

# **FACULTY OF SCIENCE**

## **Mohanlal Sukhadia University, Udaipur**

### **M.Sc. Zoology (CBCS) Programme**

(valid from session 2015-16 on wards)

#### **1. Duration of the Course**

The Master of Science Zoology programme will be of four semesters duration under Choice based Credit system which will be conducted in two years. Each semester will be of approximately 5 months (minimum 90 working days in a semester) duration.

#### **2. Eligibility:**

Candidates seeking admission to the first semester of M.Sc.(Zoology) must have a B.Sc. with Zoology or Life Sciences as one of the optional subjects or as a honours subject (10+2+3 scheme) with minimum 48% marks from a UGC recognized University

#### **3. Admissions:**

Admissions to the first semester of M.Sc.(Zoology will be made as per admission rules for M.Sc.(CBCS)

#### **4. Medium of Instruction**

The medium of instruction and examination shall be English.

#### **5. No. of Seats**

Total number of normal fee seats: As per information bulletin

#### **6. Curriculum**

6.1 M.Sc.(Zoology) programme has a two year , four semester prescribed course structure which in general terms is known as curriculum. It prescribes courses to be studied in each semester as given below

6.2 M.Sc.(Zoology) programme shall have a curriculum and course contents (syllabi) for the courses recommended by the committee courses in Botany and approved by the academic council of the university.

6.3 The programme shall follow Choice Based Credit System(CBCS) and will be governed by the Common Rules and Regulations of Masters programme under CBCS approved by the Academic Council of the University

## **7. Courses of Study and Examination (2015-16)**

### **M. Sc. ZOOLOGY: 2015–2016**

#### **(CBC System)**

#### **Course Code-MI 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

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

##### **UNIT – III**

Feeding and Digestion: Amoeboid feeding; Filter feeding; Feeding and mouth parts in insects; Feeding in Echinoderms; 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; Origin of sex; Sexual reproduction.

**M. Sc. ZOOLOGY: 2015–2016**

**(CBC System)**

**Course code- MI ZOO02CT-02 No of Credits-4**

**Paper II-Ethology and Evolution**

**UNIT - I**

Concept of Ethology - Introduction, definition and historical outline, Fixed action pattern, sign stimulus, Types and characteristics of Reflexes, Orientation, kinesis and taxis.

**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. Ecological behaviour – kin selection.

**UNIT - IV**

General concepts of evolution, detailed account of destabilizing forces of evolution, Natural selection, Isolation, Genetic drift, Geometric migration, Meiotic drive, Hardy-Weinberg law of genetic equilibrium.

**UNIT - V**

Concept of speciation, Factors responsible for speciation, Modes of speciation (Sympatric, Allopatric and Parapatric), Micro and macro-evolution: Current issues in human evolution.

**M. Sc. ZOOLOGY: 2015–2016**

**(CBC System)**

**Course code-MI ZOO03 CT03 No of Credits-4**

**Paper III -Instrumentation and Techniques in Biology**

**UNIT-I**

Animal breeding and rearing- setingup of animal house, keeping and maintenance, handling of animals, keeping of records of animals and breeding, breeding techniques, animal feeds, care of new borns, safety and precautions.

**UNIT- II**

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

**UNIT- III**

Principles and application of pH meter, colorimeter, spectrophotometer, centrifuge and ultracentrifuge, electrophoresis (Paper, agarose, PAGE), chromatography (TLC, ion exchange, column, HPLC).

**UNIT- IV**

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- V**

Microtomy- Dehydration, clearing and infiltration, embedding methods, trimming, sectioning. Cryostat sectioning and mounting, mounting media, freezing techniques, freeze drying, freeze fracture and itching. Staining techniques (Nuclear and Cytoplasmic Stains).

**M. Sc. ZOOLOGY: 2015–2016**

**(CBC System)**

**Course code-MI 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.

**UNIT- III**

Cell Cycle : Role of Microtubules in cell cycle. Cyclins 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.

**UNIT- V**

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.

**M. Sc. ZOOLOGY: 2015–2016**

**(CBC System)**

**Course code-MI 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 histolitica* 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*, *Pennatula*, *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, Phyllium, 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.

### DISSECTIONS/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 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 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.

**M. Sc. ZOOLOGY: 2015–2016**

**(CBC System)**

**Course code-MI ZOO 06CP-02 No of Credits-4**

**Practical- II**

**(Paper –III and IV)**

1. Demonstration of different instruments
  - a. Colorimeter
  - b. Spectrophotometer
  - c. Centrifuge
  - d. Fluorescence microscope
- 2 Preparation of paraffin blocks of given tissue: sectioning and staining
- 3 Preparation of cryostat section and staining
- 4 Preparation of molar solutions, buffers, mounting media, fixatives
- 5 Fixation methods and cryopreservation.
- 5 Exercise related to animal breeding and rearing.
- 6 Single double staining of paraffin sections
- 7 TLC based exercise
- 8 Permanent slides: Mitosis, Meiosis, cancer, Bone marrow etc.
- 9 Preparation of human Karyotype
- 10 Euchromatin and heterochromatin staining in onion cells.
- 11 Chromosome banding in onion root tip cells.
- 12 Transportation across RBC membrane using isotonic, hypotonic and hypertonic solution.
- 13 Sex chromatin in squamous cell epithelium of oral cavity

**Recommended books:**

K. Wilson and K.H. Goulding: A biologist's guide to principles and techniques of Practical biochemistry, ELBS Pub.

Robert Braun: Introduction to instrumental analysis, McGraw Hill Intern.

Nigel Jenkins: Animal cell biotechnology, methods and Protocols, Humana Press

R.Ralph: Methods in experimental Biology. Blackie Pub

**M. Sc. ZOOLOGY: 2015–2016**

**(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.

**M. Sc. ZOOLOGY: 2015–2016**

**(CBC System)**

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

**Paper II Environmental Toxicology**

**UNIT – I**

Environmental stress and their management, global warming, ozone depletion, acid and nitrogen deposition. Agro- chemical and pesticide pollution and their control.

**UNIT – II**

General principles toxicology. Bioassay of toxicants using different models. Dose determinations

**UNIT – III**

Bioindicators and biomarkers of environmental health. Basic concept of bioaccumulation and biodegradation of pollutants. Basic survey of environmental toxicants.

**UNIT – IV**

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.

**UNIT – V**

Safety evaluation of toxicants – environmental hazards and risk assessment; risk management and monitoring, criteria for safety evaluation.

**M. Sc. ZOOLOGY: 2015–2016**

**(CBC System)**

**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.



**M. Sc. ZOOLOGY: 2015–2016**

**(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.

**UNIT-II**

Ionic and Osmotic balance: Osmoregulators Vs osmoconformers, Osmoregulation in aquatic and terrestrial environments, other osmoregulatory organs.

**UNIT-III**

Gas exchange and acid base balance: Mechanism of inspiration and expiration in aquatic and terrestrial animals, O<sub>2</sub> and CO<sub>2</sub> transport in blood, role of Haemoglobin, regulation of body pH, Chloride shift, Haldane Effect.

**UNIT-IV**

Innate and Adaptive Immune system, Cells and organs of immune system: B-lymphocytes, T-Lymphocytes, Null-cell, Mononuclear cell, granulocytic cells, mast cells, dendrite cells. Primary lymphatic system, Thymus and Bone marrow. Nature of Antigens and Immunogens (Antigenicity and Immunogenicity Epitopes and Heptanes). Antibody classification and function.

**UNIT-V**

Complement system, major histocompatibility complex, hypersensitivity and autoimmunity, Immunodeficiency disease, Brief idea of vaccines.

**M. Sc. ZOOLOGY: 2015–2016**

**(CBC System)**

**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
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. Persistency test of synthetic chemical against pest
13. Residual toxicity test with bio insecticide.
14. Effect of heavy metals on mammalian tissues

**M. Sc. ZOOLOGY: 2015–2016**  
**(CBC System)**  
**Course code-M2 ZOO6CP-04 No of Credits-4**

**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.

**M. Sc. ZOOLOGY: 2015–2016  
(CBCS System)**

**Course code-M3ZOO01CT-09 No of Credits-4**

**Paper-I Vertebrates**

**UNIT - I**

Origin of Vertebrate, Phylogeny of Vertebrate, Characteristics of Vertebrate  
Characters of Agnatha and early gnathostomes (Placoderms). Extinct  
Vertebrates and Evolution of Jaws

**UNIT- II**

Character, origin and evolution of Pisces and Amphibia, Fish Migration  
Neoteny and Paedogenesis, Economic importance of Fishes and Amphibians.

**UNIT – III**

Evolution of terrestrial animals, Character, origin and evolution of Reptiles.  
Mesozoic reptiles and living reptiles, Dinosaurs, Archaeopteryx.

**UNIT- IV**

Character, origin and evolution of Aves, Flightless birds, Origin of flight, Flight  
Adaptation ,Types of beaks and palate in birds.

**UNIT- V**

Character, origin and evolution of Mammals. Adaptive radiation in mammals'.  
Evolution of Placenta. Cenozoic Mammals.

**M. Sc. ZOOLOGY: 2015–2016**

**(CBC System)**

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

**Paper II - Computational biology ,Biostatistics and Bioinformatics**

**UNIT-I**

Data collection and tabulation, Frequency distribution, Diagrammatic and graphical representation of statistical data, Sampling techniques, measures of sampling 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**

Statistical designing of experiments, purpose of research design and characteristics of good research designing, Setting up of experiments. 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, Important features of word processing software's. Brief idea of following:

Adobe acrobat, MS excel, MS Power point and its important features, Search engines-Google, Google Scholar, E-journals, E-books, digital library, INFLIBNET, Abstract service, Accessing scientific databases.

**UNIT-V**

Introduction to Bioinformatics, Principals of bioinformatics- useful sites for researchers, Bioinformatics in life sciences, biological data bases- Nucleic acid sequence data base: Gene bank, brief idea of Microarray, introduction to genomics and proteomics. Bioinformatics in India.

**M. Sc. ZOOLOGY: 2015–2016**

**(CBC System)**

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

**Entomology and Insect Toxicology**

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

### **UNIT-I**

#### **Taxonomy and classification of Insects**

Origin and Evolution of insects with special reference to fossil insects; causes of success of insects, An introduction to insect classification, Classification of insect's up to orders and sub orders .Use of identification keys.

### **UNIT II**

Classification of insects up to to super families in economical important groups:

Orthoptera, Lepidoptera, Diptera and Hymenoptera

### **UNIT-III**

Insect collection ,identification and preservation

Methods of collection preservation and studying of insects.

Spreading ,mounting and preservation of insects.Preservation Tips and importance of preservation.

Knowledge and use of equipment for the collection and preservation of insects, insect net, killing bottle, spreading board, insect box device for inflating larva, light trap, etc.

## **UNIT-IV**

### **Ecology of insects**

Ecology of insects in the ecology of the earth.

Population dynamics. Population growth and fluctuation and population regulatory mechanisms .Plant resistance to insects and types of resistance.

## **UNIT-V**

Biochemical adaptations to environmental stresses (Metamorphosis; Diapause, polymorphism etc.)

Effect of physical factors. . Intra and interspecific relations

Insects and humans interactions.

### **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., Harward 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: 2015–2016**

**(CBC System)**

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

**Wildlife Biology-I : Biodiversity and Wildlife Ecology**

**UNIT I**

Concepts of biodiversity, levels of biodiversity – biological, genetic, species and ecosystem diversity, Types of species: Key stone species, Umbrella species, Indicator species, Flagship species, Exotic, Indigenous and Introduced species, Value of biodiversity – direct and indirect economic values, ethical values; Threats to biodiversity – habitat destruction, fragmentation and degradation, introduction, overexploitation

**UNIT II**

Biotic community – organization and characteristics of community, ecological dominance, ecotone and edge effect, Community structure and organization (guilds, resource partitioning, niche, competitive exclusion), Ecosystem services

Population ecology – intra and interspecific competition and mutualism, density dependence – optimum foraging theory, carrying capacity, population analysis – density, sex ratio, age distribution, fecundity by age, survival by age

**UNIT III**

Ecology of major habitats: Deserts, Grasslands and Forests

Patterns of habitat utilization and dispersion, including home range – migration and corridors, predator – prey interaction

Physical factors influencing terrestrial habitats: Drought, flood, soil erosion, grazing, fire



## **UNIT IV**

Major vegetation types of India – basis of classification – their physiognomy and seasonal characteristics; phenology – species composition – distribution

Forest soils and their conservation, classification, factors affecting soil formation, physical and chemical properties, causes of soil erosion and conservation methods

## **UNIT V**

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

Silviculture – general principles, ecological and physiological factors influencing vegetation, natural and artificial regeneration of forests – nursery techniques, seed technology – collection, storage, pre-treatment and germination

**M. Sc. ZOOLOGY: 2015–2016**

**(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 trophogenicity 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;CO<sub>2</sub> 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: 2015–2016**

**(CBC System)**

**Course code-M3ZOO-03ET 01D No of Credits-4**

**Cellular Neuroscience- I: General Neurobiology**

**UNIT-I**

General organization of nervous system : Gross anatomy of brain. Subdivisions of nervous system; skull and meninges, cerebrospinal fluid, General organization of nerves, roots and ganglia, nuclei and ventricles, blood brain barrier.

**UNIT-II**

Cells of nervous system: classification and types of neurons, cytology and ultrastructure of a neuron, glia cells, dendrites and axons, myelination and synapse. Structure and functions of glial cells:

**UNIT-III**

General organization and histology ( Brief idea) of spinal cord, medulla oblongata, cerebellum, cerebral cortex, thalamus, hippocampus, hypothalamus and basal Ganglia, striatum and substantia nigra, amygdala.

**UNIT-IV**

Embryonic origin of nervous system: Neural tube and neural crest cells, their derivatives. Differentiation of nerve cells. Neurotrophic factors. Brief idea of gross development of brain, birth and migration of neurons. Neurogenesis in post embryonic and adult age. Denervation and regeneration of synaptic connections, effects of denervation on postsynaptic cell.

**UNIT-V**

Electrical properties of neurons. Conduction of nerve impulse, action potential, ion channels, voltage gated channels, synapses, synaptic vesicles, synaptic transmission, calcium hypothesis, synthesis and trafficking of neuronal proteins. Axoplasmic transport.

**M. Sc. ZOOLOGY: 2015–2016**

**(CBC System)**

**Course Code-M3ZOO04 ET02A No of Credits-4**

**Entomology and Insect Toxicology**

**Paper-II Insect Organization and Physiology**

**UNIT I**

**External Morphology of insects:** Integument: Structure, composition , functions Functional morphology of head, thorax and abdomen .

Head segmentation and appendages.

Wing development and Wing venation in insects.

**UNIT-II**

**Physiology of Insects:** Muscular system cephalic, thoracic abdominal and flight muscles, mechanism of flight in insects.

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.

**UNIT III**

Circulatory system: Morphology and physiology including. Composition of haemolymph

Respiratory system: Structure of respiratory organs and physiology. Adaptations for aquatic respiration

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

**UNIT-IV**

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-V**

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.

**M. Sc. ZOOLOGY: 2015–2016**

**(CBC System)**

**Course Code-M3ZOO 04ET02B No of Credits-4**

**Wildlife Biology-II : Conservation Biology**

**UNIT I**

Introduction to conservation biology, conservation of biodiversity – patterns and processes – *in situ* and *ex situ* conservation, international conservation bodies – IUCN, UNDP, FAO, WWF

Ex situ conservation – role of zoos and aquariums, introduction/reintroduction and translocation

In situ conservation – national parks and wildlife sanctuaries – formation and management, protection and administration

**UNIT II**

National parks of India – Ranthambore, Gir, Kaziranga, Kanha, Bandipur, Corbett, Silent Valley; Marine National Parks of India – Mannar, Gulf of Kutch

Biospheres of India and their concept

Wildlife Sanctuaries in India – Periyar, Mudumalai, Sariska, Jaisamand, Kumbhalgarh, Sitamata, Phulwari ki Nal,

**UNIT III**

Zoological Parks – formation, management – food and feeding; zoo sanitation

Community reserves and sacred groves

IUCN categories in context to Indian Wildlife (Extinct, Extinct in wild, critically endangered, endangered, vulnerable, near threatened, least concern, data deficient and not evaluated)

#### UNIT IV

Endangered and threatened animals - Mammals (*Panthera tigris*, *Panthera pardus*, *Tetraceros quadricornis*, *Manis crassicaudata*, *Gazella gazelle bennetti*, *Bos gaurus*, *Elephas maximus*), Birds (*Pavo cristatus*, *Grus leucogeranus* – Siberian white crane, *Choriotis nigriceps* – Great Indian Bustard, *Gyps bengalensis*), reptiles (*Crocodylus palustris*, Python, *Kachuga kachuga*),

#### UNIT V

Captive breeding and propagation: rehabilitation, gene banks

Wildlife forensics: DNA banks for endangered animals; Pug mark analysis, Hair analysis

Conservation ethics and values.

**M. Sc. ZOOLOGY: 2015–2016**

**(CBC System)**

**Course Code-M3ZOO04 ETC No of Credits-4**

**Limnology and Fisheries- II : Fresh Water Aquaculture**

**UNIT-I**

Aquaculture: Extensive, intensive and semi intensive culture. Scope and importance of Aquaculture in India. Culture of Indian major carps- *Labeo rohita*, *Catla catla* and *Cirrhinus mrigala*. Culture of exotic fishes introduced in India – *Cyprinus carpio*, *Ctenopharyngodon idella*, *Hypophthalmichthys molitrix* and *Tilapia mossambica*.

**UNIT-II**

Biology and culture of indigenous and exotic freshwater prawns in India. Cold water fishes- Trout, tench and golden Mahseer. Brackish water fishes- mullets, *Lates calcarifer* and *Chanos chanos*.

**UNIT-III**

Planning, construction and maintenance of fish farm. Site selection and culturable fish selection. Liming Fertilization and soil micronutrients. Fresh water weeds: importance and harmful effects, methods of eradication.

**UNIT-IV**

Predatory fishes, weed fishes and their control. Induced breeding- Hypophysation. Ovaprim, cryopreservation of gametes and embryos. Different type of hatcheries.

**UNIT-V**

Composite fish culture, Integrated Fish Farming, Monosex culture, Pen culture and Cage culture.

Indigenous crafts and gears.



**M. Sc. ZOOLOGY: 2015–2016**

**(CBC System)**

**Course Code-M3ZOO04 ET02D No of Credits-4**

**Cellular Neuroscience – II : Laboratory Tools and Techniques**

**UNIT-I**

Principles of fixation and staining nervous tissue; methods of tissue processing for microtomy, cryotomy and vibratome; golgi and other impregnation methods, staining methods of neurons and their components.

**UNIT-II**

Enzyme histochemistry- Principles and methods of localization of various enzymes- Acetylcholinesterase; NADPH-diaphorase; Na<sup>+</sup> K<sup>+</sup> ATPase; Monoamine oxidase, succinic dehydrogenase in brain tissue.

**UNIT-III**

Tools in electrophysiological studies of brain in animals. Animal activity monitoring, different types of mazes and their application in studies of behavior; learning and memory and cognitive testing of animals; Rota rod test, Grip strength meter; Pain sensitivity testing with tail flick instrument and Paw test; Open field tests and other specialized behavior methods.

**UNIT-IV**

Tracer techniques and autoradiography, quantitative techniques- cytometry, stereology, image analysis, photomicrography, stereotaxic instrument and its uses, Brief idea of MRI, CAT and EEG.

**UNIT-V**

Antigen preparation, Production of poly and monoclonal antibodies against neuropeptides; various methods of localization, light and ultrastructural immunocytochemistry.

**M. Sc. ZOOLOGY: 2015–2016**

**(CBC System)**

**Course Code-M3ZOO05CP05 No of Credits-4**

**SEMESTER – III**

**Practical- I**

**(Paper I & II)**

**1 Dissections/Labeling:**

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

2 Mounting of oral hood, velum, pharyngeal wall and endostyle of *Amphioxus*.

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*

- 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 designing of animal experiments
- 10 Exercises based on use of MS power point, MS excel, Adobe-acrobat, Google.
- 11 Analysis of data using statistical software
- 12 Exercises based on bioinformatics
- 13 Data mining for sequence analysis.
- 14 Wet based tools for sequence researches and homology screening.

**M. Sc. ZOOLOGY: 2015–2016**  
**(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, insect box device for inflating larva, light trap, etc.
- 3 Collection and preservation .of insects and their different stages.
- 4 Collection of seasonal insects, nocturnal insects, aquatic insects, crop pests, stored grain pests and insects .of medical and veterinary importance.
- 5 Identification of insects from various orders prescribed far study in the syllabus. .
- 6 Museum study for identification of insects of different orders
- 7 **Dissections**
- 8 Cockroach- Digestive. Circulatory,. Reproductive systems and Neuro endocrine complex.
- 9 Grasshopper- Digestive, Circulatory, Reproductive systems and Neuroendocrine complex
- 10 Honey bee/Wasp: Disgestive and Nervous system and sting apparatus.
- 11 Permanent preparation of Different types of mouth parts, antennae, legs and wings.
- 12 Sting apparatus of honey bee
- 13 Pollen basket of boney bee
- 14 Tympanum and spiracle of grasshopper
- 15 Whole mounts (w.m.) of various small insects
- 16 Rearing and life cycle studies of
- 17 Tribolium
- 18 Rizopertha
- 19 Heliothis /Spodoptera
- 20 Study of prepared slides:
- 21 Microtomy (Internal organs of insects):

**M. Sc. ZOOLOGY: 2015–2016**  
**(CBC System)**  
**Course Code-M3ZOO05 EP01B No of Credits-4**  
**PRACTICAL-II**

**Biodiversity, Wildlife Ecology and Conservation Biology**

1. Visit to a zoological garden. Student should submit the report on the study covering various aspects like animals observed, their food preparation and presentation
2. Identification of mammalian species using hair imprinting and scat analysis.
3. Determination of population density of animals using transect and random survey methods.
4. Population density determination on the basis of mark recapture technique.
5. Determination of species dominance and frequency using quadrant/plot method.
6. Analysis of habitat characteristics (gbh/dbh, tree height, canopy volume).
7. Analysis of vegetation in given area.
8. Project work
9. Analysis of species diversity using diversity indices.
10. Study of light intensity using Lux Meter.
11. Soil analysis: Physical: temperature, colour, texture, Chemical: moisture content, carbonates, nitrates, pH.

**M. Sc. ZOOLOGY: 2015–2016**  
**(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 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. Qualitative analysis of plankton sample
10. Report on freshwater weeds of a lake
11. Report on freshwater benthos of a lake
12. Identification and writing comments on various limnological instruments, weeds, phytoplankton, zooplankton benthos and insects.
13. Visit to various lakes and polluted streams.

**M. Sc. ZOOLOGY: 2015–2016  
(CBC System)**

**Course Code-M3ZOO05EP01D No of Credits-4**

**Practical-II**

**Cellular Neuroscience**

1. Cytological staining of nerve cells, glia and processes
2. Staining of myelin, lipofuscin, histone and nissel granules
3. Staining of pituitary cells, Staining of neurosecretory substance
4. Staining of various regions of brain and identification of various nuclei, fibers and tracts
5. Staining of degenerating neurons and fibers
6. Immunocytochemical staining of growth factors
7. Digital dissections of the nervous system of certain vertebrates
8. Isolation and separation of different nerve cell types
9. Effects of certain chemicals or drugs on neurons and glia
10. Study of prepared slides.
11. Preparation of molar solutions, preparation of various fixative and mounting media.
12. Immersion and perfusion fixation methods
13. Preparation of paraffin block of tissues and section cutting and staining
14. Paper chromatography, TLC and column chromatate
15. Cytometry
16. Breeding and rearing of various animals, colony maintenance
17. Images on various microscopes
18. Preparation of plates, labeling identification script writing.
19. Computer based statistical methods

### **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 39<sup>th</sup> Ed. Elsevier, 2005.



18. M.J.T.Fitzgerald: Clinical neuroanatomy and related Neuroscience. 4<sup>th</sup> Ed. CRC Press.
19. Richard S Snell.: Clinical Neuroanatomy for medical students. 5<sup>th</sup> 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, Churchill 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, 2<sup>nd</sup> Ed. Cold Spring Harbour Lab. Press.
27. C.S.V.Murthy: Bioinformatics. Himalya Pub.

**M. Sc. ZOOLOGY: 2015–2016**

**(CBC System)**

**Course Code-M4ZOO01CT11 No of Credits-4**

**Applied Zoology**

**UNIT – I**

Concepts of applied Zoology: Protozoans and human diseases, Helminthes and human diseases, Insects and human diseases

**UNIT - II**

Beneficial insects and Agro industry, 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. Cultivation of mulberry, Grainage and rearing of silk worm. Post harvest and cocoon production, Silk yarn reeling. Silk industry in India.

**UNIT- III**

Introduction to Vector Biology, Vector borne diseases in relation to climate change and human health. Control of Insect vectors and National vector borne programs. Changing scenario of pests of agricultural importance.

**UNIT - IV**

Habit,habitat and culture of fresh water fishes (Major carp). Fish harvesting and fish products . Fish industry in India. Pearl culture and pearl industries in India.

**UNIT - V**

Sustainable agriculture and organic farming, Principles, objectives and component of organic farming, Vermicomposting and Agriculture business management: an overview.

**M. Sc. ZOOLOGY: 2015–2016**

**(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: 2015–2016**

**(CBC System)**

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

**Paper-I ECONOMIC 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 .

Synthetic Insecticides: Classification and nomenclature, Assessment of pest status; EIL and ETL and chemical control of pests

Pheromones and other Attractants, Repellents, Chemosterillants

Biological characteristics of parasitoids, predators and pathogens and their role in nature

**UNIT-II.**

Biological control of insects as a component of IPM

Biopesticides:Herbal and Microbial ,their production and applications

Biotechnology in insect control..

Nanotechnology in Crop Protection.

**UNIT-III**

**Medical Entomology**

Flies – Types, Role in disease transmission, Case studies – Myasis.

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-IV**

Life cycle of different species of mosquitoes

Identification of various mosquito borne diseases. Surveillance and outbreak of vector borne diseases in tropical countries.

Global warming and disease outbreak.

Integrated vector management

WHO guide lines for vector surveillance and control.

## **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

**M. Sc. ZOOLOGY: 2015–2016**  
**(CBC System)**  
**Course code-M4ZOO 03ET -01B No of Credits-4**

**PAPER I**

**Wildlife Biology : Indian Wildlife**

**UNIT I**

Zoogeographical regions of India and their fauna: Himalayan, Eastern and Western ghats, Thar, Deccan plateau, Gangetic plains

Fauna of Thar Desert (Chinkara, Desert fox, Black buck, Great Indian Bustard, Indian Peafowl, Desert *Agama*)

**UNIT II**

Status, distribution, physical characteristics and ethology of: Tiger, Lion, Rhinoceros, Elephant, Mugger, Four-horned Antelope

Status, distribution, physical characteristics of some threatened plants: *Prosopis cineraria*, *Albizia lebbek*, *Azadirachta indica*, *Withania somnifera*, *Commiphora wightii*

**UNIT III**

Special Wildlife programs: Project Tiger, Project Elephant, Operation Rhino, Project Crocodile,

Wildlife of Rajasthan

Ramsar convention, Ramsar sites of India (Chilka lake, Bhoj Wetland, Wular Lake, Deepor Beel, Point Calimere Wildlife and Bird Sanctuary), Ramsar sites of Rajasthan (Keoladeo National Park, Sambhar lake)

Important Bird Areas (IBAs) of India and Rajasthan

#### **UNIT IV**

Wildlife Institutes in India: WII, BNHS, ZSI, IIFM, FSI, CAZRI, Central Zoo Authority of India

Wildlife legislation: Wildlife Protection Act, 1972; National Wildlife Action Plan, 2002; National Biodiversity Act, 2002

#### **UNIT V**

Wildlife trade and trafficking

Damages caused by wildlife- their identification and control

Animals in Indian mythology (symbols, vehicles, divinities)

**M. Sc. ZOOLOGY: 2015–2016**  
**(CBC System)**  
**Course Code-M4ZOO03ET -01C No of Credits-4**

**Paper I**

**Limnology and Fisheries**

**Fisheries Management**

**UNIT – I**

Fisheries and classification of fisheries; Lacustrine fisheries; Riverine fisheries – Ganga river system; Coastal and Deep sea fisheries.

**UNIT – II**

Fisheries of Rajasthan

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

**UNIT – III**

Pre and Post-harvest Technology: Food of culture fishes, supplementary feed. Probiotics; live-fish transport; Fish spoilage; Fish preservation; Fishery by-products.

**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: 2015–2016**

**(CBC System)**

**Course Code-M4ZOO03ET -01D No of Credits-4**

**Paper-1**

**Cellular Neuroscience- : Advance Neurobiology**

**UNIT-I**

Neurotransmitters- types and synthesis; agonists and antagonists. Brief idea of excitatory and inhibitory neurotransmitters: GABA, glycine and glutamate and their receptors, agonists and antagonists, AMPA, kainite and NMDA receptors, glutamate excitotoxicity.

**UNIT-II**

Organizational principles of adult hypothalamus, role of hypothalamus and pituitary hormones, Neuropeptide hormones- general idea, distribution , synthesis and functions; diffuse neuroendocrine system; Pineal and circadian rhythm.

**UNIT-III**

Brief idea of CNS diseases - Alzheimer's and Parkinson's; multiple sclerosis and other demyelinated disorders; disorders of lipid and glycoprotein ; disorders of amino acid metabolism; ischemia and hypoxia, epileptic seizures; motor neuron disease; Anxiety and attention disorder;

**UNIT-IV**

Neuropharmacology: General idea of drugs acting on CNS; Drugs and behavior; drugs and neural transmission; Drug abuse and dependence and prevention; Brief idea of Amphetamine, cocaine, morphine and their mode of action, Opiates, Neurotoxic substances and their effects on nervous system; drugs of herbal origin and their effects on CNS functions and disease

**UNIT-V**

Brief history of cognitive neuroscience: Brief idea of cognitive functions; Learning and memory, Hormones and behavior- General principles and effects, stress and hormones, Brief idea of brain and homeostasis.

**M. Sc. ZOOLOGY: 2015–2016**  
**(CBC System)**  
**Course Code-M4ZOO04ET -02A No of Credits-4**  
**Paper II**

**Insect Toxicology and Forensic entomology**

**UNIT-I**  
**INSECT TOXICOLOGY**

Toxicological parameters Acute and chronic, oral and dermal toxicity, ,  
Biomagnifications, maximum residue limit.  
Labeling, packing, storage and disposal  
Impact of insecticide misuse  
Mode of action of organophosphates and carbonates on target organism

**UNIT-II**

Bioassay of insecticide in laboratory  
Methods of diluting insecticide to a recommendation level  
Safe use of insecticides, Application equipments  
Host Plant Resistance-Resistance mechanisms  
Transgenic crops in pest management

**UNIT-III**

**Research methodology**

Insect laboratory and rearing equipments  
Experimental Designs in field and laboratory  
Observation techniques and mortality correction  
Use of statistics

- Descriptive statistics, Chi-square test, Student t-test
- Transformation of data: square root transformation,
- Analysis of variation
- Probit analysis

## **UNIT-IV**

### **Forensic Entomology**

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.

Forensic application of Entomology

## **UNIT-V**

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 .

**M. Sc. ZOOLOGY: 2015–2016**  
**(CBC System)**  
**Course Code-M4ZOO 04ET -02B No of Credits-4**  
**Wildlife Biology : Wildlife Management**

**UNIT I**

History and cultural background of Indian Wildlife, Needs and values of wildlife protection, Types of wildlife management, Significance of wildlife conservation, Management policies and their implementation, Factors injurious to wildlife and forests, Invasive species and its threat to native species.

**UNIT II**

Wildlife techniques: Data collection; monitoring; Methods of population surveys: Counts (Direct count - Total counts, Drive counts, Time Area counts, Indirect counts - Call counts, Track counts), Line transect estimate, Indices and Mark recapture estimate, Direct and indirect evidences, census methods, Pellet counts: Mark-recapture method - Peterson or Lincoln index method.

Environmental impact assessment (EIA), Geographic Information System (GIS), radio telemetry,

**UNIT III**

Forest management: Participatory Approach, Forest Laws in Relation to Tribal Land Conflict, Practices of forest management: water hole management, fire lines, grassland management, parapet covering of wells, Role of corridors in wildlife management, Conservation movements in India

Forest laws- Necessity general principles- Indian Forest Act,1927, Forests Conservation Act, 1980, The National Forest Policy, 1988

## **UNIT IV**

Social forestry- Objectives of social forestry programmes and their implementation in India, Types of social forestry: farm forestry, community forestry or rural forestry, extension forestry or urban forestry, wasteland management – tree farming on wastelands, afforestation of hills, slopes, wastelands, riverbanks and water

Need of Social forestry programs, Involvement of common people, Extension and education, tourism, finance in wildlife management

## **UNIT V**

Biostatistics: Scope and objectives, terms, units, symbols, mean, mode and median, sample and sampling, collection and representation of data, tabulation, diagrammatic and graphical representation of data

Tests of significance: Null hypothesis, Students T-test, Chi-Square test, Correlation and Regression.

**M. Sc. ZOOLOGY: 2015–2016**

**(CBC System)**

**Course Code-M4ZOO 04ET -02C No of Credits-4**

**Paper II**

**Limnology and Fisheries- : Fish and Fisheries Biology**

**UNIT – I**

Origin and Taxonomy of fishes: Origin and evolution of major groups of fishes; Classifications of fishes. Bio-geographical distribution of fishes.

**UNIT – II**

Fish Physiology: Respiratory system: Gills and aerial respiration; Air Bladder in fishes; Weberian ossicles; Excretion and osmoregulation in fishes

**UNIT – III**

Fish Physiology: Reproductive system and its endocrine regulation; light and sound production in fishes; Electric organs and electro-receptors in fishes; Age and growth in fishes

**UNIT – IV**

Fish pathology and Population studies: Bacterial diseases; Fungal diseases; Worm infections; Prevention and cure of fish diseases, Fish population dynamics.

**UNIT – V**

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

**M. Sc. ZOOLOGY: 2015–2016**

**(CBC System)**

**Course Code-M4ZOO03ET -01D No of Credits-4**

**Paper-II**

**Cellular Neuroscience : Animal Cell Culture**

**(With special reference to nerve cell culture)**

**UNIT-I**

History; advantage and disadvantages of cell and tissue culture methods. Application of culture methods, Set up of animal cell culture laboratory, equipments in culture; Safety; culture vessels; Aseptic techniques.

**UNIT-II**

Primary and established cell line; preparation and sterilization of glassware, apparatus, reagents and media; preparation of animal material, isolation of tissue; disaggregation methods; separation of viable and nonviable cells and characterization; Contamination.

**UNIT-III**

Cell culture media- Physico chemical properties; balanced salt solutions; complete media; selection of media and serum; natural and serum free media; tissue extracts; complex natural media; chemically defined media; methods of media preparation , storage etc.

**UNIT-IV**

Primary explants culture, slide or cover slip culture; test tube and flask culture; culture of embryonic organs; whole embryo culture, specialized cells; scale-up; cryopreservation.

**UNIT-V**

Cell counting and measurements; cytotoxicity testing; biochemical studies in culture; drug screening; Brief idea of molecular techniques. Cell and tissue culture in biomedical research, stem cells, cell and tissue bank, brief idea of neural tissue engineering and nanotechnology.

**M. Sc. ZOOLOGY: 2015–2016**

**(CBC System)**

**Course Code-M4ZOO06-CP06 No of credits-4**

**Practical- I**

**(Paper I & II)**

1. Rearing/ life cycle of stored product pest
2. Rearing/ life cycle of phytophagous pests
3. Rearing/ life cycle of medically important insects
4. Vermicomposting of waste by earthworm species.
5. Comparative toxicity test of synthetic insecticide and biopesticides
6. Life cycle of honey bee.
7. Study of permanent slides of disease causing protozoans
8. Study of permanent slides of Diseases causing helminthes.
9. Study of permanent slides of Diseases causing arthropods.
10. DNA isolation and DNA quantification
11. Agarose gel electrophoresis for DNA, RNA and protein.
12. Blotting techniques for DNA/RNA protein.
13. Preparation of dot blot- slot blots.
14. Extraction of genomic DNA from a mammalian tissue.
15. Techniques based on PCR.
16. Any other technique based on syllabus.



**M. Sc. ZOOLOGY: 2015–2016**

**(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. Collection ,identification and rearing of phytophagous pests
3. Testing of Inseticides : Bioassay.
4. .Estimation of LD50 and LC 50 using insects.
5. .Familiarity with techniques of appliances used for the application of insecticides
6. Sprayers including hand sprayers ,Dusters
7. Knowledge of rearing insects and maintaining insectary
8. Study of seasonal abundance of crop pests in near by area.
- 9 To study antennal grooming in Cockoach.
- 10 To study the blood cells in insects
- 11 To study meiosis and Polytene chromosomes in insects
- 12 To study the food preference Tribolium of any other insect
13. Green house and insect rearing equipments
- 14 Experimental Designs in field and laboratory
- 15 Observation techniques
- 16 Mortality correction
- 17 Identification and characterization of agricultural chemicals in conventional and Nano formulations. Size determination and quality of Nano formulations.
- 18 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: 2015–2016**

**(CBC System)**

**Course Code-M4ZOO06-EP02B No of credits-4**

**Practical- II**

**(Paper III and IV)**

**Indian Wildlife and Wildlife Management**

1. 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.
2. POP preparation of pugmarks and footprints
3. Designing the animal housing, enclosures and kraal.
4. Study of different types of cages.
5. Review of zoo-working plans and maps
6. Visit to a wetland for birding and identification of threats to wetlands. Student should submit the report on the study.
7. Limnological study of wetlands.
8. Permanent preparation of barbs of different avian feathers.
9. To observe foraging behavior in squirrels/mice.
10. Taxonomic identification and preparation of taxonomic key of given animals.
11. Statistical exercise

## **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, 2<sup>nd</sup> 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: 2015–2016**  
**(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 upto species level with the help of books and writing notes on fisheries habitat etc.
- 2 Bio-geographical distribution 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 Biochemical and haematological studies.
- 9 Identification and writing comments on commercially important indigenous fishes, exotic fishes, Prawns, fishing nets, boat models, hapas, etc.
- 10 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)**

Gerald Karp: Cell and Molecular biology II Eds. John Wiely.

David Fried felder: Molecular Biology II Ed. Narosa

T.A.Brown: Gene cloning IV ed. Chapman and Hall.

Benjamin Levine: Gene –I to X. Oxford Press

Robert Meyers: Molecular Biology and Biotechnology, VCH Pub.

Eric Kendel, J.H. Schwartz, T.M.Jessel: Principals of Neural Science, Mc Graw-Hill.

A.Longstaff: Instant Notes-Neuroscience, Viva books.

M. S., Gazzaniga, R. B. Ivy, G. R. Mangun : Cognitive Neuroscience, second Ed. WW Norton Press

C. A. Paul, B. Beltz, J. B-Sweeney: Discovering neurons, the experimental basis of neuroscience, Cold Spring Harbor Laboratory Press.

Nigel Jenkins: Animal Cell Biotechnology, methods and Protocols, Humana Press.

J. Freshney: Animal Cell Culture

C. T. Laurencin, L.S.Nair: Nanotechnology and tissue engineering. CRC Press.

J. Paul: Cell and Tissue Culture, Fifth Ed. Churchil Livingstone.



**M. Sc. ZOOLOGY: 2015–2016**

**(CBC System)**

**Course Code-M4ZOO06-CP02D No of credits-4**

**Practical- II**

**(Cellular neuroscience –Advance neurobiology)**

**Paper III and IV)**

1. Histochemical localization and demonstration of certain enzymes and heavy metals
2. Immunocytochemical staining of certain hormones and growth factors
3. Demonstration of axonal flow
4. Histochemical demonstration of certain heavy metals in CNS
5. Effects of CNS stimulants, depressants, psychotropic drugs, anticonvulsants and excitotoxicity substances
6. Study of animal behavior (Open field, neuromotor development, learning behavior , maternal behavior).
7. Use of various mazes
8. Study and evaluation of MRI, CAT patterns of human brain
9. Stereotaxic instrument and use of stereotaxic atlas
10. Use of various equipments in cell and tissue culture laboratory
11. Aseptic and sterilization methods
12. Collection of tissue, various methods (Mouse or rat embryos, human biopsies, embryo organs etc.)
13. Punch techniques , disaggregation methods
14. Media preparation, storage and testing
15. Slide and flask culture
16. Viable and nonviable cells, Cell viability testing using cytochemical staining
17. Cell separation by density gradient
18. Quantitation and cytotoxicity testing methods
19. Photography and image analysis