogenesis; Physiology of female reproduction: hormonal control of menstrual cycle; Structure and function of pituitary, thyroid, parathyroid, pancreas and adrenal

SUGGESTED READINGS

1. Tortora, G.J. & Derrickson, B.H. (2009). Principles of Anatomy and Physiology, 12th edn., John Wiley & Sons, Inc.
2. Widmaier, E.P., Raff, H. & Strang, K.T. (2008) Vander's Human Physiology, 11th edn., McGraw Hill
3. Guyton, A.C. & Hall, J.E. (2011) Textbook of Medical Physiology, 12th edn., Harcourt Asia Pvt. Ltd/ W.B. Saunders Company
4. Nielson: Animal Physiology, Cambridge.
5. Textbook of Physiology by A K Jain; APC New Delhi
6. Animal Physiology and related Biochemistry, H R Singh and N. Kumar SL, Nagin Chand and Co, Delhi

B. BIOCHEMISTRY

Unit 7. Carbohydrate Metabolism: Glycolysis, Krebs Cycle, Pentose phosphate pathway, Gluconeogenesis, Glycogen metabolism, Review of electron transport chain

Unit 8. Lipid Metabolism: Biosynthesis and β oxidation of palmitic acid

Unit 9. Protein metabolism: Transamination, Deamination and Urea Cycle

Unit 10 Enzymes: Introduction, Mechanism of action, Kinetics, Inhibition and Regulation

SUGGESTED READINGS

1. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). *Biochemistry*. VI Edition. W.H Freeman and Co.
2. Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009). *Principles of Biochemistry*. IV Edition. W.H Freeman and Co.
3. Murray, R. K., Granner, D. K., Mayes, P. A. and Rodwell, V. W. (2009). *Harper's Illustrated Biochemistry*. XXVIII Edition. Lange Medical Books/Mc Graw3Hill.

PRACTICALS

A. PHYSIOLOGY

1. Preparation of hemin and hemochromogen crystals
2. Examination of permanent histological sections of mammalian pituitary, thyroid, parathyroid, pancreas, adrenal
3. Examination of permanent slides of spinal cord, duodenum, liver, lung, kidney, bone, cartilage

B. BIOCHEMISTRY

1. Identification of unknown carbohydrates in given solutions (Starch, Sucrose, Lactose, Galactose, Glucose, Fructose)
 2. Colour reactions to identify functional group in the given solution of proteins
 3. Study of activity of salivary amylase under optimum conditions
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SYLLABUS OF 4th SEMESTER (Zoology)

Core Course: Zoology IV

Genetics and Evolutionary Biology (Credits: Theory-4, Practicals-2)

THEORY

Lectures: 60

A. GENETICS

Unit 1. Introduction to Genetics: Mendel's work on transmission of traits, Genetic Variation, Molecular basis of Genetic Information.

Unit 2. Mendelian Genetics and its Extension: Principles of Inheritance, Chromosome theory of inheritance, Pedigree analysis, Incomplete dominance and codominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Environmental effects on phenotypic expression, sex linked inheritance, extrachromosomal inheritance involving mitochondria and chloroplast.

Unit 3. Linkage, Crossing Over and Chromosomal Mapping: Linkage and crossing over, Cytological basis of crossing over, Molecular mechanism of crossing over, Recombination frequency as a measure of linkage intensity, two factor and three factor crosses, Interference and coincidence, Somatic cell genetics – an alternative approach to gene mapping.

Unit 4. Mutations: Chromosomal Mutations: Deletion, Duplication, Inversion, Translocation, Aneuploidy and Polyploidy; Gene mutations: Induced versus Spontaneous mutations, Back versus Suppressor mutations, Molecular basis of Mutations

Unit 5. Sex Determination: Chromosomal mechanisms, dosage compensation

Unit 6. Quantitative Genetics: Quantitative and multifactor inheritance, Transgressive variations, Heterosis

SUGGESTED READINGS

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). *Principles of Genetics*. VIII Edition. Wiley India.
2. Snustad, D.P., Simmons, M.J. (2009). *Principles of Genetics*. V Edition. John Wiley and Sons Inc.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). *Concepts of Genetics*. X Edition. Benjamin Cummings.
4. Russell, P. J. (2009). *Genetics- A Molecular Approach*. III Edition. Benjamin Cummings.

5. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. *Introduction to Genetic Analysis*. IX Edition. W. H. Freeman and Co.
6. P S Verma and V K Agrwal (2010) Cell biology, genetics, molecular biology and Evolution. S Chand & Company.

B. EVOLUTIONARY BIOLOGY

Unit 1: History of Life: Major Events in History of Life

Unit 2: Introduction to Evolutionary Theories: Lamarckism, Darwinism, Neo-Darwinism

Unit 3: Direct Evidences of Evolution: Types of fossils, Incompleteness of fossil record, Dating of fossils, phylogeny of horse

Unit 4: Processes of Evolutionary Change: Organic variations; Isolating Mechanisms; Natural selection (Example: Industrial melanism); Types of natural selection (Directional, Stabilizing, Disruptive), Artificial selection

Unit 5: Species Concept: Biological species concept (Advantages and Limitations); Modes of speciation (Allopatric, Sympatric)

Unit 6: Evolution above species level: Macro-evolutionary Principles (example: Darwin's Finches)

Unit 7: Extinction: Mass extinction (Causes, Names of five major extinctions, K-T extinction in detail), Role of extinction in evolution

SUGGESTED READINGS

1. Ridley, M. (2004). *Evolution*. III Edition. Blackwell Publishing
2. Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). *Evolution*. Cold Spring, Harbour Laboratory Press.
3. Hall, B. K. and Hallgrímsson, B. (2008). *Evolution*. IV Edition. Jones and Bartlett Publishers
4. Campbell, N. A. and Reece J. B. (2011). *Biology*. IX Edition, Pearson, Benjamin, Cummings.
5. Douglas, J. Futuyma (1997). *Evolutionary Biology*. Sinauer Associates.
6. Minkoff, E. (1983). *Evolutionary Biology*. Addison-Wesley.

PRACTICAL

A. GENETICS

1. Study of Mendelian Inheritance and gene interactions (Non Mendelian Inheritance) using suitable examples. Verify the results using Chi-square test.
2. Study of Linkage, recombination, gene mapping using the data.
3. Study of Human Karyotypes (normal and abnormal).

B. EVOLUTIONARY BIOLOGY

1. Study of fossil evidences from plaster cast models and pictures
2. Study of homology and analogy from suitable specimens/ pictures
3. Charts:
 - a. Phylogeny of horse with diagrams/ cut outs of limbs and teeth of horse ancestors
 - b. Darwin's Finches with diagrams/ cut outs of beaks of different species
4. Visit to Natural History Museum, submission of report

Discipline Specific Elective Zoology (Any One in 5th and 6th Semester)

Reproductive Biology (DSEZ-01) (Credits: Theory-4, Practicals-2)

THEORY

Lectures: 60

Unit 1: Reproductive Endocrinology: Gonadal hormones and mechanism of hormone action, steroids, glycoprotein hormones, and prostaglandins, hypothalamo–hypophyseal–gonadal axis, regulation of gonadotrophin secretion in male and female; Reproductive System: Development and differentiation of gonads, genital ducts, external genitalia, mechanism of sex differentiation.

Unit 2: Functional anatomy of male reproduction: Outline and histological of male reproductive system in rat and human; Testis: Cellular functions, germ cell, stem cell renewal; Spermatogenesis: kinetics and hormonal

regulation; Androgen synthesis and metabolism; Epididymal function and sperm maturation; Accessory glands functions; Sperm transportation in male tract

Unit 3: Functional anatomy of female reproduction: Outline and histological of female reproductive system in rat and human; Ovary: folliculogenesis, ovulation, corpus luteum formation and regression; Steroidogenesis and secretion of ovarian hormones; Reproductive cycles (rat and human) and their regulation, changes in the female tract; Ovum transport in the fallopian tubes; Sperm transport in the female tract, fertilization; Hormonal control of implantation; Hormonal regulation of gestation, pregnancy diagnosis, foeto–maternal relationship; Mechanism of parturition and its hormonal regulation; Lactation and its regulation

Unit 4: Reproductive Health: Infertility in male and female: causes, diagnosis and management; Assisted Reproductive Technology: sex selection, sperm banks, frozen embryos, in vitro fertilization, ET, EFT, IUT, ZIFT, GIFT, ICSI, PROST; Modern contraceptive technologies; Demographic terminology used in family planning

SUGGESTED READINGS

1. Austin, C.R. and Short, R.V. reproduction in Mammals. Cambridge University Press.
2. Degroot, L.J. and Jameson, J.L. (eds). Endocrinology. W.B. Saunders and Company.
3. Knobil, E. et al. (eds). The Physiology of Reproduction. Raven Press Ltd.
4. Hatcher, R.A. et al. The Essentials of Contraceptive Technology. Population Information Programme.

PRACTICALS

1. Study of animal house: set up and maintenance of animal house, breeding techniques, care of normal and experimental animals.
2. Examination of vaginal smear rats from live animals.
3. Surgical techniques: principles of surgery in endocrinology. Ovaryectomy, hysterectomy, castration and vasectomy in rats.
4. Examination of histological sections from photomicrographs/ permanent slides of rat/human: testis, epididymis and accessory glands of male reproductive systems; Sections of ovary, fallopian tube, uterus (proliferative and secretory stages), cervix and vagina.
5. Human vaginal exfoliate cytology.
6. Sperm count and sperm motility in rat
7. Study of modern contraceptive devices

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Discipline Specific Elective Zoology (Any One in 5th and 6th Semester)

WILD LIFE CONSERVATION AND MANAGEMENT (DSEZ-02) (Credits: Theory-4, Practicals-2)

THEORY

Lectures: 60

Unit 1: Wild life - Values of wild life - positive and negative; Our conservation ethics; Importance of conservation; causes of depletion; World conservation strategies

Unit 2: Habitat analysis, Evaluation and management of wild life - Physical parameters: Topography, Geology, Soil and water; Biological Parameters: food, cover, forage, browse and cover estimation; Standard evaluation procedures: remote sensing and GIS

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

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

Unit 5: National Organizations involved in wild life conservation; Wild life Legislation – Wild Protection act - 1972, its amendments and implementation

Unit 6: Management planning of wild life in protected areas; Estimation of carrying capacity; Ecotourism / wild life tourism in forests; Concept of climax persistence; Ecology of disturbance

Unit 7: Management of excess population & translocation; 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.

SUGGESTED READINGS

1. Sharma, BD: High Altitude Wildlife of India. Oxford 7 IBH Publ. Co. Pvt. Ltd. 1994.
2. Negi, SS: Himalayan Wildlife: Habitat and Conservation. 1992. Indus Publ. Company, New Delhi.
3. Pullin, AS: Conservation Biology, Cambridge, 2002.

PRACTICALS

1. Identification of flora, mammalian fauna, avian fauna, herpeto-fauna
2. Demonstration of basic equipment needed in wildlife studies use, care and maintenance (Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System, Various types of Cameras and lenses)
3. Familiarization and study of animal evidences in the field; Identification of animals through pug marks, hoof marks, scats, pellet groups, nest, antlers etc.
4. Demonstration of different field techniques for flora and fauna
5. PCQ, Ten tree method, Circular, Square & rectangular plots, Parker's 2 Step and other methods for ground cover assessment, Tree canopy cover assessment, Shrub cover assessment.
6. Trail/ transect monitoring for abundance and diversity estimation of mammals and bird (direct and indirect evidences)

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Discipline Specific Elective Zoology (Any One in 5th and 6th Semester)

MOLECULAR BIOLOGY (DSEZ-03) (Credits: Theory-4, Practicals-2)

THEORY

Lectures: 60

UNIT I:

DNA as genetic material, Structure of DNA, Types of DNA, Replication of DNA in prokaryotes and eukaryotes: Semiconservative nature of DNA replication, Bi-directional replication, DNA polymerases; The replication complex: primosome, replisome, Rolling circle replication, Unique aspects of eukaryotic chromosome replication.

UNIT II:

DNA damage and repair: causes and types of DNA damage, mechanism of DNA repair: Photoreactivation, base excision repair, nucleotide excision repair, mismatch repair, recombinational repair, nonhomologous end joining; Homologous recombination: models and mechanism.

UNIT III:

RNA structure and types of RNA, Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains

UNIT IV:

Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance and elongation RNA splicing and processing: processing of pre-mRNA: 5' cap formation, polyadenylation, splicing, rRNA and tRNA splicing.

UNIT IV: Regulation of gene expression and translation

Regulation of gene expression in prokaryotes: Operon concept (inducible and repressible system), Genetic code and its characteristics. Ribosome structure and assembly, Charging of tRNA, aminoacyl tRNA synthetases, Mechanism of initiation, elongation and termination of polypeptides, Fidelity of translation, Inhibitors of translation, Post-translational modifications of proteins.

SUGGESTED READINGS

1. Freifelder, D: Molecular Biology. Narosa Publ. House.
2. De Robertis E.D.P.: Cell and Molecular Biology, Lea & Febiger, U.S. 1987
3. Alberts et al.: Molecular Biology of the cell. Garland Publ., New York.
4. Verma, P.S. and Agrwal, V. K. Cell Biology, Genetics, Molecular biology, Evolution and Ecology (S. Chand & Co.)

PRACTICALS

1. Preparation of solutions for Molecular Biology experiments.
2. Isolation of chromosomal DNA from bacterial cells.

3. Isolation of Plasmid DNA by alkaline lysis method
4. Agarose gel electrophoresis of genomic DNA & plasmid DNA
5. Preparation of restriction enzyme digests of DNA samples
6. Demonstration of AMES test or reverse mutation for carcinogenicity

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**Discipline Specific Elective Zoology
(Any One in 5th and 6th Semester)**

**Immunology (DSEZ-04)
(Credits: Theory-4, Practicals-2)**

THEORY

Lectures: 60

Unit 1: Overview of the immune system- Introduction to basic concepts in immunology, components of immune system, principles of innate and adaptive immune system

Unit 2: Cells and organs of the immune system- Haematopoiesis, cells of immune system and organs (primary and secondary lymphoid organs) of the immune system

Unit 3: Antigens- Basic properties of antigens, B and T cell epitopes, haptens and adjuvants

Unit 4: Antibodies- Structure, classes and function of antibodies, monoclonal antibodies, antigen antibody interactions as tools for research and diagnosis

Unit 5: Working of the immune system I- Structure and functions of MHC, exogenous and endogenous pathways of antigen presentation and processing

Unit 6: Working of immune system II- Basic properties and functions of cytokines, types and functions of complement system

Unit 7: Immune system in health and disease I- Hypersensitivity: types and functions, introduction to concepts of autoimmunity and immunodeficiency

Unit 8: Immune system in health and disease II- Infectious agents and how they cause diseases, course of adaptive response to infection, general introduction to vaccines

SUGGESTED READINGS

1. Kindt, T. J., Goldsby, R. A., Osborne, B. A., Kuby, J. (2006). VI Edition. Immunology. W.H. Freeman and Company.
2. Delves, P. J., Martin, S. J., Burton, D. R., Roitt, I.M. (2006). XI Edition. Roitt's Essential Immunology, Blackwell Publishing.

PRACTICALS

1. Study of lymphoid organs (by slides or micrographs)
2. ABO blood group determination
3. Ouchterlony's double diffusion assay
4. Preparation, cell count and percentage viability of spleenocytes
5. Enzyme linked immunosorbent assay (DOT-ELISA)
6. Demonstration of immunoelectrophoresis

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**Discipline Specific Elective Zoology
(Any One in 5th and 6th Semester)**

**APPLIED ZOOLOGY (DSEZ-05)
(Credits: Theory-4, Practicals-2)**

THEORY

Lectures: 60

Unit 1: Introduction to Host-parasite Relationship: Host, Definitive host, Intermediate host, Parasitism, Symbiosis, Commensalism, Reservoir, Zoonosis

Unit 2: Epidemiology of Diseases: Transmission, Prevention and control of diseases: Tuberculosis, swine flu, typhoid

Unit 3: Rickettsiae and Spirochaetes: Brief account of *Rickettsia prowazekii*, *Borrelia recurrentis* and *Treponema pallidum*

Unit 4: Parasitic Protozoa: Life history and pathogenicity of *Entamoeba histolytica*, *Plasmodium vivax* and *Trypanosoma gambiense*

Unit 5: Parasitic Helminthes: Life history and pathogenicity of *Schistosoma haematobium*, *Ancylostoma duodenale* and *Wuchereria bancrofti*

Unit 6: Insects of Economic Importance: Biology, Control and damage caused by *Helicoverpa armigera*, *Pyrilla perpusilla* and *Papilio demoleus*, *Callosobruchus chinensis*, *Sitophilus oryzae* and *Tribolium castaneum*; Safe storage of stored grains

Unit 7: Insects of Medical Importance: Life cycle, medical importance and control of *Pediculus humanus corporis*, *Anopheles*, *Culex*, *Aedes*, *Xenopsylla cheopis*, *Phlebotomus argentipes*

Unit 8: Animal Husbandry: Preservation and artificial insemination in cattle; Induction of early puberty and synchronization of estrus in cattle

Unit 9: Poultry Farming: Principles of poultry breeding, Management of breeding stock and broilers, Processing and preservation of eggs

Unit 10: Fish Technology: Genetic improvements in aquaculture industry; Induced breeding and transportation of fish seed

SUGGESTED READINGS

1. Park, K. (2007). *Preventive and Social Medicine*. XVI Edition. B.B Publishers.
2. Arora, D. R and Arora, B. (2001). *Medical Parasitology*. II Edition. CBS Publications and Distributors.
3. Kumar and Corton. *Pathological Basis of Diseases*.
4. Atwal, A.S. (1986). *Agricultural Pests of India and South East Asia*, Kalyani Publishers.
5. Dennis, H. (2009). *Agricultural Entomology*. Timber Press (OR).
6. Hafez, E. S. E. (1962). *Reproduction in Farm Animals*. Lea & Fabiger Publisher
7. Dunham R.A. (2004). *Aquaculture and Fisheries Biotechnology Genetic Approaches*. CABI publications, U.K.
8. Pedigo, L.P. (2002). *Entomology and Pest Management*, Prentice Hall.

PRACTICALS

1. Study of permanent slides/photomicrographs and specimens of *Plasmodium vivax*, *Entamoeba histolytica*, *Trypanosoma gambiense*, *Schistosoma haematobium*, *Ancylostoma duodenale* and *Wuchereria bancrofti*
2. Study of arthropod vectors associated with human diseases: *Pediculus*, *Culex*, *Anopheles*, *Aedes* and *Xenopsylla*.
3. Study of insect damage to different plant parts/stored grains through damaged products/photographs.
4. Identifying feature and economic importance of *Helicoverpa (Heliothis) armigera*, *Papilio demoleus*, *Pyrilla perpusilla*, *Callosobruchus chinensis*, *Sitophilus oryzae* and *Tribolium castaneum*
5. Visit to poultry farm or animal breeding centre. Submission of visit report
6. Maintenance of freshwater aquarium

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Discipline Specific Elective Zoology (Any One in 5th and 6th Semester)

ANIMAL BEHAVIOUR AND ECOLOGY (DSEZ-06) (Credits: Theory-4, Practicals-2)

THEORY

Lectures: 60

UNIT I

ANIMAL BEHAVIOUR: The science of behaviour: History, scope and terminology. Proximate and ultimate causes of behaviour. Instinct: Definition and characteristics (sign stimuli and Fixed Action Pattern). Learning behaviour: Definition. Spatial learning. Associative learning, classical conditioning, operant conditioning, language learning. Imprinting. Kin recognition. Instinct versus learning behaviour.

UNIT II

Biological rhythms. The Biological Clock. Circadian rhythms and their synchronisation seasonal rhythms. Photoperiodism. Communication: Visual, olfactory, acoustic. Chemoreception: Chemicals (pheromones) as signals in insects, fish and mammals. Hormonal Control of behaviour. Cooperation and conflict: Evolution of altruism.

UNIT III

ECOLOGY: Definition, Scope, Importance, Application. Limiting Factors: Liebig's law of the minimum, Shelford's law of tolerance. Combined concept of limiting factor, Factor interaction. Homeostasis. Biogeochemical cycle: Concept & Types of biogeochemical cycle (nitrogen, phosphorus, carbon & water cycle).

UNIT- IV

Ecosystem Concept; Abiotic and Biotic factors and their interdependence. Energy flow; Food chains & Ecological pyramids. Habitat Ecology: Concept of habitats & ecological niche.

UNIT V

Population: Concept & attributes: Biotic potential, Density, Natality, Mortality; Population growth forms; Carrying capacity; Community: Concept & characteristics: Density, Dominance, Diversity & Stratification. Environmental pollution (Air, water, solid waste, Radioactive); Environmental Impact Assessment.

SUGGESTED READINGS

1. Alcock, John: Animal Behavior: An Evolutionary Approach Published by Oxford University Press, ISBN 10: 0878930205 ISBN 13: 9780878930203 1989
2. Goodenough, Judith, Betty McGuire, Elizabeth Jakob: Perspectives on Animal Behavior, Wiley & Sons, New York. 1993
3. Grier, JW: Biology of Animal Behaviour, Mosby 1984.
4. Davies, NB and Krebs: An Introduction to Behavioural Ecology (3rd ed.) Blackwell 1993.
5. Lehner, PN: Handbook of Ethological Methods, Garland STPM Press, New York, 1979.
6. Halliday, T.R.: Animal Behaviour Vol. 1 & 2 Communication, 1983.
7. Arora, M P. Animal Behaviour. Himalayan Publishing House 1996
8. Kendeigh, Charles: Animal Ecology, Prentice Hall 1961.
9. Odum, EP: Fundamentals of Ecology, Saunders Co. Publ., 1993 Indian ed.
10. Ricklefs, RE: Ecology, Newton Mass, Chiron Press 1974
11. Singh, HR and Neeraj Kumar: Ecology and Environmental Science, Vishal Publishing Co., Jalandhar 2014

PRACTICALS

1. Models Based on different aspects of animal behaviour and ecology
2. Population study of available terrestrial and aquatic animals
3. Physicochemical study of soil and water

SKILL ENHANCEMENT COURSES (One each in 3rd, 4th, 5th, and 6th Semester) (Credits 2)

PUBLIC HEALTH AND HYGIENE (SECZ-01)

Lectures: 30

Unit 1: Scope of Public health and Hygiene – nutrition and health – classification of foods – Nutritional deficiencies - Vitamin deficiencies.

Unit 2: Environment and Health hazards – Environmental degradation – Pollution and associated health hazards.

Unit 3: Communicable diseases and their control measures such as Measles, Polio, Chikungunya, Rabies, Plague, Leprosy and AIDS.

Unit 4: Non-Communicable diseases and their preventive measures such as Hypertension, Coronary Heart diseases, Stroke, Diabetes, Obesity and Mental ill-health.

Unit 5: Health Education in India – WHO Programmes – Government and Voluntary Organizations and their health services – Precautions, First Aid and awareness on sporadic diseases.

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SKILL ENHANCEMENT COURSES
(One each in 3rd, 4th, 5th, and 6th Semester)
(Credits 2)

AQUARIUM FISH KEEPING (SECZ-02)

Lectures: 30

Unit 1: The potential scope of Aquarium Fish Industry as a Cottage Industry. Exotic and endemic species of Aquarium fishes. General Aquarium maintenance – Budget for setting up an aquarium fish farm as a Cottage Industry.

Unit 2: Common characters and sexual dimorphism of Fresh water and Marine Aquarium fishes such as Guppy, Molly, Gold fish, Angel fish, Blue morph, *Puntius conchoni* and *Barilius bendelisis*

Unit 3: Food and feeding of Aquarium fishes – Use of live fish feed organisms. Preparation and composition of formulated fish feeds.

Unit 4: Live fish transport – Fish handling, packing and forwarding techniques.

Unit 5: General Aquarium maintenance – budget for setting up an Aquarium Fish Farm as a Cottage Industry.

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SKILL ENHANCEMENT COURSES
(One each in 3rd, 4th, 5th, and 6th Semester)
(Credits 2)

PISCICULTURE (SECZ-03)

Lectures: 30

Unit 1: Scope of Aquaculture. Importance of cultivable fresh water, marine ornamental species.

Unit 2: Fish farm Maintenance – Farm management technique, water quality, temperature and accessories in Farm management viz Aerator, Filter, paddler

Unit 3: Fish culture technique, Monoculture, Polyculture and monosex culture, Induced fish breeding, Integrated fish farming

Unit 4: Fish nutrition and fish formulations live fish live fish transport.

Unit 5: Prevention and control of fish diseases.

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SKILL ENHANCEMENT COURSES
(One each in 3rd, 4th, 5th, and 6th Semester)
(Credits 2)

POULTRY FARMING (SECZ-04)

Lectures: 30

Unit 1: External morphology of variety of Fowls such as Plymouth Rock, Light Sussex, Minorca, Rhode Island, Red and White Leghorn.

Unit 2: Classification of Fowls based on their use: Meat type such as Broilers, Egg type such as White Leghorn and Commercial layers, Dual purpose varieties, Game and Ornamental purpose varieties.

Unit 3: Feeding Poultry – Management of Egg Layers – Management of Broilers in large scale farms.

Unit 4: Poultry diseases Viral, Bacterial, Fungal, Protozoan and Parasitic Lice etc., Prevention and precautions during vaccination.

Unit 5: Management of a modern Poultry Farms – Progressive plans to promote Poultry as a Self-Employment venture.

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SKILL ENHANCEMENT COURSES
(One each in 3rd, 4th, 5th, and 6th Semester)
(Credits 2)

SERICULTURE (SECZ-05)

Lectures: 30

Unit 1: Classification of commercial varieties of mulberry. Mulberry plantation establishment and cultivation practices.

Unit 2: Diseases of mulberry – fungal, bacterial, viral and Nematode diseases, Deficiency diseases and their remedial measures.

Unit 3: Silkworm rearing operations – Chawki rearing and Late age rearing techniques.

Unit 4: Physical and commercial characters of Cocoons. Reeling operations, Importance of by-products of Sericulture.

Unit 5: Economics of Sericulture – Future and progress of Sericulture Industry in India. Prospects of Sericulture as Self-Employment venture.

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SKILL ENHANCEMENT COURSES
(One each in 3rd, 4th, 5th, and 6th Semester)
(Credits 2)

APICULTURE (SECZ-06)

Lectures: 30

Unit 1: History – Biology and classification of honey bees, species of honey bees, social organization of honey bee colony.

Unit 2: Bee hive – Flora for apiculture – Selection of bees for apiculture, Method of bee Keeping – Indigenous method of Extraction of honey

Unit 3: Modern method of apiculture – Appliances for modern method. Diseases of Honey bee and control measures.

Unit 4: Products of bee keeping: Honey–Bee wax–Honey: Production, Chemical composition – Economic importance of Honey bee wax.

Unit 5: Bee enemies – Bee keeping industry – Recent efforts – Modern method in employing honey bees for cross pollination in horticultural gardens.