

M. Sc. ZOOLOGY: 2020–2021

(CBC System)

Course Code-M1 ZOO 01CT-01 No of Credits-4

Paper I: Biosystematics, Structure and Function of Invertebrates

UNIT – I

Biosystematics: Basic concepts of Taxonomy; Rules of nomenclature; Basis of invertebrate classification; Hierarchy of categories; Molecular Cytotaxonomy: Importance of cytology and genetics in taxonomy.

UNIT – II

Body plans; Coelom, Symmetry, Metamerism

Locomotor mechanisms: Amoeboid locomotion; Ciliary locomotion; Flagellar locomotion; Non-jointed appendages; Jointed appendages

UNIT – III

Feeding apparatus of Invertebrates

Feeding and Digestion: Microphagy, Macrophagy; Herbivores, Omnivores, Carnivores, Filter feeding; Ciliary feeding,

Digestion: intracellular and extracellular digestion.

UNIT – IV

Endocrine system: Neurosecretory cells; Endocrine structures in invertebrates; Role of hormones in moulting and metamorphosis in Insects and Crustaceans.

UNIT – V

Reproduction: Asexual reproduction; Parthenogenesis; Sexual reproduction. Metagenesis in Coelenterates. Regeneration in Invertebrates; Larval forms of invertebrates and their significance

M. Sc. ZOOLOGY: 2020–2021

(CBC System)

Course Code- M1 ZOO02CT-02 No of Credits-4

Paper II-Ethology and Evolution

UNIT - I

Concept of Ethology – (SS,ASE,ARM IRM), Flush Toilet Model, Definition and Historical outline(Three Nobel Laureate), Patterns of Behaviour, Fixed Action pattern, Reflex Action, Sign stimulus, Orientation, kinesis and taxis. Methods of studying behavior.

UNIT - II

Social Organization and its advantages. Eusociality, Insect Societies, Primate Societies, Parental care in Fishes, Amphibians and Mammals.

UNIT – III

Learning- Types of Learning, Biological Rhythms, Reproductive Behaviour – Display, Courtship, Sexual Selection and Mating Systems. Ecological Behavior – Altruism and kin selection. Hormones and Pheromones Influencing Behavior of Animals

UNIT - IV

General Concepts of Evolution(Lamarckism, Darwinism and Neo Darwinism),Detailed account of destabilizing forces of evolution: Natural selection, Genetic drift, Meiotic drive, Hardy-Weinberg law of genetic equilibrium calculating allele, gene and Genotype frequency, mathematical calculation of Frequency Changes in Mutation, Geological Time Scale .

UNIT - V

Concept of Species and Speciation, Isolation and Isolating Mechanism, Factors responsible for Speciation, Modules of Speciation (Sympatric, Allopatric and Parapatric), Micro and Macro-evolution: human evolution: Human Evolutionary History; Placing Humans on Tree of Life; Genomics and Human Evolution; Current Issues in Human Evolution.

Suggested Literature:

1. Mechanism of Animal Behaviour, Peter Marler and J. Hamilton; John Wiley & Sons, USA
2. Animal Behaviour, David McFarland, Pitman Publishing Limited, London, UK
3. Animal Behaviour, John Alcock, Sinauer Associate Inc., USA

4. Animal Behaviour, Reena Mathur, Rastogi Publications , Meerut.
5. Exploring Animal Behaviour, Paul W. Sherman & John Alcock, Sinauer Associate Inc. Massachusetts, USA
6. An Introduction to Animal Behaviour, A. Manning and M.S Dawkins, Cambridge University Press.
7. Evolution, Hall, B. K. and Hallgrimsson, B., Jones and Bartlett Publisher, Sudbury, USA
8. Evolution, Strickberger, M.W. Jones and Bartlett Publishers, Boston , London, UK.

M. Sc. ZOOLOGY: 2020–2021

(CBC System)

Course Code-M1 ZOO03 CT03 No of Credits-4

Paper III -Instrumentation and Techniques in Biology

UNIT- I

Principles and application of Phase contrast, Fluorescence, Transmission, Scanning, Confocal and Atomic force microscopes, Micrometry.

UNIT- II

Principles and application of pH meter, colorimeter, spectrophotometer, Centrifuge and Ultracentrifuge, Electrophoresis (Paper, agarose, PAGE), Chromatography (TLC, Ion exchange, Column &HPLC).

UNIT- III

Fixation and Fixatives: Methods of fixation, chemicals used as fixatives and their preparation, chemical basis of fixation (formaldehyde, glutaraldehyde, chromium salts, mercury salts, alcohol and acetone), washing and post fixation methods, decalcification, Cryopreservation.

UNIT- IV

Microtomy- Dehydration, Clearing and Infiltration, Embedding methods, Trimming, Sectioning. Stains and Staining techniques: cellular organelles stain (mitochondria, Golgi Apparatus, ER, Nuclear and Cytoplasmic Stains, Double and Triple stain), Cryostat sectioning and Mounting, Mounting media, Freezing techniques, Freeze drying, Freeze fracture and itching.

UNIT- V

Autoradiography, RIA and ELISA, Scintillation techniques, Histochemical and Immunotechniques: immunocyto chemistry, Antibody generation, immunoprecipitation, flow cytometry

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Course code-M1 ZOO 04 CT-04 No of Credits-4

Paper IV -Cell and Molecular Biology

UNIT- I

Biomembranes: Basic structure, Transport across cell membranes, Diffusion, Osmosis (Uniports, Symports and Antiports), Ion Channels, Active Transport and Membrane Pumps, Electrical properties of biomembranes and Membrane potential.

UNIT- II

Cell adhesion and Communication: Tight junctions, Gap junctions, Connexins, Desmosomes and Spot desmosomes.

Cell–Cell signaling : Second messenger system, cAMP , Cell surface receptors and intra cellular receptors. Protein mediated signaling in mammalian and bacterial system (G-proteins, Tyrosine kinase, Serine/threonine kinase,).

UNIT- III

Cell Cycle : Role of Microtubules in cell cycle. Cyclines and cycline dependent kinases, Regulation of CDK – cyclin activity; Check points of cell cycle.

Biology of Aging: Maximum life span and life expectancy, Causes of aging, genetic instability, free radicals, oxidative damage and antioxidants, Telomerase.

Cell Death: Necrosis and Apoptosis; genes involved in apoptosis.

UNIT- IV

Intracellular transport : Intracellular protein trafficking, Signal hypothesis. Golgi sorting : Post and co-translational modifications. Lysosomal polymorphism. Regulation of intracellular transport.

Metabolic Pathways and its Network: A broad outline of metabolic pathways and their linkage, metabolism of primary metabolites – monosaccharides, lipids, essential amino acids and nucleotides.

UNIT- V

DNA repair and recombination, RNA synthesis and processing, Protein synthesis and processing, Control of gene expression at transcription and translation level.

C-value Paradox, Euchromatin and Heterochromatin. Human karyotype, Chromosomal banding (Paris conference nomenclature).

Somatic Cell Genetics : Cell fusion and hybrid agents, mechanism of fusion Formation of Heterokaryon (Hybrid selection and chromosomal segregation). Applications of Hybridoma technology.

Suggested Literature:

1. Molecular Cell Biology, Lodish et. al., (2007), W.H. Freeman and Company, New York, USA

2. Molecular Biology of the Cell, Alberts et. al., (2008), Garland Science, Taylor & Francis Group, New York, USA.
3. Cell Physiology Source Book : A Molecular approach, Sperelakis, (2001), Academic Press, New York, USA.

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Course code-M1 ZOO 05 CP 01 No of Credits-4

Practical – I

(Paper I and II)

1 STUDY OF MUSEUM SPECIMENS

(A) PROTOZOA

Amoeba proteus w.m., *Paramecium* .w.m., *Paramecium* fission
Paramecium conjugation, *Plasmodium* (signet ring), *Vorticella* w.m.,
Nyctotherus w.m., *Entamoeba histolytica* w.m., Radiolarian ooze,
Ceratium w.m., *Volvox* w.m., *Monocystis* trophozites

(B) PORIFERA

Hyalonema, *Euplectella*, *Leucosolenia*, *Cliona*, *Spongilla*, *Chalina*,
Euspongia, *Sycon*, *Hircinia*, *Grantia* *Olynthus*

(C) COELENTERATA

Physalia, *Porpita*, *Gorgonia*, *Metridium*, , *Aurelia*, *Corallium*, *Adamsia*,
Edwardsia, *Cerianthus*, *Fungia*, *Pennatulata*, *Madrepora*, *Vallela*,
Sagarita, *Renilla*, *Zoanthus* *Favia*, *Virgularia*, *Millepora* *Alcyonium*.

(D) PLATYHELMINTHES AND ASCHELMINTHES

Taenia, *Fasciola*, *Echinococcus*, *Ascaris*(male and female),
Dracunculus, *Dugesia*.

(E) ANNELIDA

Polynoe, *Phoronis*, *Chaetopterus*, *Pontobdella*, *Nereis*, *Heteronereis*,
Hirudinaria, *Glycera*, *Eunice*, *Terebella*, *Arenicola*, *Bonelia*, *Aphrodite*,
Eurythoe

(F) ARTHROPODA

Squilla, *Palaemon*, *Scolopendra* *Julus*, Queen termite, *Papillio*,
Bombyx mori, *Vespa*, *Sacculina* on Crab, *Locust*, *Carcinus*, *Limulus*,

Hermit crab, Balanus, Peripatus, Pediculus, Lepisma, Phyllum, Mantis religiosa, Palamnaeus, Cimex, Lepas

(G) MOLLUSCA

Sepia, Loriculus, Teredo, Chiton, Aplysia, Doris, Dentalium, Octopus, Ligula, Mytilus, Pila, Margeritifera, Turbinella, Ostrea, Pinctada, Solen, Loligo, Limax, Pecten, Nautilus, Patella.

(H) ECHINODERMATA

Asterias, Ophioderma, Clypeaster, Echinus, Holothuria, Antedon, Ophiothrix

2 STUDY OF PREPARED SLIDES

(A) PORIFEERA

L.S. of *Grantia*, T.S. of *Sycon*, L.S. Of *Sycon*, *Leucosolenia* Spongin fibres, Gemmule, Spicules.

(B) COELENTERATA

Hydra with bud, T.S. of *Hydra*, L.S. of *Hydra*, T.S. of Testes *Hydra*, T.S. of Ovary of *Hydra*, *Obelia* colony.

(C) PLATYHELMINTHES AND ASCHELMINTHES

Schistosoma W.M., *Taenia* immature proglottid, *Taenia* mature proglottid, *Taenia* gravid proglottid, *Miracidium* larva W.M., Sporocyst larva W.M., *Cercaria* larva W.M., *Redia* larva W.M., T.S. of gonads of *Fasciola*, T.S. of *Planaria*, T.S. of *Ascaris* female, T.S. of *Ascaris* female, *Trichinella spiralis* cyst W.M., *Enterobius* W.M., *Ancylostoma* W.M.

(D) ANNELIDA

Tubifex W.M., septal nephridia of *Pheretima*, L.S. of anterior region of *Pheretima*, T.S. through Pharynx of *Pheretima*, T.S. of typhlosolar region of *Pheretima*, T.S. through gizzard of *Pheretima*, T.S. through prostate gland of *Pheretima*, T.S through stomach of *Pheretima*, W.M. of jaw of *Hirudinaria*, T.S. of *Neries*, W.M. of *Glossiphonia*.

(E) ARTHROPODA

W.M. of *Culex* male, W.M. of *Culex* female, W.M. of pupae of *Culex*, W.M. of pupae of *Anopheles*, W.M. of *Anopheles* male, W.M. of *Anopheles* female, Mouth parts of male *Culex*, Mouth parts of female *Culex*, Mouth parts of male *Anopheles*, Mouth parts of female *Anopheles*, Different types of mouth parts, Different types of legs: jumping, clinging, running, pollinating, W.M. of *Pediculus*, W.M. of *Xenopsylla*, W.M. of *Lucifer*, W.M. of Zoea larva, W.M. of Nauplius larva, W.M. of Metanauplius, W.M. of *Mysis*, W.M. of *Caprella*, W.M. of *Cypris*, W.M. of Alima larva, W.M. of trachea of *Periplaneta*, W.M. of salivary glands of *Periplaneta*, W.M. of larva of *Anopheles*.

(F) MOLLUSCA

T.S. of *Lamellidens*, T.S. of *Lamellidens* through foot, T.S. gill of *Lamellidens*, Glochidium larva, Valiger larva, W.M. of radula *Pila*, T.S. of osphradium of *Pila*.

(G) ECHINODERMATA

C.S. of arm *Asterias*, T.S. of tube feet of *Asterias*, W.M. of pedicellaria of *Asterias*, W.M., Bipinnaria larva, W.M. of Echinopluteus larva.

3 PERMANENT PREPARATIONS OF THE FOLLOWING:

- (a) Protozoa** : Preparation of culture of various protozoans, mounting of various protozoans including parasitic forms
- (b) Porifera** : Gemmules, spicules, spongin fibres
- (c) Coelenterata** : *Obelia* colony medusa, *Pennaria*, *Sertularia*, *Pluniularia*, *Companularia*, *Hydra*, *Hydra* with gonads.
- (d) Helminthes** : Immature, mature and gravid proglottids, scolex of *Taenia* larval forms
- (e) Annelida** : *Pheretima*: Ovary, septal nephridium, seta (*in situ*)

spermatheca. *Neries* and *Heteroneries* Parapodia trochophore larva, *Hirudinaria*: Jaws and testicular nephridia.

- (f) **Athropoda** : *Apis*: Sting apparatus *Periplaneta*: Salivary glands testes, spermatheca. Mounting of various types of mouth parts. Mounting of various larval forms
- (g) **Mollusca** : *Pila*: Mounting of gill, osphradium and radula, *Lamellidens* : Gill lamella.
- (h) **Echinodermata** : Mounting of larval forms

Preparation of Taxonomic Keys.

VIRTUAL DISSECTIONS/DRAWING AND LABELING

- 1 Annelida : General anatomy, alimentary canal and reproductive system of *Pheretima* and *Hirudinaria*.
- 2 Mollusca : General anatomy and nervous system of : *Mytilus*, *Aplysia*, *Sepia* and *Loligo*.
- 3 Arthropoda : Nervous system of *Squilla*, *Vespa* and *Apis*. General anatomy, alimentary canal nervous system and reproductive system of *Schistocerca*.
- 4 Echinodermata: *Holothuria*: Flag labelling of various organs. *Echinus*: Aristotle's lantern.

Ethology and Evolution

- 5 Antennal grooming behavior of Cockroach
- 6 Learning in rat/mice.(Trial and Error and latent learning)
- 7 Food preference in stored product pests.
- 8 Maternal and nest building behaviour in rat/mice.
- 9 Habituation in Rat/Mice.
- 10 Exploratory Behaviour in Rat/Mice.

- 11 To study the orientational responses of larvae to volatile and nonvolatile stimuli .
- 12 Estimation of gene and genotype frequency in the light of Hardy Weinberg Law based on facial traits, blood group (ABO) and PTC
- 13 Demonstration of density dependent selection in plants and animal population.
14. Pedigree analysis (autosomal, X linked and Y linked traits only).

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Practical- II

(Paper –III and IV)

- 1 Demonstration of practical usage of :
 - a. Colorimeter
 - b. Spectrophotometer
 - c. Centrifuge
 - d. Fluorescence microscope
- 2 Exercise on chromatography
- 3 Preparation of paraffin blocks of given tissue: sectioning and staining
- 4 Preparation of cryostat section and staining
- 5 Preparation of molar solutions, buffers, mounting media, fixatives
- 6 Single and double staining of paraffin sections
- 7 Preparation of different stains, staining methods
- 8 Permanent slides: Mitosis, Meiosis, cancer, Bone marrow etc.
- 9 Preparation of human Karyotype
- 10 Euchromatin and heterochromatin staining in onion cells.
- 11 Transportation across RBC membrane using isotonic, hypotonic and hypertonic solution.
- 12 Sex chromatin in squamous cell epithelium of oral cavity
- 13 Preparation of Bone marrow chromosomes

Recommended books:

1. K. Wilson and K.H. Goulding: A biologist's guide to principles and techniques of Practical biochemistry, ELBS Pub.
2. Robert Braun: Introduction to instrumental analysis, McGraw Hill Intern.
3. Nigel Jenkins: Animal cell biotechnology, methods and Protocols, Humana Press
4. R. Ralph: Methods in experimental Biology. Blackie Pub

M. Sc. ZOOLOGY: 2020–2021

(CBC System)

Course code-M2 ZOO 01CT-05 No of Credits-4

Paper I: Biodiversity and Conservation Biology

UNIT – I

Concepts of biodiversity; Levels of biodiversity – genetic biodiversity, intraspecific diversity, species richness, ecosystem and biome diversity; Hotspots of Biodiversity; India as a mega-diversity nation.

UNIT – II

Habitat degradation, fragmentation and destruction; Climate change; poaching of wildlife and man-wildlife conflicts; Over exploitation and over abundance, environmental impact assessment.

UNIT – III

Introduction to Conservation Biology; Characteristics of endangered species; Endangered species of India; Conservation of biodiversity: in-situ and ex-situ conservation; Conservation categories of taxa according to IUCN, CITES and WPA.

UNIT – IV

Plant animal interactions: Herbivory, plant defenses and food selection. Ecology of seed dispersal and pollination by animals. Plant animal interactions in the context of population ecology and community ecology.

UNIT – V

Introduction to Restoration Ecology: Captive breeding and Propagation; Human factors leading to extermination/extinction of species. Traditional values of tribals and local people around protected area. Species reintroduction programs: Rhino and Tiger reintroduction.

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Course Code-M2 ZOO 02 CT06 No of Credits-4

Paper II Environmental Toxicology

UNIT – I

Fundamentals and basic concepts of Toxicology; Bioindicators and biomarkers of environmental health. Basic concept of bioaccumulation and biodegradation of pollutants. Basic survey of environmental toxicants: Agro-chemical and pesticide pollution and their control.

UNIT – II

Toxicological testing methods; Dose response relationship; Toxicity curve and cumulative toxicity; General test design; Bioassay of toxicants using different models; Dose determinations

UNIT – III

Routes of exposure of toxicants; absorption of toxicants – site mechanism and kinetics of absorption. Distribution of toxicants – plasma concentration and storage and excretion of toxicants. Safety evaluation of toxicants – environmental hazards and risk assessment; risk management and monitoring, criteria for safety evaluation.

UNIT – IV

Natural Toxins and their Health hazards: Microbial Toxins: Anthrax, Botulism, *Staphylococcal* enterotoxin, Mycotoxicosis, Mushrooms; Invertebrates toxins: Sponges, Coelenterates, Annelids, Arthropoda, Molluscs and Echnioderms
Vertebrate Toxins: Fishes, Amphibians and Reptiles; Plant Toxins: Castor; Oleander; Rhododendron

UNIT – V

Toxicants and Public Health: Toxic chemicals and their effects; pesticides; heavy metals; fertilizers; food additives; Occupational Hazards and Diseases: Pneumoconiosis (Silicosis, Anthracosis etc.), Occupational dermatitis

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Course code-M2ZOO03CT-07 No of Credits-4

Paper III -Developmental Biology

UNIT-I

Differentiation of gonads in Mammals. Production of male and female gametes and its hormonal control. Organization of egg cytoplasm. Types of Ova and sperm and their basis.

UNIT-II

Fertilization, Biochemistry of fertilization. Cell surface molecules in sperm-egg recognition. Parthenogenesis. Cleavage, Blastulation and Gastrulation. Fate maps.

UNIT-III

Commitment, specification, Embryonic Induction (induction of primitive nervous system and eye lens induction), Competence, determination and differentiation. Establishment of symmetry. Axes and pattern formation.

UNIT-IV

Morphogenesis of Brain. Neural crest cells and their derivatives. Differentiation of neurons. Development of eyes, heart, alimentary canal and its accessory organs. Metamorphosis in Amphibia and Insects and its hormonal control.

UNIT-V

Evolution of cleidoic egg and viviparity. Extra embryonic membranes. Implantation and Placentation. Stem cells and potency. Environmental regulation of normal development. Animal cloning and its socio-ethic issues. Modern techniques of developmental biology: their uses and misuses.

Suggested Literature:

- 1 Developmental Biology, Gilbert, (8th Ed., 2006) Sinauer Associates Inc., Massachusetts, USA.
- 2 Principles of Development, Wolpert, Beddington, Brockes, Jessell, Lawrence, Meyerowitz, (3rd Ed., 2006), Oxford University Press, New Delhi, INDIA.
- 3 Analysis of Biological Development, Kalthoff, (2nd Ed., 2000), McGraw-Hill Science, New Delhi, INDIA.

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(CBC System)

Course Code-M2ZOO 04CT08 No of Credits-4

Paper IV--Animal Physiology and Immunology

UNIT-I

Thermoregulation and cold tolerance: Heat balance and exchange; endotherms and ectotherms; counter current heat exchangers; torpor, hibernation and aestivation.

Ionic and Osmotic balance: Osmoregulators and osmoconformers; Osmoregulation in aquatic and terrestrial environments; Counter current mechanism (mechanism for concentration of urine and its excretion); Hormonal control of regulation of water and salt balance

UNIT-II

Sensing the environment: Photoreception; Chemoreception; Mechanoreception; echolocation; Chromatophores and bioluminescence

UNIT-III

Gas exchange and acid base balance: Mechanism of inspiration and expiration in aquatic and terrestrial animals; O₂ and CO₂ transport in blood; role of Haemoglobin in regulation of body pH; Chloride shift, Haldane Effect.

ECG – its principle and significance, cardiac cycle; types of synapse; neurotransmitters; signal transmission between nerves and muscles; neuroendocrine regulation of endocrine glands

UNIT-IV

Immunology: Types of immunity; Cells and organs of immune system; Lymphatic system and organs; Antigens and antibodies; antigen-antibody interactions; Immunogens (Antigenicity and Immunogenicity Epitopes and Heptanes).

UNIT-V

Major histocompatibility complex: Types and Structures; antigen processing and presentation, activation and differentiation of B and T cells, B and T cell receptors, primary and secondary immune modulation, the complement system, Immunodeficiency disease and autoimmunity; Hypersensitivity; Vaccines and their types

Suggested Literature:

- 1 General and Comparative Animal Physiology, Hoar W. S. (ed), Prentice Hall, India

- 2 Comparative Physiology (Handbook of Physiology): Vol. 1, 2, Dantzler, W.H. (ed.) Oxford University Press, New York, USA
- 3 Animal Physiology: Adaptation and Environmental, Nelson K. S. (ed) Cambridge University Press, Cambridge, UK
- 4 Kuby Immunology, Richard, Thomas, Barbara, Janis, (5th Ed., 2003), W. H. Freeman and company, New York, USA.
- 5 Immuno Biology- The immune system in health and disease, Janeway, Travers, Walport and Shlomchik, (6th Ed., 2005), Garland Science Publishing, New York, USA.
- 6 Immunology, David, Brostoff and Roitt, (7th Ed., 2006), Mosby & Elsevier Publishing, Canada, USA.

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Course Code-M2 ZOO05- CP03 No of Credits-4

Practical – I

(Paper I and II)

1. Visit to natural habitats and protected areas and wetlands of Rajasthan for detailed study: Student should submit the report on the study covering major fauna, flora and geography.
2. Locating the hotspots and biosphere reserves on the map of the world.
3. Determination of population density of animals, species dominance and frequency using quadrant/plot method.
4. Analysis of habitat characteristics (gbh/dbh, tree height, canopy volume).
5. Analysis of species diversity using diversity indices.
6. Study of various modes of seed dispersal.
7. Study of various modes of pollination.
8. Identification and comments on spots of endangered species: Leatherback sea turtle, gharial, great Indian bustard, long billed vulture, Siberian crane, Nilgiri langur, Royal Bengal tiger, Asian elephant, blue whale, Indian Rhinoceros .
9. Preparation of serial dilution of doses and study of bio-safety equipments
10. Determination of LC50 and LC 90 using insect as a model
11. Bioassay of different bio-pesticides with different mode of actions against pests/vectors
12. Toxicity and adulteration testing in food products
13. Residual toxicity test with bio insecticide.
14. Effect of toxicants on chromosomes of animal
15. Effect of toxicants on animal tissues (histopathology)
16. Report on any one type of Occupational hazardous event of past

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Practical- II
(Paper III and IV)

- 1 Study of permanent slides :
 - (a) T.S. of mammalian ovary and testis
 - (b) Chick embryo w.m. and T.S. of 18 hours, 24 hours, 36 hours, 48 hours and 72 hours.
 - (c) W.M. of mammalian sperm
 - (d) Cleavage, blastula and gastrula of frog.
- 2 Extraction and observation of cauda epididymal sperms of mammals.
- 3 Preparation of permanent mount of chick embryo of different hours stages.
- 4 Perpetration of Permanent Mount Cleavage, Blastula, Gastrula of Frog.
- 5 Study of permanent slides of various cells of immune system.
- 6 Study of permanent slides of various immune organs viz spleen, thymus, bone-marrow, kidney, lymph nodes, MALT.
- 7 Demonstration of Vital capacity.
- 8 Dissection of various organs and glands associated with immune system.
- 9 Demonstration of clotting time, bleeding time.
- 10 Preparation of haematin crystals.
- 11 Determination of ESR under various disease conditions.
- 12 Determination of PCV and MCV
- 13 Determination of health status of self on the basis of analysis of blood smear.

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Course code-M3ZOO01CT-09 No of Credits-4

Paper-I Vertebrates

UNIT - I

Outline Classification of the Chordates and characters; Origin and adaptive radiation of chordates; Origin and Evolution of Agnatha: Ostracoderms and Cyclostomes and early gnathostomes (Placoderms), Phylogeny of Vertebrate

UNIT- II

Origin, evolution and affinities of Pisces; Origin, evolution and adaptive radiation of Amphibia; Neoteny and Paedogenesis; Parental care; Fish Migration

UNIT – III

Origin, evolution and affinities of Reptiles; Mesozoic reptiles ; Dinosaurs; Living reptiles; Rhynchocephalia; Chelonia, Crocodilia and Squamata; Archaeopteryx

UNIT- IV

Origin, evolution and affinities of Aves; Flightless birds ; Origin of flight, Flight Adaptation; Migration; Types of beaks and palate in birds.

UNIT- V

Origin, evolution, affinities and adaptive radiation of Mammals (Prototheria and Metatheria); Evolution of Placenta; Cenozoic Mammals.

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Course Code-M3 ZOO 02 CT-10 No of Credits-4

Paper II - Biostatistics, Computational Biology and Bioinformatics

UNIT-I

Introduction to Biostatistics, Scope, Importance and Application of Biostatistics; Data: Types, Collection and Tabulation, Frequency distribution, Diagrammatic and graphical representation of statistical data, Sampling techniques, measures of central tendencies.

UNIT-II

Standard deviation and standard error, Correlation and regression, Basic idea of testing significance, level of significance, Students T test, Chi-Square test, F test, analysis of variance, Basic knowledge of computer statistical programs – Prism, SPSS.

UNIT-III

Probability distributions (Binomial, Poisson and Normal). Statistical designing of experiments, purpose of research design and characteristics of good research designing, Biasness, Placebo effect, types of statistical errors, risk in statistical testing, Factorial design, Variables, Controls and standards.

UNIT-IV

Definition and characteristics of different type of computers (Desktop, Note book, Workstation, Server and Mainframe) Major Operating systems, Internet tools, Web services, email services, Viruses and antivirus tools,

Brief idea of following:

Adobe acrobat, MS Word, Excel and Power point, its important features and commands , Search engines-(Yahoo, Google, etc), Brief idea about E-journals, E-books, digital library, INFLIBNET, Shodhganga and Gangotri, Abstracting service (Pubmed, Medline etc), Accessing scientific databases. Plagiarism, types of plagiarism and tools for plagiarism detection. Brief idea of Simulation and Modelling of Biological Systems.

UNIT-V

Introduction to Bioinformatics, Principals of bioinformatics- useful sites for researchers, Bioinformatics in life sciences; brief idea of Microarray; Introduction to genomics and proteomics; Protein prediction tools and docking. world-wide biological databases - Nucleic acid and Protein sequence data base. Bioinformatics in India.

Suggested Literature:

1. Principles of Biostatistics, Pagano M., Gauvreau, K, (2000), Duxbury Press, USA
2. Bioinformatics for Dummies, Claverie J. M., Notredame C., (2nd Ed., 2007), Wiley Publishing, Inc., New York, USA
3. Bioinformatics: Sequence and Genome Analysis, Mount, D. W. (2nd Ed., 2001), Cold Spring Harbor Laboratory Press, New York, USA

M. Sc. ZOOLOGY: 2020–2021

(CBC System)

Course Code-M3ZOO 03 ET-01A No of Credits-4

Entomology and Insect Toxicology

**Paper- I SYSTEMATIC ENTOMOLOGY, INSECT ORGANIZATION AND
ECOLOGY**

UNIT-I

Origin and Evolution of insects: Major steps in evolution of insects, Fossil insects, Causes of success of insects, Classification of insects up to orders (Special emphasis on Orthoptera, Lepidoptera, Diptera and Hymenoptera up to family), using identification keys.

UNIT II

External Morphology of insects: Integument: Structure, Composition, Morphology of head, thorax and abdomen. Head segmentation and appendages. Wing development and Wing venation in insects. Flight muscles, Mechanism of flight in insects.

UNIT-III

Insect society: Evolution of Sociality, Eusociality, Social organization and social behavior in honey bee, ants, termites and wasps. Parasites of social insects, Altruism in relation to social insects.

Knowledge and use of equipment for the collection and preservation of insects

UNIT-IV

Effect of Abiotic and Biotic factors on insects, Population dynamics. Population growth and fluctuation and population regulatory mechanisms.

Host plant insect interactions: Factors which influence insect host plant interactions and Plant resistance to insects

UNIT-V

Biochemical adaptation to environmental stress (Hibernation, Aestivation, Diapause

Polymorphism, Metamorphosis, Swarming). Insects and humans interactions, Insecticide application equipments

Suggested Literature:

1. A general text book of entomology, Imms , A. D., Chapman and Hall, UK

2. Introduction to the study of insects, Borror, D. J., Triplehorn, C. A., and Johnson, N. F., M Saunders College Publication, USA
3. Principles of Insect Morphology, Snodgrass, R. E., Cornell Univ. Press, USA
4. The Insect Societies, Wilson, E. O., Harvard Univ. Press, UK
5. Host Selection by Phytophagous insects, Bernays, E. A., and Chapman, R. F., Chapman and Hall, New York, USA
6. Insect Plant Biology, Schoonhoven, L. M., van Loop, J. A., and Dicke. M. Pub. Oxford Univ. Press. USA

M. Sc. ZOOLOGY: 2020–2021

(CBC System)

Course Code-M3ZOO-03 ET01B No of Credits-4

Wildlife Biology-I : Biodiversity and Wildlife Ecology

UNIT I

History of Biogeography, Biological processes in biogeography, Endemism, Refugia. Ecology of dispersal and faunal exchange. Biogeographic classification of India.

Concepts of Biodiversity, levels of biodiversity, different species concepts: Key stone species, Umbrella species, Indicator species, Flagship species, and Exotic/introduced. Value of biodiversity; Ecosystem services.

UNIT II

Population ecology: Demography, life history and dynamics parameters, evolution of life history: r & K selection, allometry, aging and sexing; Population simulation, Predator-prey relationship. **Population genetics:** history, process, and applications.

Biological community ecology– organization, stability or competition (guilds, resource partitioning, niche and competitive exclusion), ecological dominance, ecotone, edge effect, and trophic interactions. Evolution of ecological communities.

UNIT III

Habitat Ecology: Ecology of major habitats- Deserts, Grasslands, wetlands and Forests. Map overlay approach in habitat evaluation. Key habitat attributes for habitat measuring and monitoring. Carrying capacity of habitats.

Animal home ranges, territories and their estimators. Biological Corridors. Physical and anthropogenic factors influencing terrestrial habitats.

UNIT IV

Behavioural Ecology: Evolutionary approaches to animal behavior. Group living: costs, and benefits. Predators-prey interactions. Competition for resources, sexual selection; mating system and parental care. Selfishness and altruism.

Co-operation and helping in birds, mammals and fishes.

UNIT V

Forest ecology: Forest soils- classification of soils, factors affecting soil formation, physical and chemical properties, causes of soil erosion and conservation methods.

Ecological and physiological factors influencing vegetation; natural and artificial regeneration of forests – nursery techniques, seed technology – collection, storage, pre-treatment and germination.

Forest mensuration – methods of measuring diameter/girth, height and canopy cover of trees.

M. Sc. ZOOLOGY: 2020–2021

(CBC System)

Course Code-M3ZOO 03ET01C No of Credits-4

Limnology and Fisheries- I: Limnology

UNIT-I

Definitions of lakes. Benefits of lakes. Origin of Lakes. Lake classification
Morphometric features of Lake and their importance in tropho genecity of lakes

UNIT-II

Physical factors of Lake water with particular reference to-
Temperature: Thermal stratification and heat budget; Light; Turbidity;
Density; Waves and currents (a brief account)

UNIT-III

Chemical factors of Lake water with particular reference to-pH;
Dissolved gases, BOD and COD; Nitrates and Nitrogen Cycle;
Phosphates and Phosphorus cycle; CO₂ and carbon cycle.

UNIT-IV

Definition, classification, distribution and limnological significance of
plankton, nekton and benthos. Biological productivity and Energy flow.

UNIT-V

Indices of Lake Productivity, Eutrophication- causes and control.
Water purification techniques. Wet lands – definition, brief account and
conservation measures.

M. Sc. ZOOLOGY: 2020–2021

(CBC System)

Course Code-M3ZOO04 ET02A No of Credits-4

Entomology and Insect Toxicology

PAPER-II INSECT PHYSIOLOGY AND TOXICOLOGY

UNIT-I

Digestive System: Alimentary canal and Physiology of digestion.

Nutrition: Nutritional requirement of insects, Adaptations to liquid diet, Role of micro organisms (Bacteria, Protozoa, Fungi) in digestion.

Respiratory System: Structure of Respiratory Organs and Physiology. Adaptations for Aquatic Respiration

UNIT-II

Circulatory System: Morphology and physiology including. Composition of haemolymph

Excretory System: Structure of excretory organs Cryptonephridial system and physiology of excretion.

Reproductive Systems: Structure and physiology. Male and female reproductive organs; Spermatogenesis and Oogenesis, Structure of insects egg, Types of larvae, pupae and metamorphosis, role of endocrines in growth and development, Parthenogenesis.

UNIT-III

Nervous System: Morphology and physiology

Neuro-endocrine System: Morphology and physiology.

Sense Organs: auditory organs, sound and light producing organs, visual organs and physiology of vision

UNIT IV

Classification of insecticides; Mode of entry, Mode of action. Chemical nature, Concept of Ist, IIrd, IIIrd generation of insecticides.

Structure and mode of action of Organochlorides, Organophosphates, Carbamates, Pyrethroids, Insect Growth Regulators, Botanicals (natural pyrethroids, rotenone, neem products, nicotine)

UNIT V

Principles of Toxicology, Basic Concepts: (Toxicants, Toxicity, Effects and Responses, Dose-Response Relationship)

Evaluation of Insecticide Toxicity: Methods of Toxicity Testing: Acute Toxicity, Sub-Acute Toxicity, Chronic Toxicity, Lethality Test (LC50, LC90 LD 50 & LD 90)

Insecticide Metabolism: Detoxification Enzyme and their role in Metabolism, Insecticide Resistance and Management.

Suggested Literature:

1. The Insects: Structure and function, Chapman, R. F., Cambridge University Press, UK
2. Physiological system in Insects, Klowden, M. J., Academic Press, USA
3. The Insects, An outline of Entomology, Gullan, P. J. , and Cranston, P. S., Wiley Blackwell, UK
4. Insect Physiology and Biochemistry, Nation, J. L., CRC Press, USA
5. Toxicology and Risk Assessment: A Comprehensive Introduction, Greim H., and Snyder, R. (ed), John Wiley and Sons, UK
6. The Complete Book of pesticide management, Whitford, F., Wiley Interscience, John Wiley and Sons, UK
7. Safer Insecticides, Hodgson, E., and Kuhr, R. J., (ed), Marcel Dekker Inc., New York, USA
8. Pesticide Application Methods, Matthews, G, A., Blackwell Science, London, UK
9. Pesticide Biochemistry and Physiology, Wilkinson, C. F., Plenum Press, New York, UK
10. Metabolic pathways of agrochemicals Part II, Roberts, T. R., and Hutson, D. H. The Royal Society of Chemistry, UK

M. Sc. ZOOLOGY: 2020–2021

(CBC System)

Course Code-M3ZOO 04ET02B No of Credits-4

Wildlife Biology-II : Conservation Biology

UNIT I

Historical and cultural background of Indian wildlife; Major vegetation types of India- basis of classification, and distribution; Zoogeographical regions of India and their fauna. Protected area network of India and Rajasthan.

UNIT II

Species conservation projects: Project Tiger, Elephant, Rhino, Crocodile. Wildlife of Rajasthan, Ramsar convention, Ramsar sites of India and Rajasthan; Important Bird Areas (IBAs) of India and Rajasthan. Wildlife conservation movements in India.

UNIT III

Brief history of Indian ornithology, endemic and threatened birds of India; bird morphology (with bills, claws, diurnal and nocturnal), plumages, moult, and mimicry.

Body size variation in mammals and its influence on life history and metabolic rates. Digestive system of herbivores and carnivores.

UNIT IV

Wildlife Institutes in India: WII, ZSI, IIFM, FSI, CAZRI, WCCB, Central Zoo Authority; Wildlife legislation: Wildlife (Protection) Act, 1972; National Wildlife Action Plan, 2002; National Biodiversity Act, 2002.

UNIT V

Human-wildlife interaction: Introduction, types, damages caused by wildlife, factors influencing conflict and management measures. Wildlife trade and trafficking. Snake bite, venom, anti-venom, first aid and management of snake bite cases.

M. Sc. ZOOLOGY: 2020–2021

(CBC System)

Course Code-M3ZOO04 ETC No of Credits-4

Limnology and Fisheries- II : Fresh Water Aquaculture and its management

UNIT-I

Aquaculture: Introduction and scope in India Extensive, intensive and semi intensive culture.

UNIT-II

Cold water fishes- Trout, Tench and golden Mahseer. Brackish water fishes- mullets, *Lates calcarifer* and *Chanos chanos*.

Fisheries of economically important fishes: Sardine; Bombay duck; Mackerel; Hilsa.

UNIT-III

Freshwater weeds- Importance, harmful effects and methods of eradication. Predatory fishes, weed fishes and their control. Blue revolution

UNIT-IV

Planning, construction and maintenance of fish farm. Different type of hatcheries.

Site selection and culturable fish selection. Fish Preservation and conservation.

UNIT-V

Composite fish culture, Integrated Fish Farming, Monosex culture, Pen culture and Cage culture. Induced breeding- Hypophysation. Ovaprim, cryopreservation of gametes and embryos.

Fish Behavior: Migration in fishes; Reproductive and shoaling behavior; Parental care; Orientation and homing.

M. Sc. ZOOLOGY: 2020–2021

(CBC System)

Course Code-M3ZOO05CP05 No of Credits-4

SEMESTER – III

Practical- I

(Paper I & II)

1 Virtual Dissections/Drawing and Labeling:

(a) Cranial nerves and electric organs of *Torpedo*, Accessory respiratory organs of *Anabas*, *Channa*, *Clarias*.

(b) Virtual dissection of *Scoliodon*; Frog and mammal (Virtual dissection will be done if facility is available or else drawing and labeling of the diagram)

2 Mounting of oral hood, velum, pharyngeal wall and endostyle of *Amphioxus*; Spicules of *Herdmania*; *Histological preparation of any 2 animal tissue*

3 Museum specimens and slides-

Protochordata : *Salpa*- sexual and asexual, *Botrylus*, *Herdmania*.

Fishes : *Rhinobatus*, *Chimaera*, *Acipensor*, *Amia*,
Periophthalmus, *Echeneis*, *Exococtus*, *Notopterus*,
Trichures, *mastacembalus*, *Diodon*, *Protopterus*,
hemiramphus

Amphibians : *Ichthyophis*, *Necturus*, *Triturus*, *Alytes*, *Pipa*,
Ambyostoma, *Hyla*, *Rhacophorus*

Reptiles : *Draco*, *Varanus*, *Calotes*, *Mobuia*, *Ophiosaurus*,
Heloderma, *Typhlops*, *Naja*, *Vipera*, *Bungarus*,
Hydrophis, *Eryx*, *Natrix*

Birds : *Bubo*, *Malvis*, *Eudynamis*, *Corvus*, Model of
Archaeopteryx, *Antegone*,

Mammals : *Ornithorhynchus, Manis, Pteropus, Hystrix, Felis domesticus*

Permanent slides related to vertebrate phyla

- 4 Comparison of axial skeleton of *Labeo, Rana, Varanus, Columba* and Rabbit.
- 5 Exercise based on data collection and tabulation.
- 6 Exercised based on diagrammatic and graphical representation of statistical data
- 7 Exercised based on determination standard deviation, standard error , testing of significance
- 8 Student T test, Chi-Square test, F Test and analysis of variance- basic knowledge of these tests.
- 9 Exercise based on Probability distributions (Binomial, Poisson and Normal).
- 10 Exercise based on designing of animal experiments
- 11 Exercises based on use of MS power point, MS excel, Adobe-acrobat, Google.
- 12 Analysis of data using statistical software
- 13 Exercises based on bioinformatics
- 14 Data mining for sequence analysis.
- 15 Wet based tools for sequence researches and homology screening.

M. Sc. ZOOLOGY: 2020–2021

(CBC System)

Course Code -M3ZOO 05 EP01A No of Credits-4

Practical-II

Entomology and Insect Toxicology

- 1 Field trips for collection and preservation of insects of various orders.
 - 2 Knowledge and use of equipment for the collection and preservation of insects, insect net, killing bottle, spreading board, light trap, etc.
 - 3 Collection of seasonal insects, nocturnal insects, aquatic insects, crop pests, stored grain pests and insects of medical and veterinary importance.
 - 4 Identification of insects from various orders prescribed for study in the syllabus. .
 - 5 Collection of various types of social insects and their nests
 - 6 Testing of Insecticides: Bioassay.
 - 7 Estimation of LD50 and LC 50 using insects.
 - 8 Familiarity with techniques of appliances used for the application of insecticides
 - 9 Sprayers including hand sprayers, Dusters
 - 10 Demonstration of effects of endocrine hormones on the development of insects
- Dissections (Digital)**
- 11 Cockroach- Digestive, Circulatory, Reproductive systems and Neuroendocrine complex.
 - 12 Grasshopper- Digestive, Circulatory, Reproductive systems and Neuroendocrine complex
 - 13 Honey bee/Wasp: Digestive and Nervous system and sting apparatus.
 - 14 Permanent preparation of Different types of mouth parts, antennae, legs and wings.
 - 15 Sting apparatus of honey bee
 - 16 Pollen basket of honey bee
 - 17 Tympanum and spiracle of grasshopper
 - 18 Whole mounts (w.m.) of various small insects
 - 19 Study of prepared slides:
 - 20 Microtomy (Internal organs of insects)

M. Sc. ZOOLOGY: 2020–2021
(CBC System)
Course Code-M3ZOO05 EP01B No of Credits-4
PRACTICAL-II

Biodiversity, Wildlife Ecology and Conservation Biology

1. Spotting: **Indian Wildlife**

Amphibians: Common Indian toad (*Duttaphrynus melanostictus*), **Purple frog** (*Nasikabatrachus sahyadrensis*), Indian skipper frog (*Euphlyctis cyanophlyctis*), Indian Bullfrog (*Hoplobatrachus tigerinus*)

Reptiles: Gharial, Mugger crocodile (*Crocodylus palustris*), Termite hill gecko, House Gecko, Indian Rock Python (*Python molurus*), Kachuga kachuga, Calotes versicolor, Bengal Monitor (*Varanus bengalensis*), Red Sand Boa (*Eryx johnii*), Indian Trinket Snake (*Coelognathus helena*), Indian rat snake (*Ptyas mucosa*), Indian Krait (*Bungarus caeruleus*), Spectacled cobra (*Naja naja*)

Aves: White-rumped vulture (*Gyps bengalensis*), Indian Peafowl (*Pavo cristatus*), River tern (*Sterna aurantia*), Great **hornbill** (*Buceros bicornis*), Lesser florican (*Sypheotides indicus*), Sociable lapwing (*Vanellus gregarius*)

Mammals: Indian Lion (*Panthera leo*) Tiger (*Panthera tigris*), , Snow leopard (*Panthera uncia*), Four-horned antelope (*Tetraceros quadricornis*), Indian pangolin (*Manis crassicaudata*), Indian Gazelle (*Gazella bennettii*), Gaur (*Bos gaurus*), Asian Elephant (*Elephas maximus*), Hoolock Gibbons, Red Panda, Indian Wild Ass, Nilgiri Tahr, Lion-tailed Macaque

Flora: Semal (*Bombax ceiba*), Siris (*Albizia lebbeck*), Arjun (*Terminalia arjuna*), Bargad (*Ficus benghalensis*), Chilbil (*Holoptelelea integrifolia*), Kadamb (*Mitragyna parvifolia*), Palas (*Butea monosperma*),

2. Visit to a zoological garden. Student should submit the report on the study covering various aspects like animals observed, their food preparation and presentation
3. Designing the animal housing, enclosures and kraal.
4. Study of different types of cages.
5. Review of zoo-working plans and maps
6. Limnological study of wetlands.

7. Determination of species dominance and frequency using quadrant/plot method.
8. Analysis of habitat characteristics (gbh/dbh, tree height, canopy).
9. Analysis of vegetation in given area.
10. Analysis of species diversity using diversity indices.
11. Soil analysis: Physical: temperature, colour, texture, Chemical: moisture content, carbonates, nitrates, pH.

M. Sc. ZOOLOGY: 2020–2021
(CBC System)
Course Code-M3ZOO05EP01C No of Credits-4
Practical-II

Limnology and Fisheries

1. Measurement of the area of the lake.
2. To calculate shoreline and shore line development index of a lake.
3. To measure following parameters.
 - (a) Water temperature
 - (b) Depth of visibility
 - (c) pH
4. Estimation of total alkalinity in a water sample.
5. Estimation of chlorides in the water sample
6. Estimation of dissolved oxygen in the water sample
7. Estimation of gross primary productivity of water by dark and light bottle method
8. Estimation of BOD of the given lake water/waste water
9. Identification of various fishing crafts and gears
10. Identification of various aquatic insects
11. Identification of various freshwater planktons
12. Identification of various freshwater aquatic weeds and Aquatic plants
13. Qualitative analysis of plankton sample
14. Report on freshwater weeds of a lake

15. Report on freshwater benthos of a lake
16. Identification and writing comments on various limnological instruments, weeds, phytoplankton, zooplankton benthos and insects.
17. Visit to various lakes and polluted streams.

Suggested reading

1. Cryostat and vibratome sectioning, mounting and staining. Wild A. Soils and the Environment An Introduction. Cambridge University Press, Cambridge. .1993.
2. Cunningham W.P. and Saigo B.W. Environmental Science A global concern Win. C. Brown Publishers, London, 1995.
3. Goel MM.. Sharma M.C. and Purohit N.K. Problems of Environment Management in India. Anupriya Publishing House, Jaipur, 1999.
4. Enger E.D. and Smith B.F. Environmental Science (A study of interrelations) Win. C. Brown Pub. (Latest Edition).
5. Botkin D. And Keller E. Environmental Science. Earth as a Living Planet, Keller.
6. Smith RL. : Ecology and Field Biology. Harper and Reo. Publishers.
7. Berwick S.H. and Saharia, V.B.: The Development of international Principles and Practicals of wildlife research and Management: Asian and American Approaches Eds. Oxford Univ. Press, Delhi.
8. VB. Saharia, Wildlife in India, Natraj Publishers, Dehradun.
9. Ali S. and Ripley D.RA pictorial Guide to the birds of the'Indian Sub-continent BNHS Publications, 1995.
10. Prater S.H. The Book of Indian Animals, BNHS Publication.
11. Sharma,VD.: Wild wonders of Rajasthan. Prakash Books, New Delhi, 1998.
12. Ali S. Hand Book of Indian birds, BNHS Publications.
13. Giles R.H. and Toschik: Wildlife Management Techniques. The Wildlife Society Washington D.C.
14. SK Sharma. Ethno-Zoology.Himanshu Publication.Udaipur1998.

15. A.Verma. Conserving biodiversity of Rajasthan (With emphasis on Wild Fauna and Flora) Himanshu Publication, Udaipur. 2008.
16. Eric Kendel, J.H. Schwartz, T.M.Jessel: Principals of Neural Science, Mc Graw-Hill.
17. Susan Standing: Gray's Anatomy: The anatomical basis of clinical practice 39th Ed. Elsevier, 2005.
18. M.J.T.Fitzgerald: Clinical neuroanatomy and related Neuroscience. 4th Ed. CRC Press.
19. Richard S Snell.: Clinical Neuroantomy for medical students. 5th Ed. Lippincott-Williams and Wilkins, 2001.
20. A.Longstaff: Instant Notes-Neuroscience, Viva books.
21. H.Lyons: Theory and strategy in histochemistry. Springer Verlag.
22. J.D. Bancroft and A. Stevens. Theory and Practice of Histological techniques, Churchl Livingstone
23. J.D.Bancroft. Histochemical Techniques, Butterworth.
24. AGE Pearse, Principles of histochemistry Vol I and II.
25. M. Pagano and K. Gauvreau, Principals of Biostatistics, Duxbury Press.
26. D.W.Mount: Bioinformatics: Sequence and Genome analysis, 2nd Ed. Cold Spring Harbour Lab. Press.
27. C.S.V.Murthy: Bioinformatics. Himalya Pub.

M. Sc. ZOOLOGY: 2020–2021

(CBC System)

Course Code-M4ZOO01CT11 No of Credits-4

Applied Zoology

UNIT – I

Protozoans and human Diseases: Life history and pathogenicity of *Entamoeba histolytica*, *Plasmodium vivax* and *Trypanosoma gambiense*

Helminthes and human Diseases: Life history and pathogenicity of *Ancylostoma duodenale* and *Wuchereria bancrofti*

UNIT- II

Insects and human diseases: Medical importance and control of Mosquitoes species, Flies, Flea, Lice, Ticks and Mites ;National vector borne Disease Control programs.

UNIT - III

Beneficial insects:

Apiculture: Different species and life cycle of honey bees. Behaviour and communication in bee colony, Bee keeping: Modern methods and industries in India

Sericulture: Life cycle of silk worm. Types of silk moth and silk. Culture of silk worm, Silk industry in India.

Lac culture: Lac insects, life cycle, culture and lac industry in India

UNIT - IV

Aquaculture: Culture of fresh water fishes (Major carps), Induced breeding, Economic importance of fishes. Fish industry in India.

Pearl culture and pearl industries in India.

UNIT - V

General account of Bacteria and viruses in relation to diseases. COVID-19, Brief idea of Industrial, Medical and Environmental microbiology; Sustainable agriculture and vermitechology

Suggested Literature:

1. Fishponds in Farming Systems, Zijpp, V. D., Verreth, J. A. J., Tri, L. Q., van Mensvoort, M. E. F., Bosma, R. H., and Beveridge, M. C. M., Wageningen Academic Publishers, Netherlands

2. Aquaculture Principles and Practices, Pillay, T. V. R., Blackwell Publishing, USA
3. Aquaculture and Fisheries Biotechnology Genetic Approaches, Dunham, R. A., CABI Publishing, USA

M. Sc. ZOOLOGY: 2020–2021

(CBC System)

Course Code-M4ZOO02CT-12 No of Credits-4

Animal Biotechnology

UNIT- I

An over view of biotechnology, history, definition of recombinant DNA technology, milestones in development of r-DNA technology , tools of genetic engineering, Restriction endonucleases, cloning vectors, expression vectors, insertion vectors

UNIT-II

Isolation of genes, synthesis of genes, sequencing of gene, gene amplification, labeling of nucleic acid, molecular probes, Cloning techniques, formation of recombinant DNA, gene transfer methods, transgenic, transfection, Recombination – selection and screening.

UNIT-III

Nucleic acid hybridization, genomic and c-DNA library, FISH, Electrophoresis, blotting techniques, dot blots, slot blots, RFLP, RAPD, DNA finger printing, Chromosome walking , Reporter genes, marker genes,

UNIT-IV

Studying transcript of a cloned gene, posttranscriptional and translational processing, gene targeting, studying regulation of gene expression. Human genome project, Gene therapy.

UNIT-V

Role of biotechnology in health care - Vaccine production, biotechnology in diagnosis, Ethical and social implications of gene technology, patenting laws, IPR, bio-safety regulations.

**M. Sc. ZOOLOGY: 2020–2021
(CBC System)**

Course Code-M4ZOO03 ET -01A No of Credits-4

**Paper-I ECONOMIC, MEDICAL, FORENSIC and COMMERCIAL
ENTOMOLOGY**

UNIT-I

PESTS OF ECONOMIC IMPORTANCE AND THEIR MANAGEMENT:

Identification, damage symptoms, life cycle and management of important insect pests of vegetables fruits and stored grains and surveillance of pests
Pheromones and other Attractants, Repellents, Chemosterillants
Biological characteristics of parasitoids, predators and pathogens and their role in nature. Biological control of insects as a component of IPM

UNIT-II

Medical Entomology

Flies: Types, Role in disease transmission, Case studies – Myiasis and Control strategy

Fleas: Morphology, Life cycle, Role in plague transmission, Control strategy

Ticks: General consideration, Soft and Hard ticks - External morphology, Life cycle, Disease relationship and control measures.

Mites: Morphology, Life cycle, diseases and Control strategy

UNIT-III

Life cycle of different species of mosquitoes

Surveillance and outbreak of vector borne diseases in tropical countries.

Global warming and disease outbreak.

Integrated vector management

WHO guidelines for vector surveillance and control.

Malaria Control agencies and programmes in India – NMCP, NMEP, UMS, RBM, EMCP, NVBDCP, NCDC, NIMR, ICMR and WHO.

UNIT-IV

Forensic Entomology: Introduction, Insects of Forensic Importance, Use of insects and other arthropods in investigations of human and animal deaths, thefts, illegal drug trade and in court-of-law proceedings that may result from such investigations.

Entomological Evidence identification, recording and recovery skills at a crime scene; Entomological Evidence identification, and recording in the laboratory
Familiarization with ACPO protocol for collecting entomological evidence.

UNIT-V

Commercial Entomology

Different species of honeybees, their identification, life cycle and division of labour in the colony Modern beekeeping Management of apiary and Beekeeping in India.

Types of silkworms, their nature and life cycle Brief idea of sericulture and silk industries in India; Brief idea of lac culture and lac industries in India

Suggested Literature:

1. Medical and Veterinary Entomology Mullen, G. , Durden, L., Academic Press, USA
2. Medical and Veterinary Entomology, Kettle, D. S., Cabi Press, USA
3. Medical Entomology for students, Service, M. Cambridge University Press, UK
4. Ecology of insects, Speight, M. R., Hunter, M. D., & Watt, A. D., Wiley-Blackwell, UK
5. Insect Plant Biology, Schoonhoven, L. M., van Loon, J.A., & Dicke, M., Publisher Oxford University Press, USA
6. Interrelationship between insects and Plants, Jolivet, P., CRC Press, USA
7. Chemical Ecology of Insects, Carde, R. T., and Bell, W. J., Chapman & Hall, New York, USA

M. Sc. ZOOLOGY: 2020–2021
(CBC System)
Course code-M4ZOO 03ET -01B No of Credits-4

PAPER I

Wildlife Biology : Indian Wildlife

UNIT I

Wildlife census and sampling: total count, index count, types of sampling, invasive (trapping, drive count, line and strip transect method, point count, mark-recapture method) and non-invasive sampling (pellet count, call count, time species count, track count and play-back method). Concept of double count/observation. Basic concept of occupancy modeling.

Animal behavior study techniques: random/haphazard sampling, ad-libitum sampling, focal animal sampling, all occurrence, sequence sampling, one zero sampling and scan sampling.

UNIT II

Use of indirect evidences in species habitat studies. Basics of Pug mark study.

Introduction to wildlife telemetry. Basics of remote sensing and Geographic Information System (GIS): introduction, types of data, data inputs, data organization, uses and geo-referencing.

UNIT III

Forest and wildlife management: Types of wildlife management, Management policies and their implementation. Participatory approach of common people. Practices of forest management - water hole management, fire lines, grassland management, parapet covering of wells, Role of corridors in wildlife management. Introduction and types of social forestry.

Forest laws- Necessary general principles- Indian Forest Act 1927, Forests Conservation Act 1980, The National Forest Policy 1988, Forest Laws in Relation to Tribal Land Conflict.

UNIT IV

Wildlife forensics: Nature of wildlife crimes, investigations and scientific processes. Macro and micro histological study of mammals' hairs: hair types, characteristics, study techniques. Microscopic characters of birds' feather. Molecular markers used in wildlife forensics.

Captive breeding and propagation, Rehabilitation of animals.

UNIT V

Introduction to scientific method and hypothesis testing. Types of data distribution and its salient features. Null and alternative hypothesis. Level of significance. Types of statistical errors. One-tailed and two-tailed tests. Parametric and non-parametric test of significance. Data transformation, boot-strap and Jack-knife procedure.

M. Sc. ZOOLOGY: 2020–2021
(CBC System)
Course Code-M4ZOO03ET -01C No of Credits-4

Paper I

Limnology and Fisheries

Fish Taxonomy and Physiology

UNIT – I

Origin and Taxonomy of fishes: Origin and evolution of major groups of fishes; Classifications of fishes and Extinct fishes
Fisheries and classification of fisheries; Lacustrine fisheries; Riverine fisheries
Ganga river system; Coastal and Deep sea fisheries and Fisheries of Rajasthan

UNIT – II

Fish Physiology: Respiratory system: Gills and aerial respiration; Air Bladder in fishes; Weberian ossicles; Excretion and osmoregulation in fishes
Fish Physiology: Reproductive system and its endocrine regulation; light and sound production in fishes; Electric organs and electro-receptors in fishes; Sense organs in fishes.

UNIT – III

Pre and Post-harvest Technology: Food of culture fishes, supplementary feed. Probiotics; live-fish transport; Fish spoilage; Fish preservation; Fishery by-products. Fish pathology: Bacterial diseases; Fungal diseases; Worm infections; Prevention and cure of fish diseases, Age and growth in fishes, Types of fins and scales in fishes

UNIT – IV

Fish Biotechnology: Application of genetics and biotechnology in fisheries; Importance of fish genetics and hybridization; Androgenesis. Gynogenesis, Production of transgenic fishes.

UNIT – V

Aquatic Pollution: Types and sources; Impact of pollution on fishes; Treatment of waste water; Bioremediation.

M. Sc. ZOOLOGY: 2020–2021
(CBC System)
Course Code-M4ZOO04ET -02A No of Credits-4
DISSERTATION

M. Sc. ZOOLOGY: 2020–2021
(CBC System)
Course Code-M4ZOO 04ET -02B No of Credits-4
DISSERTATION

M. Sc. ZOOLOGY: 2020–2021
(CBC System)
Course Code-M4ZOO 04ET -02C No of Credits-4
DISSERTATION

M. Sc. ZOOLOGY: 2020–2021

(CBC System)

Course Code-M4ZOO06-CP06 No of credits-4

Practical- I

(Paper I & II)

1. Rearing/ life cycle and identification of medically important insects and pests
2. Identification of various fishing crafts and gears
3. Identification of various cultivable of major carps
4. Demonstration of Life cycle of honey bee and silkworm.
5. Study of permanent slides of disease causing protozoans
6. Study of permanent slides of Diseases causing helminthes.
7. Study of permanent slides of Diseases causing arthropods.
8. Vermicomposting of waste by earthworm species.
9. DNA isolation and DNA quantification
10. Agarose gel electrophoresis for DNA, RNA and protein.
11. Blotting techniques for DNA/RNA protein.
12. Preparation of dot blot- slot blots.
13. Extraction of genomic DNA from a mammalian tissue.
14. Techniques based on PCR.
15. Any other technique based on syllabus.

M. Sc. ZOOLOGY: 2020–2021

(CBC System)

Course Code-M4ZOO06-EP02A No of credits-4

Practical- II

Entomology and Insect toxicology

(Paper III and IV)

1. Mosquito Species, identification and collection of mosquitoes
2. Dissection and examination of mosquitoes for malaria parasite infection (Conventional and Molecular).
3. Collection and Identification of flea, ticks and mites
4. Collection, Identification and recording of forensically important insects from animal cadavers.
5. Collection, identification and rearing of phytophagous pests
6. Knowledge of rearing insects and maintaining insectary
7. Study of seasonal abundance of crop pests in near by area.
8. To study antennal grooming in Cockroach.
9. To study the blood cells in insects
10. To study meiosis and Polytene chromosomes in insects
11. To study the food preference Tribolium of any other insect
12. Green house and insect rearing equipments
13. Experimental Designs in field and laboratory
14. Identification and characterization of agricultural chemicals in conventional and Nano formulations. Size determination and quality of Nano formulations.
15. A tour to visit important centers of entomological studies.

SUGGESTED READINGS (Entomology)

- (1) Textbook of Entomology By Packard, Publisher: New York, The Macmillan company; London, Macmillan and co., ltd.
- (2) Borror and DeLong's Introduction to the Study of Insects by Norman F. Johnson and Charles A. Triplehorn (May 19, 2004)
- (3) The Insects: An Outline of Entomology by Professor P. J. Gullan and P. S. Cranston (Mar 2, 2010)
- (4) Integrated Pest Management : Concepts, Tactics, Strategies and Case Studies Academic press. Edited by: Edward B. Radcliffe, University of

Minnesota

- (5) Photographic Atlas of Entomology and Guide to Insect Identification [Spiral-bound] James L. Castner (Author)
- (6) How to Identify Insects to Order - How to Make an Awesome Insect . extension.entm.purdue. - United States
- (7) Introduction to Integrated Pest Management [Hardcover] Mary Louise Flint (Author), Robert van den Bosch (Author) Castner, published by Feline Press, Gainesville, FL (2000)
- (8) The Insects: An Outline of Entomology 4th Edition (2010) P.J. Gullan and P.S. Cranston ISBN# 978-1-4443-3036-6, Blackwell Publishing.
- (9) A Field Guide to the Insects of North America North of Mexico Peterson Field Guide Series, Borror and White.
- (10) Elementary Text-book of Entomology. Kirby, W.F. (1885) W. Swan Sonnenschein and Co. Paternoster Square. London.
- (11) Text Book Of Entomology :A.D.IMMS,
- (12) Biopesticides: A Biotechnological Approach::S.R.JOSHI ,New Age International.

Purdue Forensic Science Website:

<http://www.extension.entm.purdue.edu/forensics/>

Purdue Forensic Science Club Website:

<http://web.ics.purdue.edu/~pufsc/>

Patrick Jones Website:

13 Chemical Ecology of Insects, Carde, R. T., and Bell, W. J., Chapman and Hall, New York, USA

14 Entomology and Pest Management, Pedigo, L. P., Prentice Hall, New Jersey, USA

15. Concepts of IPM, Norris, Caswell-Chen and Kogan, Prentice-Hall, USA

16. Agricultural insects pests of the tropics and their control, Hill, D. S., Cambridge University Press, UK

M. Sc. ZOOLOGY: 2020–2021

(CBC System)

Course Code-M4ZOO06-EP02B No of credits-4

Practical- II

(Paper III and IV)

Indian Wildlife and Wildlife Management

1. Spotting: **Fauna and flora of Rajasthan**
 - **Amphibians:** The Indian burrowing frog (**Sphaerotheca breviceps**), Marbled balloon frog (*Uperodon systoma*), Marbled balloon frog (*Uperodon systoma*)
 - **Reptiles:** Brooke's House Gecko (*Hemidactylus brookii*), Brilliant Ground Agama (*Trapelus agilis*) Fan-throated lizard (*Sitana ponticeriana*), *Crocodylus palustris*, Python, Indian Star Tortoise, Hardwick's Spiny-tailed lizard (*Saara hardwickii*), Russell's viper (*Daboia russelii*), Indian chameleon (*Chamaeleo zeylanicus*)
 - **Aves:** Sarus crane (*Grus antigone*), Great Indian Bustard (*Choriotis nigriceps*), White-naped tit (*Machlolophus nuchalis*), Green munia (*Amandava formosa*), Egyptian vulture (*Neophron percnopterus*), Demoiselle crane (*Grus virgo*)
 - **Mammals:** Leopard (*Panthera pardus*), Smooth-coated Otter (*Lutrogale perspicillata*), Sloth Bear (*Melursus ursinus*), Barasingha (*Rucervus duvaucelii*), Black buck (*Antilope cervicapra*), Indian Giant flying squirrel (*Petaurista philippensis*), Chinkara (*Gazella bennetii*)
 - **Flora:** Khejri (*Prosopis cineraria*), Guggal (*Commiphora wightii*), Ronj (*Acacia leucophloea*), Mahua (*Madhuca indica*), Sagwan or teak (*Tectona grandis*), Salar (*Boswellia serrata*), Tendu (*Diospyros melanoxylon*), Dhok (*Anogeissus pendula*), Rohida (*Teccomella undulata*)
 - **Equipments:** Laser range finder, clinometers, spotting scope, GPS, Sound meter
2. Visit to natural habitats and wildlife sanctuaries, desert, mountain range, wetland and especially Rajasthan for the detail study: Student should submit the report on the study covering major fauna, flora and geography and management of the visited field.
3. Visit to a wetland for birding and identification of threats to wetlands. Student should submit the report on the study.
4. POP preparation of pugmarks and footprints.
5. Identification of mammalian species using hair imprinting and scat analysis.
6. Determination of population density of animals using transect and random survey methods.

7. Population density determination on the basis of mark re-captures technique.
8. Permanent preparation of barbs of different avian feathers.
9. To observe foraging behavior in squirrels/mice.
10. Field data import, Data export, Creating maps, geo-referencing and other related exercises using GIS software.
11. Statistical exercises.
12. Project work/dissertation of Paper IV

SUGGESTED READINGS (Wild Life Biology)

1. Wild A., Soils and the Environment An Introduction. Cambridge University Press, Cambridge. ..
2. Cunningham W.P. and Saigo B.W. Environmental Science A global concern Win. C. Brown Publishers, London.
3. Goel MM.. Sharma M.C. and Purohit N.K., Problems of Environment Management in India. Anupriya Publishing House, Jaipur.
4. Enger E.D. and Smith B.F., Environmental Science (A study of interrelations) Win. C. Brown Pub. (Latest Edition).
5. Botkin D. And Keller E. Environmental Science. Earth as a Living Planet, Keller.
6. Smith RL. : Ecology and Field Biology. Harper and Reo. Publishers.
7. Berwick S.H. and Saharia, V.B.: The Development of international Principles and Practicals of wildlife research and Management: Asian and American Approaches Eds. Oxford Univ. Press, Delhi.
8. VB. Saharia, Wildlife in India, Natraj Publishers, Dehradun.
9. Ali S. and Ripley D.RA pictorial Guide to the birds of the'Indian Sub-continent BNHS Publications.
10. Prater S.H. The Book of Indian Animals, BNHS Publication.
11. Sharma,VD.: Wild wonders of Rajasthan. Prakash Books, New Delhi.
12. Ali S. Hand Book of Indian birds, BNHS Publications.
13. Giles R.H. and Toschik: Wildlife Management Techniques. The Wildlife Society Washington D.C.

14. SK Sharma. Ethno-Zoology. Himanshu Publication. Udaipur.
15. A. Verma. Conserving biodiversity of Rajasthan (With emphasis on Wild Fauna and Flora) Himanshu Publication, Udaipur.
16. Aaron, N.M. (1973). Wildlife ecology. W.H. Freeman Co. San Francisco, U.S.A.
17. Katwal/Banerjee, Biodiversity conservation in managed and protected areas. Agrobios, India.
18. Negi, S.S., Biodiversity and its conservation in India. Indus Publishing Co., New Delhi.
19. Anthony R.E. Sinclair, John M. Fryxell and Graeme Caughly, Wildlife Ecology, Conservation and Management, 2nd Edn. Blackwell Publishing, U.S.A.
20. Sharma, B.D. Indian Wildlife Resources, Ecology and Development. Daya Publishing House, Delhi.
21. Tiwari, S.K. Zoogeography of India and Asia. CBS Publisher and Distributors, New Delhi.
22. Ram Bramha Sanyal, A Handbook of the Management of Animals in Captivity.
23. Hosetti, B.B., Concepts in Wildlife Management, Daya Publishing House, Delhi.
24. Negi, S.S. Manual for Wildlife Management in India.
25. Gopal, Rajesh, Fundamentals of Wildlife Management, Justice Home, Allahabad, India.

M. Sc. ZOOLOGY: 2020–2021
(CBC System)
Course Code-M4ZOO06-EP02C No of credits-4
Practical- II
(Paper III and IV)

Practical- II: Limnology and Fisheries

- 1 Identification of fishes using morphometric characters and to fill up the fish identification chart
- 2 Bio-geographical distribution of major groups of fishes on world map.
- 3 Ova diameter measurement in the given sample of ovary.
- 4 Gut content analysis of any carp fish.
- 5 Dissection/Labeling of Weberian ossicles
- 6 Dissection/Labeling of pituitary gland.
- 7 Determination of fish age by scale method.
- 8 Calculation of fin formula
- 9 Identification of various cultivable fin fishes
- 10 Identification of various cultivable shell fishes
- 11 Identification of various predatory and weed fishes
- 12 Identification of common ornamental fishes
- 13 Identification of fish eggs, larvae, fry, fingerlings of fishes.
- 14 Biochemical and haematological studies.
- 15 Identification and writing comments on commercially important indigenous fishes, exotic fishes, Prawns, fishing nets, boat models, hapas, etc.
- 16 Visits to various lakes, fish farms, landing centres and polluted streams for limnological and fisheries study, preparation of field report.

SUGGESTED READINGS (Limnology and Fisheries)

1. Gerald Karp: Cell and Molecular biology II Eds. John Wiely.
2. David Fried felder: Molecular Biology II Ed. Narosa
3. T.A.Brown: Gene cloning IV ed. Chapman and Hall.
4. Benjamin Levine: Gene –I to X. Oxford Press
5. Robert Meyers: Molecular Biology and Biotechnology, VCH Pub.
6. Eric Kendel, J.H. Schwartz, T.M.Jessel: Principals of Neural Science, Mc Graw-Hill.
7. A.Longstaff: Instant Notes-Neuroscience, Viva books.
8. M. S., Gazzaniga, R. B. Ivy, G. R. Mangun : Cognitive Neuroscience, second Ed. WW Norton Press
9. C. A. Paul, B. Beltz, J. B-Sweeney: Discovering neurons, the experimental basis of neuroscience, Cold Spring Harbor Laboratory Press.
10. Nigel Jenkins: Animal Cell Biotechnology, methods and Protocols, Humana Press.
11. J. Freshney: Animal Cell Culture
12. C. T. Laurencin, L.S.Nair: Nanotechnology and tissue engineering. CRC Press.
13. J. Paul: Cell and Tissue Culture, Fifth Ed. Churchil Livingstone.

POST GRADUATE DIPLOMA IN
PUBLIC HEALTH ENTOMOLOGY

Part A SEMESTER I

Paper IA (DPHE 1- CT-01A)

Anophelines, Culicines and their medical importance

UNIT I

General characteristics of Mosquitoes, Differentiation between anophelines and culicines and characteristic features of genus Anopheles, Culex, Aedes and Mansonia. Resting, feeding and Breeding habits of adults; Gonotrophic cycle.

UNIT II

Life cycle of Malaria Mosquitoes and Transmission factors.

Malaria: Distribution of malaria vectors in India. Epidemics: Concepts and control/management. Principles of malaria eradication and control: Malaria Control in India – NMCP, NMEP, MPO, PfCP, UMS, RBM, EMCP, NVBDCP, WHO, Global Malaria Control Strategy. Transgenic mosquitoes.

UNIT III

Life cycle of filaria Mosquitoes and Transmission factors.

Lymphatic filariasis Biology and ecology of Culex quinquefasciatus and Mansonioides vectors, Survey methods: Conventional – entomological; Prophylaxis and control; National and international scenario

UNIT IV

Arboviral diseases-Japanese encephalitis: Geographical distribution – vectors, Dengue and chikungunya: Distribution – vectors – transmission, Prophylaxis and control; National and international scenario

UNIT V

Epidemiological indices: Infection and infectivity rates, vector density, Annual biting rate, mf rate, mf density, endemicity rate, Annual infective biting rate, Transmission Intensity Index (TII) and Annual Transmission Potential (ATP). National Filaria Control Programme in India LF elimination strategy – Annual single dose MDA and Morbidity management measures

Paper II A (DPHE 1- CT-02A)

Sand flies, Black flies, Muscoid flies and their medical Importance

UNIT I

Phlebotomid sandflies Classification of family Psychodidae –Differences between the genus Phlebotomus and Sergentomyia - Habitat – Habit – Distribution -Morphology of mouth parts and reproductive system – Biology of immature – Behaviour of adults; feeding, resting and oviposition behaviour - Gonotrophic cycle.

UNIT II

Muscoid flies (filth breeding flies): Classification - Habitat – Habit – Distribution - Morphology of mouth parts and reproductive system – Biology of immature – Behaviour of adults; feeding, resting and oviposition behaviour. Impact of sanitation on fly abundance.

UNIT III

Muscoid flies (Myiasis flies): Morphology of mouth parts and reproductive system – Mode of infection of myiasis maggots – Accidental, facultative and obligatory myiasis – Characteristic features of myiasis flies - Medical importance of myiasis in human.

Tsetse flies: Biology: life cycle and distribution, Biology of immature – Behaviour of adults; feeding, resting and oviposition behaviour.

UNIT IV

Black flies: Classification of family Simuliidae - Habitat – Habit – Distribution - Morphology of mouth parts and reproductive system – Biology of immature and adult – Disease transmission cycle.

UNIT V

Forensic Entomology and Flies

Present status and recent advances in detection of crime with different types of insects specially flies. Observations pattern on the succession pattern of different types of flies on an animal carcass: A case study.

Paper III A (DPHE 1 -CT-03A)

Other Arthropods of Medical and Veterinary Importance

UNIT I

Fleas – Classification Morphology and life cycle of fleas Distribution and transmission cycle of Plague and Murine typhus

Lice – Classification Morphology and life cycle of lice Distribution and transmission cycle of Epidemic typhus and Relapsing fever

UNIT II

Ticks – Classification Morphology and life cycle of ticks Distribution and transmission cycle of Kyasanur Forest Disease (KFD) and Tick Typhus

Mites – Classification Morphology and life cycle of mites Distribution and transmission cycle of Scrub typhus and Scabies.

UNIT III

Arthropods as vectors of human diseases: Modes of disease transmission: vertical and horizontal transmission - biological, mechanical and contact - transmission cycle - interseasonal maintenance.

Bugs: Reduviid bugs and bed bugs: Distribution, domiciliary forms and sylvatic forms; Modification of head size in relation to feeding - Structural and functional morphology and reproduction and life cycle - defecation – parasite transmission and disease spread

UNIT IV

Cockroaches: Distribution and morphological characteristics ; Importance of cockroaches - mechanical carriers of parasite, pathogens - pest or disease vectors - and life cycle - feeding, resting behaviour - factors favouring breeding – Environmental and chemical control – feasibility and effectiveness; parasitoids and cockroaches

UNIT V

Cyclops: Distribution, morphology of Cyclops – Different species and vectors of dracunculiasis - and Aquatic habitats and breeding – life span – man and Cyclops – invasion and disease transmission - protected water supply and disease control – anti Cyclops measures - Control programme and achievements

Venomous arthropods: Hazards posed by spiders, scorpions, ants, bees, wasps

Paper IV A (DPHE 1- CT-04A)

Integrated Methods of Vector Management

UNIT I

Chemical Control of Vectors:

Insecticides - Classes of insecticides - Organochlorine (OC), Organophosphorus (OP), Carbamates (C), Pyrethroids (PY)

Insect Growth Regulators (IGR) - Repellents & attractants - Formulations- solid and liquid formulations Mode of action of insecticides OC, OP, C, PY & IGRs - Mechanism of resistance - Methods of overcoming resistance problem

UNIT II

Insecticide Application Equipments: Types - Application - Types of nozzle - Determination of droplet size - classification of different sprays - Application procedures: Application rates - conversion factors - preparation of spray suspension - conversion tables for dosages - Area measurement and dosage determination.

IVM approaches, importance and advantages: Fundamentals of IVM - Appropriate methods in vector management - Criteria for vector control options

UNIT III

Insecticide Resistance and Management Present status of insecticide resistance - Impact of insecticide resistance on the control of vectors - Socio economic impact of resistance (Administrative, operational, Financial, Social and Agricultural implications) - Detection and monitoring of vector resistance - Insecticide targets and mechanism of resistance - Resistance management.

Eco-environmental Systems: Food chain / Web – Prey and Predator interactions - Principles of an eco-epidemiological approach to address multiple vector borne diseases - Water Management

UNIT IV

Agriculture and Public Health Practices: Water, Fertilizers, Pesticides effects on insects - Integration of IPM and IVM – Regulation and Policy related to vector control – Environmental & health Impact Assessment – Implementation of IVM Strategy

UNIT V

Community participation: Community participation in vector management - Community empowerment – sustenance of participation – Inter-sectoral collaboration.

Information, Education and Communication: KAP assessment – Communication strategies such as communication for behavioral impact (COMBI)/ behavioral change and communication (BCC)

Practicals IA (DPHE 1 -CP-01A)

1. Collection & Identification of Ticks and mites, Bed bugs, Triatomine bugs, Fleas, Head louse, Body louse, Cockroaches, Houseflies, Sandflies, Black flies

2. Mounting

Mouth parts, Wing, Different types of hairs and scales of thorax and abdomen/head/wing, Palpi, Scutellum, Hind leg-characteristics of different segments, Male genitalia, Egg, larvae, Pupae – description of siphon, respiratory trumpet of collected materials

3. Differentiation between Anopheles, Aedes and Culex

4. Field survey for Anophelines

Adult stage- Indoor and Outdoor resting mosquitoes – density measurement

Laval Stage- breeding habitats (a) Collection and rearing of larval samples (b) Measuring the immature density (c) Identification of larvae and emerged adults

5. Assessment of man-vector contact
6. Age determination & Estimation of gonotrophic cycle
7. Dissection of *Culex quinquefasciatus* and demonstration of various filarial larval
8. Observing and understanding the characteristic features of the life stages of the genus *Phlebotomus*, *Musca*, *Chrysomyia*, *Simulium* etc. with live or preserved specimens. Identification of some of the flies of forensic importance.
9. Techniques involved in rearing some of the medically important insects.
10. Forensic Entomology : Time of Death, Decomposition, and the Insects Used in Death Investigation

Practicals II A (DPHE 1-CP-02A)

1. Demonstration of representative specimens of fleas, lice, ticks and mites
2. Collection, sampling and live demonstration of vectors
3. Incidence and surveillance around tribal belt , A case study
4. Identification of bugs, cockroaches and Cyclops
5. Mounting of mouthparts and salivary glands of cockroaches
6. Laboratory evaluation of mosquito larvicide
7. Handling of different pesticide application equipments-Pneumatic sprayer for indoor residual sprayer, Knapsack sprayer for larviciding, thermal fogger for space spraying
8. Determination of larval susceptibility to different insecticides: Preparation of stock solutions and various concentrations; Methods of testing.
9. Determination of adult susceptibility to different insecticides: Preparation of insecticide impregnated papers; methods of testing using WHO test kit.
10. Monitoring of insecticide resistance in field strains against larvicides/adulticides
11. Residue analysis (Colorimetric methods; HPLC Technique)

Part B SEMESTER II

(To be completed at AIIMS, Jodhpur)

Paper -IB (DPHE 2-CT-05B)

Anophiline and Culicine Diagnosis, treatment and prognosis

UNIT I

Life cycle of human malaria parasites and Transmission factors. Taxonomic position of different species - Distinguishing characters of different species of human malarial parasites, Distribution of Plasmodium parasite species in India. Epidemiology: Malaria ecosystems – urban, rural, forest, coastal malaria with reference to vector ecology

UNIT II

Survey: Methods of vector incrimination - Conventional, immunological and molecular techniques; (Conventional – dissection and staining of salivary glands/Midgut, Molecular and immunological techniques), Epidemiological (parasitological and entomological) indices. Surveillance – Conventional, immunological and molecular methods for detection of parasites and species identification in humans. Treatment

UNIT III

Molecular and immunodiagnostic methods including xenomonitoring and PCR techniques for parasites and species identification

Chemotherapy: Selective treatment – mass drug administration – medicated salt – side reactions.

National and international status and drug policy - drug resistance and its detection by conventional and molecular techniques. Role of WHO and other National institutes in eradication of mosquito borne diseases

UNIT IV

Lymphatic filariasis: History and geographic distribution of lymphatic filariasis - Taxonomic position of different species - Distinguishing characters of different species/strains, Life history of *Wuchereria bancrofti* and *Brugia malayi*; Parasite morphology and microfilariae periodicity; Biology and ecology of *Culex quinquefasciatus* and *Mansonioides* vectors; Survey methods– parasitological and clinical

Brief description of zoonotic parasites and animal models.

UNIT V

Arboviral pathogens

Classification of Arboviruses - Dengue, Chikungunya, Japanese encephalitis, Zika, West Nile, and Yellow fever viruses - Geographic distribution - Viral structure and replication - Transmission and maintenance cycle.

Paper II B (DPHE 2-CT-06B)

Sand flies, Black flies, Muscoid flies and their medical Importance

Medical importance of sand fly – borne diseases: MAJOR Diseases arising from sand flies black flies and mucoid flies

UNIT I

Major diseases arising from sand flies, their symptoms, prevalence, distribution, prognosis, diagnosis and control

UNIT II

Major diseases arising from black flies, their symptoms, prevalence, distribution, prognosis, diagnosis and control with special reference to Simuliidae family

UNIT III

Major diseases arising from mucoid flies, their symptoms, prevalence, distribution, prognosis, diagnosis and control

UNIT IV

Present status – recent advances in managing these diseases with special reference to kala azar. Cutaneous Chandipura virus: prevalence and distribution.

UNIT V

Various National Vector Borne Disease Control Programmes in India
Role of WHO and major National institutes in eradication of fly borne diseases

Paper III B (DPHE 2-CT-07B)

Other Arthropods of Medical and Veterinary Importance

UNIT I

Prevalence of diseases transmitted by fleas, lice, ticks and mites in India

The triatomines or reduviidae (bed bugs) transmit Chagas disease (American trypanosomiasis).

UNIT II

Different bacterial infections: bartonellosis (Trench fever), borreliosis (relapsing fever), and certain types of rickettsiosis (typhus).

Plague and rickettsial pathogens - morphology & identification

UNIT III

Lyme disease, tick-borne meningoencephalitis, KFD Disease, Crimean–Congo hemorrhagic fever, tick-borne relapsing fever, Q fever, the tick-borne spotted fevers, babesiosis, ehrlichiosis, tularemia.

UNIT IV

Cockroaches: Environmental management: cleanliness and hygiene, reduction of accessibility - chemical and biological control - baits and traps - repellents - modern methods.

Diseases caused by bugs and other arthropods, their symptoms, diagnosis, prevention and control

UNIT V

Diseases associated with rodents: Plague - Salmonellosis - Leptospirosis - chemotherapy and prevention and control.

Role of WHO, WHOPS and major National Institutes in eradication of flea, lice, tick and mite borne diseases

Paper IV B (DPHE 2-CT-08B)

Biological & Environmental Methods for the Control of Vectors

UNIT I:

Romanomermis species: life cycle, host susceptibility, biocontrol potential, mass production & application methods.
Insect predators - Toxorhynchytes species, Aquatic bugs/beetles – efficacy on mosquito control and methods of application.

UNIT II:

Larvivorous fish: Different types – characteristic features
Biocontrol/predatory potential – operational use – Mass culture – technique on field release, Precautions.

Natural enemies of Arthropods- Competitors - pathogens - parasites - parasitoids - predators - distribution and their role

UNIT III:

Biolarvicides: Larvicidal bacilli: Bacillus thuringiensis, B. sphaericus.
Pupicidal bacilli: B. subtilis and Pseudomonas fluorescens.

Fungal pathogens of mosquitoes: Coelomyces, Lagenidium, Beauveria & Metarhizium.

Production, formulation evaluation of bio control agents in the laboratory and field.

UNIT IV:

Management of Public Health Pesticides

Elements of management of public health pesticides: Product registration - Procurement - Label - Storage and transport - Distribution - Application - Disposal - surveillance of pesticide poisoning - Quality control; Safe use of pesticides: general principles of safety measures - medical surveillance; Operative procedures: Preparation of spray materials - House treatment with residual spraying - Larvicidal - Rodenticidal - Herbicidal treatments - Diagnosis and treatment of poisoning.

UNIT V:

Environmental modification and manipulation; equipments for environmental management; impact of environment management on the components of environment; planning, organization and evaluation of environment management measures; Personal protection measures.

Practical I B (DPHE 2-CP-03B)

1. Preparation of stains – JSB-I, JSB-II
2. Blood smear preparation and staining
3. Identification of malaria parasites-*Plasmodium vivax*, *P. falciparum* and *P. malariae*
- 4 Parasite counting and density grading
- 5 Public health workers, health centres, and Govt policies regarding Malaria
- 6 Night blood survey
- 7 Staining and examination of thick blood smears for M.F. (Malaria Falciparum)
- 8 Demonstration of membrane filtration technique
- 9 Demonstration of ICT card test
- 10 Demonstration of Og4C3 technique
- 11 Clinical symptoms, Clinicopathological studies, Treatment Diagnosis, Prognosis and Vaccination process, Public health issues and Govt policies for Leishmaniasis, Kala-azar, and other diseases caused by Sand flies, Black flies and Mucoïd flies.

Practicals II B (DPHE 2-CP-04B)

- 1. Clinicopathological symptoms, Treatment, Medicine, Diagnosis and Prognosis, Public health awareness programme**
2. Demonstration of community mobilization techniques
- 3. Case study**
 1. Isolation and identification of bacterial pathogens
 2. Testing of mosquito larvicidal and pupicidal activity
 3. Slide show- mycopathogens
 4. R. iyengari-demonstration
 5. Identification of larvivorous fish
 6. Handling of equipments for Environmental Management
 7. Tools used for personal protection measures
- 4. Visit To Different Institutes Like ICMR And Vector Research Stations For General Identification And Disease Diagnosis And Management By Both Centres As A Part Of Project**