

# M.Sc. Zoology I SEMESTER

# Paper-1 Biodiversity and Taxonomy

### Unit-1 Definition & Basic Concept of biosystematics and taxonomy

- a. Historical resume of systematics
- b. Importance & application of biosystematics in biology
- c. Material basis of biosystematics-different attributes
- d. Theories of biological classification, hierarchy of categories

### Unit-2 Trends in biosystematics- concept of different conventional & newer aspects

- a. Chemo taxonomy
- b. Cytotaxonomy
- c. Molecular taxonomy
- d. Molecular prospective on the conservation of diversity
- e. Diversity & ecosystem process: theory, achievements and future directions

### Unit-3 Dimension of speciation & taxonomic characters

- a. Dimension of speciation-type of lineage changes, production of additional lineage
- b. Mechanism of speciation in panmictic and apomictic species

c. Species concepts-species category, different species concepts; sub-species and other infra-specific categories

d. Taxonomic characters-different kinds, origin of reproductive isolation-biological mechanism of genetic incompatibility



#### Unit-4 Procedure keys in taxonomy

- a. Taxonomic procedures-taxonomic collections, preservation, curetting process of identification
- b. Taxonomic keys-different kinds of taxonomic keys, their merits & demerits
- c. Systematic views-different kind of publications
- d. Process of typification & different zoological types

e. International Code of Zoological Nomenclature (ICZN)-its operative principles, interpretation and application of important rules, Zoological nomenclature; formation of scientific names of various taxa

#### Unit-5 Biodiversity indicators and indices

- a. Diversity in Biogeographical regions
- b. Taxon based biodiversity indicators
- c. Structure and function based biodiversity indicators
- d. Shannon-Weiner index
- e. Dominance index
- f. Similarity and dissimilarity index
- g. Association index



# Paper-2 Computational Biology

### Unit-I Basic Mathematics and Bio-statistics I

- a) Matrices
- b) Probability distribution and & their properties
- c) Summarization tabulation and graphical representation of data, Box plot
- d) Descriptive statistics
- e) Sampling Theory

#### Unit-2 Biostatistics-2

a) Tests of Significance- Types of Errors, Null Hypothesis, Level of Significance and Degrees of Freedom, Steps involved in testing of hypothesis

b) Student 't' test and Chi-square test

c) Correlation: Types of Correlation and identification through Scatter Diagram,Computation of Correlation Coefficient 'r' and its testing.

d) Regression and its testing

#### **Unit-3 Biostatistics -3**

- a) Analysis of Variance
- b) Basic Principle of Experimental design
- c) CRD, RBD, LSD
- d) Non-parametric tests

Unit-4 MS-word-MS word and different component of MS-word window; introduction to different menu file, edit, view, insert, format, tools: Creating a table and inserting & deleting row and column in a table, alignment tool bar, numbering and bullets tools, font setting, font size, font style, font color, etc., introduction to drawing tool bar. MS-excel MS excel and different component of MS excel window, explain the using of formula and function, creating a new work sheet, inserting, deleting and renaming a sheet, page setup, print preview and print a sheet.

Unit-5 MS-power point creating a presentation by using auto content wizard, by using templates. by using blank presentation, introduction to slide transition and custom animation option, insert and delete a slide.

Internet: Creating an E-mail account, sending and receiving of E-mail, address book, chatting, introduction to search, Engine, searching in Internet. URL, HTTP, FTP, Domain name, WWW, Virus and Antivirus.



# Paper-3 Molecular Cell Biology

#### Unit-1 Introduction- Biomembranes, Cytoskeleton (experimental system in cell biology)

- a. Molecular composition & arrangements, functional consequences
- b. Transport across cell-membrane-Diffusion, active transport and pumps. uniports, symports and antiports.
- c. Membrane potential
- d. Co-transport by symporters or antiporters
- e. Transport across epithelia
- f. Microfilaments and microtubulus-structure and dynamics
- g. Microtubuls and mitosis
- h. Cell movements-intracellular transport, role and kinesin and dynein, signal transduction mechanism

#### Unit-2 Cell-Cell Signaling, Adhesion & Communication

- a. Cell surface receptors
- b. Second messenger system
- c. MDP kinase pathways
- d. Signaling from plasma membrane to nucleus
- e. Ca dependent homophilic cell-cell adhesion
- f. Ca Independent homophilic cell-cell adhesion
- g. Gap junctions and connection
- h. Cilia & Flagella

### Unit-3 Cell Matrix Adhesion & Cell Cycle

- a. Integrins
- b. Collagen
- c. Non-collagen components
- d. Auxin and cell expansion
- e. Cellulose fibril synthesis and orientation
- f. Cyclines&cyclin dependent kinases
- g. Regulation of CDK-cyclin activity



#### Unit-4 Genome organization & Intracellular Protein Traffic

- a. Hierarchy in organization
- b. Chromosomal organization of genes & non-coding DNA
- c. Mobile DNA
- d. Morphological & functional elements of eukaryotic chromosomes
- e. Genetic analysis in Cell Biology
- f. Protein synthesis on free & bound polysomes
- g. Uptake into ER
- h. Membrane proteins, Golgi sorting, post-translational modifications
- i. Biogenesis of mitochondria, & nuclei
- j. Trafficking mechanisms

#### Unit-5 Cancer & Aging

- a. Biology of cancer.
- b. Biology of aging.
- c. Apoptosis-definition, mechanism & significance



# Paper -4 Structure and Function in Invertebrates

#### Unit-1 Organization of Coelom

- a. Acoelomates
- b. Pseudocoelomates
- c. Coelomates: Protostomia & Deuterostomia

#### Unit-2 Locomotion, Nutrition and Digestion

- a. Flagella & ciliary movement in Protozoa
- b. Hydrostatic movement in Coelenterata, Annelida & Echinodermata
- c. Patterns of feeding and digestion in lower metazoan
- d. Filter feeding in Polychaeta, Mollusca & Echinodermata

#### **Unit-3 Respiration & Excretion**

- a. Organs of respiration: Gills, Lungs and trachea
- b. Respiratory Pigments
- c. Mechanism of Respiration
- d. Organs of excretion: coelom, coelomoducts, Nephridia and Malphigian tubules
- e. Mechanism of excretion
- f. Excretion and osmoregulation

#### Unit-4 Nervous System, Invertebrate larvae

- a. Primitive nervous system: Coelenterata and Echinodermata
- b. Advanced nervous system: Annelida, Arthropoda (Crustacea and Insecta) and Mollusca (Cephalopoda)
- c. Trends in neural evolution
- d. Larval forms of free living invertebrates
- e. Larval forms of parasites
- f. Strategies and evolutionary significance of larval forms

#### Unit-5 Minor Phyla

- a. Concept and significance
- b. Organization and general characters of minor phyla



## M.Sc. Zoology I Semester

## LABORATORY COURSE I (Credits 0+3)100 Marks

- 1. Different component of MS Word Window
- 2. Different options of file menu
- 3. Different options of Edit menu
- 4. Different options of Insert menu
- 5. Different options of Format menu
- 6. Different options of Drawing toolbar
- 7. Creating a table in MS word document. Inserting and deleting rows and columns in a table.
- 8. Using a spell checker in MS word document.
- 9. Using a formula in MS Excel worksheet.
- 10. Using different function fx in MS Excel worksheet.
- 11. Creating a chart in MS Excel worksheet.
- 12. Creating a presentation by using Wizard in Power point.
- 13. Creating a presentation by using blank presentation in Power point.
- 14. Using different animation scheme in slide and object (text and picture).
- 15. Creating e-mail account. Sending and receiving an e-mail.
- 16. Searching information in internet by using different search engine.
- 17. To Calculate correlation Coefficient "r"
- 18. To Calculate Regression coefficient "byx, bxy"
- 19. To analyze the completely randomized design
- 20. To analyze one-way classification and two-way classification.



# LABORATORY COURSE II (Credits 0+3)100 Marks

- 1. Major demonstration of Advanced nervous system of Invertebrates:
  - (i) Annelida
  - (ii) Arthropoda
  - (iii)Mollusca
- 2. Minor demonstration of respiratory and excretory organs of Invertebrates:
  - (i) Gills, Lungs and Trachea
  - (ii) Nephridia, malpighian tubules and statocyst
- 3. Digital demonstration of whole mounts and histological section of Invertebrate animals.
- 4. Preparation of permanent slides of larvae of invertebrates
- 5. Techniques of Taxonomic Procedure
  - A. Collection
  - B. Preservation
  - C. Curetting
  - D. Identification
- 6. Composition and assessment of the taxonomic diversity in a habitat
- 7. Influence of climatic condition on taxonomic diversity in a given habitat
- 8. Demonstration of intra & inter cellular substances.
- 9. Demonstration of Cilia and flagella
- 10. Demonstration of DNA structure.
- 11. Demonstration of Malignant and benign tumour





# M.Sc. Zoology II SEMESTER

# Paper-5 Comparative Anatomy of Vertebrates

Unit-1 Origin of Chordata & the Nature of Vertebrate Morphology

- a) Concept of protochordata
- b) Definition, scope & relation to other disciplines
- c) Origin & Classification of Vertebrates
- d) Importance of the study of vertebrate morphology

Unit-2 Vertebrate Integument, General Plan of Circulation in Various Groups

- a) Development, general structure & functions of skin and its derivatives
- b) Glands, scales, horns, claws, nails, hoofs, feathers and hairs
- c) Blood
- d) Evolution of heart
- e) Evolution of aortic arches, and portal systems



Unit-3 Respiratory System & Skeletal System

- a) Characters of respiratory tissue
- b) Internal & external respiration
- c) Comparative account of respiratory organs
- d) Form, function, body size and skeletal elements of the body
- e) Comparative account of jaw suspensorium. Vertebral column
- f) Limbs & girdles

# Unit-4 Evolution of urinogenital system in Vertebrate Series

# Unit-5 Sense Organs & Nervous System

- a) Simple receptors
- b) Organs of Olfaction and taste
- c) Lateral line system
- d) Electro reception
- e) Comparative anatomy of the brain in relation to its functions
- f) Comparative anatomy of spinal cord
- g) Nerves-cranial, peripheral & autonomous nervous system



# Paper-6 Genetics and Genetic Engineering

### Unit-1 Organisation of Genes and Chromosomes

- a) Organization of Chromatin-Nucleosome, molecular anatomy of eukaryotic chromosomes
- b) Structure and organization of telomere, centromere and kinetochore, polytene chromosomes
- c) Unique and repetitive DNA, Euchromatin and Heterochromatin, Constitutive and Facultative heterochromatin, chromatin domains and boundary function
- d) Basic ideas of Prokaryote genome, eukaryotic genome
- e) Sex determination and dosage compensation in C. elegans, Drosophila and human
- f) Transposable elements Prokaryote and eukaryotes

### **Unit-2 Genetic Imprinting**

- a) Imprinting of genes, epigenetic regulation by DNA methylation
- b) Somatic cell genetics
- c) Cell fusion and technology
- d) Heterokaryon selecting hybrids and chromosomes mapping
- e) Hybridoma
- f) Microbial genetics
- g) Bacterial conjugation, transformation and transduction

### Unit-3 Genetics of Cell cycle

- a) Genetic regulation of cell division in yeast and eukaryotes regulation of CDK cyclin activities
- b) Molecular basis of cellular check points
- c) Molecular basis of neoplasia
- d) Recombination and repair



- e) Recombination: homologous and nonhomologous recombination, site specific and transpositional recombination
- f) DNA repair mechanism: types of prokaryotes and eukaryotes

# **Unit-4 Recombinant DNA technology**

- a) Cloning vectors for eukaryotes
- b) DNA cloning mechanism
- c) Genomic/c DNA library

# Unit-5 Genome expression analysis

- a) Southern and Northern analysis
- b) Western blotting
- c) DNA microarray and its application
- d) In-situ localization techniques(FISH and GISH)



# Paper-7 Developmental Biology

### **Unit-1 Gametogenesis**

- a) Spermatogenesis- Hormonal regulation of Spermatogenesis, sperm structure. gene function in Spermatogenesis
- b) Oogenesis-Hormonal control of Oogenesis, gene expression during Oogenesis. maturation and ovulation
- c) Fertilization: Sperm egg association, Biochemistry of fertilization
- d) Egg activation and formation of diploid zygote nucleus.

Unit-2 Gene expression during the initiation of development

- a) Maternal regulation over early development
- b) Expression of embryonic genome
- c) Gene expression during the initial development of mammals

### **Unit-3 Cellular Differentiation**

- a) Promoter structure and function, enhancer structure and function
- b) Transcription factors: Transregulation of promoter and enhancer
- c) Nucleosomes and the activation of repressed chromatin
- d) Locus control regions-globin gene transcription
- e) DNA methylation and gene activity

# Unit-4 Cellular interaction during organ formation

- a) A secondary induction: Instructive and permissive interactions
- b) Paracrine factors
- c) Epithelial mesenchymal interaction
- d) Formation of parenchymal organs



e) Induction at single cell level

Unit-5 Development of Tetrapod limb

- a) Formation of limb bud
- b) Generation of the proximal distal axis of the limb
- c) Generation of the dorsal ventral axis
- d) Cell death and the formation of digits
- e) Environmental regulation of normal development
- f) Environmental disruption of normal development



# Paper-8 Tools & Techniques for Biology

### Unit-1 Assay, Analytical instruments & Microscopy

- a) Definition and criteria of reliability
- b) Chemical assays
- c) Biological assays-in vivo and in vitro assays
- d) Principles and uses of analytical instruments-Balances, pH spectrophotometer, ultracentrifuge, densitometic scanner, spectrofluorometer, chemiluminometer, radioactivity counters, differential scanning calorimeter,meter, colorimeter.ESR & NMR spectrometer
- e) Microscopy-Principle of light transmission, electron, phase contrast, fluorescence, electron cryo, confocal, scanning electron microscopes, Microphotography, Image analyzers

Unit-2 Microbiological Technique, Cell culture techniques & Cryotechniques

- a) Media preparation & sterilization
- b) Inoculation & growth monitoring
- c) Use of fermentors
- d) Biochemical mutants and their use
- e) Microbial assays
- f) Design & functioning of tissue culture laboratory
- g) Cell proliferation measurements
- h) Cell viability testing
- i) Culture media preparation & cell harvesting methods
- j) Cryopreservation for cells, tissue, organisms
- k) Cryotechniques for microscopy
- I) Freeze-drying for physiologically active substances



Unit-3 Separations techniques in biology & Computer Technique

- a) Molecular separations by chromatography, electrophoresis, precipitation
- a) Organelle separation by centrifugation etc.
- b) Cell separation by flow cytometry, density gradient centrifugation, unit gravity centrifugation, affinity adsorption, anchorage based techniques etc.
- c) Computer aided techniques for data presentation, data analyses, statistical techniques, special software for specific tasks

Unit-4 Radioisotope & mass isotope techniques in biology & Immunological Technique

- a) Sample preparation for radioactive counting
- b) Autoradiography
- c) Metabolic labelling
- d) Magnetic Resonance Imaging
- e) Techniques based on antigen-antibody interactions

### **Unit-5 Surgical techniques**

- a) Organ ablations (e.g: ovariectomy, adrenolectomy etc.)
- b) Perfusion techniques
- c) Indwelling catheters
- d) Stereotaxy
- e) Parabigsis



# M.Sc. Zoology II Semester

# LABORATORY COURSE III (Credits 0+3)100 Marks

- 1. Demonstration of nervous system of fish
- 2. Demonstration of Ampulla of Lorenzini, eye ball and internal ear
- 3. Digital Demonstration of histological slides of vertebrates
- 4. Study of disarticulated skeleton of chordate animals
- 5. Study of different stages of Development in frog and chick
- 6. Preparation of permanent slides of developing stages from egg of hen.

# M.Sc. Zoology II Semester

# LABORATORY COURSE IV (Credits 0+3)100 Marks

- 1. Comments upon the structure and application of analytical instruments
  - Colorimeter
  - Spectrophotometer
  - ESR and NMR spectrometer
  - Microtomy
  - Chemotrophic instruments
- 2. Problem based on Mendelian theory
- 3. Problem related to Hardy- Weinberg equilibrium
- 4. Problem related to Chi-squire test



SEMESTER-3

# Paper-9 Human Physiology and Endocrinology

### Unit I

- Digestive system- structure of alimentary canal digestion, digestive glands, a. movements of gastrointestinal tract. b.
- Digestion, absorption and metabolism of carbohydrates, proteins and lipids. c. Enzymes and enzyme activity, Co-enzymes.
- Blood and body fluids-red blood cells, white blood cells, platelets, coagulation e.
- Blood groups, blood transfusion, blood volume. f.
- Lymphatic system and lymph, tissue fluid and edema.

### Unit II

- Respiratory System- physiological anatomy of respiratory tract, mechanism of a. respiratory tract, exchange of gasses, artificial respiration, and pulmonary function test (PFT).
- b. Transport of excretory gas.
- c. Cardiovascular system- cardiac cycle, foetal circulation and respiration, hemorrhage, blood pressure, ECG cardiac function curve.
- Muscles physiology- structure of skeletal muscles, muscular contraction d.
- Neuromuscular junction, smooth muscles, disorder of skeletal muscle. e.

### Unit III

- a. Excretory system- kidney, nephron,
- b. Urine formation
- c. Renal function test
- d. Structure and function of skin, glands of skin.
- e. Nervous system- Structure of neuron, classification and properties of nerve fibre, synapse, neuro transmitters, structure and function of brains, physiology of sleeps, epilepsy, autonomic nervous system.

### Unit IV

- a. Sense organ- structure of eye and visual process.
- b. Structure of ear and mechanisms hearing.
- c. Auditory defects.
- d. Sensation of taste.
- e. Sensation of smell.

### Unit V

- a. Endocrinology- hormones, pituitary gland, thyroid gland, parathyroid gland, pancreas,
- b. Endocrine function of other organs.
- c. Reproductive system- male reproductive system,
- d. Female reproductive system. Menstrual cycle, ovulation, infertility, pregnancy,
- e. Placenta,
- Mammary glands lactation, f.
- Fertility control.

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# Suggested Readings:-

- 1. Medical Physiology- Sembulingam, K and P Sembulingam, JayPee Brothers.
- 2. Medical Physiology- C.C. Chaterjee.
- 3. Animal physiology and related Biochemistry- Singh, H.R. Vishal Publications
- 4. Animal Physiology: Mechanisms and Adaptation, R.Eckert, W.H. Freeman & Company.
- 5. Text Book of Endocrinology, R.H. Williams, W.B.Saunders.
- 6. Endocrine Physiology, C.R.Martin, Oxford University Press.
- 7. Recent Journals of Concerned Paper

# Paper-10 Population Ecology and Environmental Physiology

### Unit-I

- a. Population and their characters.
- b. Demography: Life tables, generation time, Reproductive value.
- c. Population growth: Growth of organisms with non-overlapping generations; Stochastic and time lag models of Population growth Stable age distribution.
- d. Population regulation: Extrinsic and intrinsic mechanisms.

### Unit-II

- a. Adaptations: Levels of Adaptations, significance of body size.
- b. Aquatic environments: Fresh water, marine, shores and estuarine environments.
- c. Eco-physiological adaptations to fresh water environments.
- d. Eco-physiological adaptations to marine environments.
- e. Eco-physiological adaptations to terrestrial environments.

### Unit-III

- a. Environmental limiting factors
- b. Inter and Intra-specific relationship
- c. Predatory- prey relationship, Predator dynamics and Optimal foraging theory(patch choice, diet choice, prey selectivity, foraging time)
- d. Mutualism, Evolution of Plant pollinator interactions

### Unit-IV

- a. Environmental pollution and human health
- b. Conservation and management of Natural Resources
- c. Environmental Impact Assessment
- d. Sustainable development

### Unit-V

- a. Concept of Homeostasis
- b. Endothermic and physiological mechanism of regulation of the body temperature
- c. Physiological response to oxygen deficient stress
- d. Physiological response to body exercise

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# Suggested Reading Material

- Ecology, Individuals, Populations and Communities. Begon, M., J.L. Harper and C. R. Townsend., Blackwell science, Oxford, UK.
- 2. Ecological Concepts. Cherrett, J.M., Blackwell Sci. Publi. Oxford, UK.
- 3. Population Biology. Elseth, B.D. and K.M. Baumgartner., Van Nostrand co., New York.
- 4. Fundamentals of Ecological Modeling. Jorgensen, S.E., Elsevier, New York.
- 5. Ecology. Krebs, C.J., Harper & Row, New York.
- 6. Ecological Methodology. Krebs, C.J., Harper & Row, New York.
- 7. Statistical Ecology. Ludwig, J.A. and J.F. Reynolds, 1988., John Wiley & Sons, New York.
- 8. Evolutionary Ecology. Pianka, E.R., Harper & Row, New York.
- 9. Ecology. Ricklefs, R.E. and G. Miller., W.H. Freeman & Co., New York
- 10. Ecological Methods. Roughgarden, J., Southwood, T.R.E.
- 11. Ecological Simulation. Primer. Swartzman, G.L. and S.P. Kaluzny., MacMillan, New York.
- 12. Recent Journals of Concerned Paper

# Paper-11 Evolution and Animal Behaviour

### Unit-I

- 1. Arguments of Evolutionary ideas and evolutionary theories since Darwin
- 2. Evolutionary process
  - a. Mechanism producing Genetic diversity
  - b. Phenotypic diversity by the regulation of gene expression
- 3. Natural Selection and adaptation
  - a. Concept of stabilizing selection, disruptive selection, frequency dependent selection
    - b. Balancing selection
    - c. Adaptation program
    - d. Neutral theory of evolution and Neutralist- Selectionist controversy

#### Unit-II

- 1. Gene frequencies in population
  - The Hardy-Weinberg principal and analysis of gene frequencies in natural population.
  - .b. Major factors influencing gene frequencies (migration, inbreeding)
  - c. Effects of selection and mutation on gene frequencies .
  - d. Gene flow between subpopulation.
  - e. Genetic drift.

### 2. Pattern and trends in evolution

- Constructing evolutionary trees, measures of genetic relationship among organism.
- b. Molecular clock of evolution.
- c. Molecular phylogeny.

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### Unit-III

Learning & memory

- a. Conditioning and habituation
- b. Insight learning.
- c. Association learning. d. Reasoning.
- e. Cognitive skills

#### Unit-IV

- 1. Foraging
  - a. Optimal foraging theory
  - b. Foraging and predation risk : defense strategies against predators
  - c. Territoriality and group foraging

### 2. Aggression

- a. Aggressive behavior
- b. Game theory models and strategies.

# Unit-V Control and development of behavior and communication

- Neural and hormonal control of behavior. a.
- b. Chemical communication.
- C. Visual communication.
- d. Light communication.
- e. Audio communication.
- f. Species specificity of songs.
- Evolution of language (primates) g.

### Suggested Reading Material

- 1. Evolution, Th. Dobzhansky, F.J.Ayala, G.L.Stebbines&J.M.Valentine. Surject Publication Delhi.
- 2. Evolutionary Biology, D.J.Futuyama, Suinuaer Associates, INC Publishers, Dunderland.
- 3. Genes & Evolution, A.P.Jha, John Publication, New Delhi.
- 4. Species Evolution-The role of chromosomal change, M.King, The Cambridge University Press, Cambridge,
- 5. Evolutionary Genetics, J.M.Smith, Oxford University Press, New York.
- 6. Evolution, M.W.Strikberger, Jones &Bartett Publishers, Boston London.
- 7. Animal Behaviour: An evolutionary Approach, J. Alcock, Sinauer Assoc., Sunderland, Mass. USA
- 8. Principles of Animal Communication, J.W. Bradbury and S.L. VehrencampSinauer Assoc., Sunderland, Mass. USA
- 9. The Evolution of Parental care, T.H.Clutton-Brock, Princeton University Press, Princeton, NJ, USA
- 10. I. Ethology: The Biology of Behaviour, Eibl-Eibesfeldt, I. Holt, Rinehart & Winston, New York.

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- 11. The Mechanism and Evolution of Behaviour, J.L.Gould.
- 12. The Evolution of Communication, M. Hauser, MIT Press, Cambridge, Mass, USA.
- Animal Behaviour: A synthesis of ethology and comparative psychology, McGraw-Hill, New York.
  Behavioural Ecology 1 P to 1
- 14. Behavioural Ecology, J.R.Krebs&N.B.Davies, Blackwell, Oxford, UK
- 15. Sociobiology: The New Synthesis. E.O.Wilson. Hardvard University Press, Cambridge, Mass. USA

### **Optional** paper

A student can offer any one of the special papers i.e. Entomology or Environmental Biology in their M.Sc. fourth semester. The number of students to be accepted for each special paper will be decided by the department at beginning of fourth semester.

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### I. ENTOMOLOGY Paper-12-Insect Physiology and Systematics

### Unit-I: Systematics

 a. Outline classification up to orders (According to Imm's), Characters and classification up to families

- b. Thysanura
- c. Diplura
- d. Protura
- e. Collembola
- f. Ephemeroptera
- g. Odonata
- h. Plecoptera
- i. Grylloblattoidea
- j. Orthoptera
- k. Phasmida

### Unit-II: Characters and classification up to families

- a. Isoptera
- b. Psocoptera
- c. Siphunculata
- d. Hemiptera
- e. Thysanoptera
- f. Mallophaga

# Unit-III: Characters and classification up to families

- a. Neuroptera
- b. Lepidoptera
- c. Diptera
- d. Siphonoptera
- e. Hymenoptera
- f. Coleoptera

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# Unit-IV: Insect Physiology-1

- a. Digestive system Digestion, Absorption, Nutrition
  - b. Excretory system Excretion and organ of excretion
- c. Respiratory system Terrestrial, Aquatic, Endoparasitic
- d. Circulatory system Haemolymph its constituents and functions e. Endocrine glands and concept of neurosecretion, brain hormone, ecdysone and juvenile hormone

# Unit-V: Insect Physiology-2

- a. Reproductive system Spermatogenesis, Oogenesis, mating, oviposition, Parthenogenesis
- b. Nervous system Nerve impulse generation, Axonal & synaptic transmission
- c. Visual system Functional unit of compound eye, Image formation, Light & dark adaptation
- d. Sound production Organs, mechanism and significance
- e. Bioluminescence Concept, mechanism and significance of light production

# Suggested Reading Material

- 1. Imm's General Text Book of Entomology, Revised by-Richards O.W. & Davis R.G., Vol. I, II Asia Pub. House
- 2. General and Applied Entomology, K.K.Nayar, T.N.Ananthakrishnan&B.V.David; Tata McGraw Hill Pub. Co. Ltd., New Delhi.
- 3. Entomology, Matheson Robert, International Books and Periodicals, Supply service New Delhi.
- 4. College entomology, E.O.Essig, Macmillan New York
- 5. Principles of Insect Physiology, V.B.Wigglesworth, Methuen, London
- 6. Modern entomology, D.B.Tembhare, Himalaya Pub. House, Delhi
- 7. Recent Journals of Concerned Paper

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# II. WILD LIFE BIOLOGY

# Paper-13 Environment & Animals

# Unit-1: Environmental Quality & Animals

- 1. Environmental quality indices
- 2. Environmental indices- Air pollution, Water pollution, Noise pollution & Soil pollution
- 3. Environment and standards criteria- Water, Air, Noise, Radiation 4. Environmental Toxicology
- 5. Environmental practices

# Unit-II: Resource selection by Animals

- 1. Introduction
- 2. Resource selection functions
- 3. Statistical modeling
- 4. Estimating resource selection
- 5. Analysis of the amount use

### Unit-III: Stress Physiology-1

- 1. Basic concept of environmental stress and strain, concept of elastic and plastic strain, stress resistance, stress avoidance and tolerance
- 2. Adaptation, acclimation and acclimatization
- 3. Concept of homeostasis
- 4. Endothermy and physiological mechanism of regulation of body temperature
- 5. Physiological adaptation to osmic and ionic stress; mechanism of cell volume regulation

### Unit-IV: Stress Physiology-2

- 1. Osmoregulation in aqueous and terrestrial environment
- 2. Physiological response to oxygen deficient stress
- 3. Physiological response to body exercise
- Meditation, yoga and their effects 4.

### Unit-V: Conservation Biology

- 1. Biological diversity
- Keystone species, Measurement of biodiversity
- 3. Bioethics and conservation
- 4. Causes of extinction, IUCN Red Data Book, Protected areas
- Peoples participation

### Suggested Reading Material

- Fundamentals of Ecology, Odum, Saunders 1.
- Ecology, Odum, Amerind 2.
- Ecology, Ricklefs, W.H. Freeman 3.
- Animal Physiology: Mechanism and Adaptation, R. Eckert, W.H. Freeman & 4. Company, New York
- Resource Selection by Animals, F.J. Manly, Lyman L. McDonald, Dana 5. L.Thomas, Chapman & Hall, New York ISBN0 412 40140 1

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- 6.
- General and Comparative Animal Physiology, W.S. Hoar, Prentice Hall of India 7.
- Animal Physiology: Adaptation & Environment, Schiemdt Nielsen, Cambridge Physiology: A regulatory System Approach, F.L. Strand, Macmillan Publishing 8.
- Environmental & Metabolic Animal Physiology, C.L. Prosser, Wiley-Liss Inc. 9.
- 10. Recent Journals of Concerned Paper

Laboratory Course V

# M.Sc. Zoology (III Semester)

### (Credits 0+3)100 Marks

- 1. Demonstration and localization of invertebrate and vertebrate endocrine glands through virtual mode.
- 2. Demonstration of techniques in vertebrates i.e, Hypophytsectomy, ovarioctomy, costation, Thyroidectomy, Adrenolectomy& pancreactomy through virtual mode.
- 3. Determination & separation of carbohydrates, proteins & lipids in milk.
- 4. Determination of respiratory rate in any vertebrate.
- 5. Detection of urea, Uric Acid & Ammonia, in excretion.
- 6. Demonstration of blood groups, RBCs, WBCs, (TLC & DLC) in human blood.
- 7. Demonstration of blood pressure in man.
- 8. Demonstration of Animal behavior against different environmental stimuli.
- 9. Demonstration of territorial behavior.
- 10. To study the parental care in animals.
- 11. Demonstration of learning behavior.

### (Credits 0+3)100 Marks

### Laboratory Course VI **Optional:** Entomology

The practical work in general shall be based on the syllabus prescribed in theory:-

1. To study the structure of followings:-

Head capsule and its type, antenna and its modification, mouth parts and its types, legs & wings and their modification, different types of larvae and pupae through virtual mode.

2. Demonstration of different organs system of Cockroach. Central Nervous system of Wasp through virtual mode.

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- 3. Demonstration of
  - Salivary gland of cockroach
  - Sting gland in Honey bee and wasp.
- 4. Demonstration of different group of insects through virtual mode.



### Laboratory Course VII

### (Credits 0+3)100 Marks

# **Optional: Wild Life Biology**

- 1. Experiments to identify kind, structure & function of Ecosystems.
- 2. Experiments related to Eco-energetic & Energy flow.
- 3. Problems related to International & National Environmental legislation.
- 4. Problems for population characteristics.
- 5. Measurements of pollution in Air/Water/Soil.
- 6. Case studies.

### SEMESTER IV

### Paper-14-Applied Entomology

Unit-I: Brief knowledge of main pest of following crops with special reference to marks of Identification, Nature of damage, life history & control measure

- Cereals- Rice gall midge, green leaf hopper, ear cutting caterpillar, Jowar stem a. borer, shoot fly termite
- b. Sugercane& cotton- Early shoot borer, Top shoot borer, Pink boll worm, cotton boll worm, Spotted boll worm
- c. Pulses & Oil Seed- Gram cut worm, Gram caterpillar, Tur pod fly, Bihar hairy caterpillar, linseed caterpillar, Mustards aphid, Soybean girdle beetle
- d. Fruits & Vegetables- Potato tuber moth, Fruit and shoot borer of brinjal and okara, Red pumpkin beetle, Mangoes-Cecidomyiids
- e. Stored grains- Rice weevil, Pulse beetle, Lesser grain moth & control of stored grain pests

Unit-II: Medical & Veterinary Entomology

- a. Pest of public health importance
- b. Insect born diseases
- c. Pests of farm animals

Unit-III: Forest and Forensic Entomology

- a. Defoliators
- b. Sap-suckers
- c. Borers
- d. General methods of control of forest insect pests
- e. Definition and history of forensic entomology
- f. Carpse-associated arthropods classes and its relationships
- g. Forensic entomological techniques

#### Unit-IV: Industrial Entomology

- a. Sericulture- Mulberry sericulture, Tasar sericulture, Muga sericulture &Ericulture
- b. Silk Production- Components and methods
- Enemies of silk worms

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d. Apiculture; Kinds of honeybees, organizations, Language biology and

- e. Bee keeping methods and apparatus
- f. Lac culture- Lac insects, its life history and enemies, Host plants g. Propagation of lac insects
- h. Uses of lac

Unit-V: Insect Pest control

- a. Natural control
- b. Applied control-Cultural, Physical, Mechanical
- c. Insecticidal method-Classification of insecticides
- d. Biological control-Predators, parasitoids & pathogens; merits and
- e. Integrated pest management (IPM)
- f. Other methods-Attractant, Repellents, Pheromonal, hormonal and genetic method
- g. Application of dusters & sprayers

# Suggested Reading Material

- 1. General and Applied Entomology-K.K. Nayar, T.N. Ananthakrishnan& B.V. David; Tata McGraw Hill Pub. Co. Ltd., New Delhi
- 2. A Text book of Agricultural Entomology-Y.K. Mathur, K.D. Upadhyay
- 3. Destructive and Useful Insects-Metcalf C.L. &W.B.Flint, McGraw Hill Pub. Co.
- 4. Medical and Veterinary Entomology-D.S. Kettle, Croom Helm, Beckenham, Kent, England
- 5. Entomology in Human and Animal Health-R.F. Harwood & M.T. James, McMillan, New York
- 6. A Text book of Agricultural Entomology-Pruthi, ICAR, New Delhi
- 7. A text book of Applied Entomology-Srivastava Vol. I & II, Kalyani Pub., New Delhi
- 8. Agricultural Pests of India and South east Asia-Atwal, Kalyani Pub., New Delhi
- 9. Insects and Mites of Crops in India-M.R.G.K. Nair, ICAR, New Delhi
- 10. Bee Keeping in India-Singh, ICAR, New Delhi
- 11. Bee Keeping in Tropics-Smith Longman
- 12. A Handbook of Practical Sericulture-Ullal&Narsimha, Central SIN Board, Bombay
- 13. Hand Book of Crop Pest Control- K.K. Marwaha, K.H. Siddiqui& J.P. Singh, Kalyani Pub., New Delhi
- 14. General Text Book of Entomology (Medical & Veterinery Impotence)-Vol. 1 & 11 W.S. Patton & A.M. Evans, Akashdeep Pub. House Delhi

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- 15. Modern Entomology-D.B. Tembhare, Himalaya Publication House, Delhi
- 16. Recent Journals of Concerned Paper

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# aper-15-Wild Life Biology

# init-I: Environmental Impact Assessment

- a. Overview
- b. Methodologies for Assessing Impacts
- c. The Assessment process
- d. Impact Statements
- e. Mitigations

# nit-II: Ecological Data: Design, Management and Processing

- a. Research Design, Data Management Process
- b. Scientific Database, Data Quality Assurance
- c. Metadata
- d. Archiving Ecological Data
- e. Data Transformation

### nit-III: Wild Life Techniques

- a. Animal Population- Planning a census, Sample count, block count, road side counts
- b. Damage Control- Elephant impact on woody vegetation, Electric fences, Electric fence design, trench design, Rubble wall designs
- c. Capture- Live trapping, Mist netting, Rocket netting, Tools (Equipment, Drugs, Plan, Ungulates, Elephant & Rhinoceros, Large carnivores)

# Init-IV: Resource and Environmental Management

- a. Change, complexity, uncertainty and conflict, Sustainable development
- b. Ecosystem approach, Forecasting and backcasting, Assessing alternatives
- c. Adaptive environmental management
- d. Partnership and participation, Local knowledge system, Gender and development
- e. Alternative dispute resolution, Implementation, Monitoring and evaluation, Managing for change, complexity, uncertainty and conflict

### Init-V: Planning Wild Life Management in Protected Areas

- a. Wild life management plan
- b. Planning process
- c. Question of change
- d. Boundaries and protected area status
- e. Strategies

### uggested Reading Material

- 1. A Manual for Planning Wild Life Management in Protected Areas, Vishvas B. Sawarker, Wild Life Institute of India, Dehra Dun
- 2. Resource and environmental management, Bruce Mitchell, Longman London ISBN 0 582 23796 3
- 3. Manual of Wild Life Technique for India, Ed. By J.B. Sale & K. Berkmuller, Wild Life Institute of India, Dehra Dun
- 4. Ecological Data: Design, Management and Processing, W.K. Michener & J. W. Brunt, Blaclwell Science Ltd. Oxford ISBN 0-682-05231-7

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- 5. Environmental Impact Assessment, P.A. Erickson, Academic Press London
- 6. Journals of Biological Science: Flora and Fauna
- 7. Recent Journals of Concerned Paper

# M.Sc. Zoology (IV Semester)

# Laboratory Course: VIII

# **Optional Applied Entomology**

The practical work in general shall be based on the syllabus prescribed in theory:-

- 1. Identification of insect pests using digital photography, image capturing techniques transferring the picture from camera to computers.
- 2. Life cycle and control measures of pests of different crops/ vegetables/stored products.
- 3. Medical entomology: study of life stages of medically important insects.
- 4. Identification of major vector species.
- 5. Social insects: morphological studies of social insects.
- 6. Identification, life cycle and natural enemies of silk worms, honey bees and lac insects.
- 7. Application used in insect control-types and application of sprayers and dusters.

### Laboratory Course: IX

### (Credits 0+3)100 Marks

(Credits 0+3)100 Marks

### **Optional Wild Life Biology**

- 1. Weather Data Collection
- 2. Faunal Census
- 3. Biodiversity Measurement
- 4. Population Estimation
- 5. Identification Technique
- 6. Damage control and capture of Wild Animals
- 7. Planning and Management
- 8. Field Trip

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