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Directorate of Distance Education**

ZOOLOGY

Syllabus for M.Phil (Zoology) 1st and 2nd Semester Session 2014-2015

| Semester I | Title of the Course | Marks | | | Credits |
|------------|----------------------------|-------|----|-------|---------|
| | | IA | UE | Total | |
| Paper I | Research Methodology | 20 | 80 | 100 | 4 |
| Paper II | Recent Advances in Biology | 20 | 80 | 100 | 4 |
| Paper III | Advances in Nematology | 20 | 80 | 100 | 4 |

| Semester II | Title of the Course | Marks | | | Credits |
|-------------|--|-------|----|-----|---------|
| Paper IV | Special Papers (Choose Any One) 1. Crustacean Endocrinology and Reproduction 2. Human Genetics 3. Pollution Biology 4. Environmental physiology 5. Wildlife Ecology and Management 6. Limnology | 20 | 80 | 100 | 4 |
| Paper V | Special Papers (Choose Any One) 1. Advances in insect Biology and pest management 2. Insect pests control and toxicology 3. Eco Toxicology 4. Aquaculture and Fisheries 5. Proteomics and Molecular Cell Physiology 6. Conservation Biology | 20 | 80 | 100 | 4 |
| Paper VI | Dissertation and Viva Voce Viva Voce 50 marks Dissertation 150 marks | | | 200 | 8 |

Paper – I : Research Methodology

UNIT I:

PRINCIPLES AND APPLICATION

Electron microscopy (SEM & TEM) –UV visible spectrophotometer, Atomic absorption spectrophotometer – Centrifuges, low, high and ultracentrifuge -PCR –pH meter –ELISA.

UNIT II:

SEPARATION AND ANALYTICAL TECHNIQUES

Chromatography: High performance liquid chromatography and Gas Chromatography; Thin layer chromatography –**Electrophoresis:** paper and disc gel Immunoelectrophoresis. **Tracer technique:** Geiger muller counter, scintillation counter and Autoradiography.

UNIT III:

HISTOLOGICAL AND HISTOCHEMICAL METHODS

Histochemical techniques; Protein, Carbohydrates lipids and DNA –Histological preparation of tissues for light and electron microscopy, immunochemical localization.

UNIT IV:

DATA PROCESSING AND ANALYSIS

Biostatistics: Correlation Co-efficient; simple linear regression, student 'T' test; chi - square test, 'F' test; ANOVA – one way; two way and multiple way; Computer Science: Classification – hardware, input and output devices, main and auxiliary memories, CPU; Software application – Word, Excel, Power point, Internet.

UNIT V :

RESEARCH METHODS AND THESIS WRITING:

Identification, selection and scope of research problems – methods of literature collection and review –planning and execution of investigation –Thesis writing –preparation and presentation of research papers for journals, conferences –preparation of short communications and review articles.

Paper II - Recent Advances in Biology

UNIT I: MOLECULAR BIOLOGY

Regulation of gene expression in Prokaryotes and Eukaryotes; Operon Concept; Environmental regulation of gene expression

–regulation of gene by steroid hormones in invertebrates (insects), vertebrates (Mammals). Oncogenes and cancer on molecular basis.

UNIT II: IMMUNOLOGY

Antigen; Structure and functions of different classes of immunoglobins; primary and secondary immune response lymphocytes and accessory cells. Humoral and cell –mediated immunity; MHC; mechanism of immune response and generation of immunological diversity.

UNIT III : ENVIRONMENTAL POLLUTION

Different types of pollutant – acute and chronic toxicity; Bioassay LC50 values environmental pollution and their impact on animals

– Biomagnification –Detoxification mechanism; synergistic and antagonistic effects of pollutants –microbial and environmental degradation of pesticides. Environmental Impact Assessment.

UNIT IV: MICROBIAL GENETICS

Lysogeny and lytic cycle in bacteriophages – Bacterial transformation

– Host cell restriction, transduction, complementation – molecular recombination –plasmids and bacteriophage based vectors for DNA and genomic libraries.

UNIT V: BIOTECHNOLOGY

Microbial fermentation – organic Microbes in decomposition and recycling process -Isolation of DNA and RNA from Animal tissues

-Transgenic animals.

Paper III : Advances in Nematology

Unit 1

History and development of nematology in India and abroad – Position of nematode in animal kingdom – Importance of nematodes to plants and animals.

Unit 2

Structure of nematode cuticles, sense organs, digestive, reproductive and nervous system. General characters of Class Secernentea. Tylenchoidea – General characters of Tylenchidae, Pratylenchidae, Hoplolaimidae, Heteroderidae, and Tylenchoidea with examples. Classification of plant parasitic nematodes based on feeding habits.

Unit 3

General characters of class Adenophorea. Nematodes of human and animals - Threadworms, Hookworms, Lungworms, Gape worms, Guinea worms, Eyeworms, Wuchereria, Heartworms, Ascaris and pinworms. Biology of Entomopathogenic nematodes.

Unit 4

Principle of nematode management – physical methods (soil solarisation, hot water treatment, seed cleaning), cultural methods (deep ploughing, fallowing, crop rotation), biological control (antagonistic crops), chemical control – soil fumigants and nematode management.

Unit 5

Major nematode parasites and their symptoms in Rice (*Aphelenchoides besseyi*, *Hirschmaniella oryzae*); Wheat (*Anguina tritici*, *Heterodera avenae*); Cotton (*Rotylenchulus reniformis*); Tomato (*Meloidogyne incognita* and *M. javanica*); potato (*Globodera rostochiensis*, *Globodera pallida*); Banana (*Pratylenchus coffeae*, *Radopholus similis*). Nematode sample collection – nematode extraction (Cobb's technique, centrifugal floatation, Cyst extraction).

References

1. Maggenti, A. 1981: General Nematology. Springer-Verlag, New York Heidelberg Berlin.
2. Swarup, G and Dasgupta. 1986: Plant Parasitic Nematodes of India, Problems and progress. Indian Agricultural Research Institute, New Delhi -110012.
3. Khan, M.R. 2008: Plant Nematode Methodology, Morphology, Systematics, Biology and Ecology. Science Publisher, Edenbridge Ltd.

Paper IV : I. Crustacean Endocrinology and Reproduction

UNIT - I: GENERAL BIOLOGY OF CRUSTACEA

General characters of the phylum Arthropoda – Class Crustacea: General characters; Classification; Types – Various body systems

- Osmoregulation – Feeding mechanisms – Diversity and conservation of Crustacea.

UNIT - II: NEURO-ENDOCRINE SYSTEM OF CRUSTACEA

Neurosecretory system of crustacean brain – Sinus gland X - organ complex – Y - organ – Hormonal regulation in molting, growth and reproduction – Hormonal manipulation of crustacean reproduction – Mechanism of vitellogenin synthesis – Fertilization – Various types of parental care of eggs - Stages of embryonic development Metamorphosis – Different larval forms.

UNIT- III: AQUACULTURE OF CRUSTACEA

Prawn culture – Crab culture (fattening) – Lobster culture – Site selection and preparation of culture ponds – Physicochemical factors

- Hatchery production of seeds – Food: Live feed; Artificial feed; Balanced diet (iso-nitrogenous and iso-caloric) – Predators and Parasites in aquaculture - Economics of Aquaculture.

UNIT- IV: TOXICOLOGY AND PATHOLOGY OF CRUSTACEA

Xenobiotics substances and their toxic effects on crustacean - Toxicity tests – Causes for different diseases - Disease causing pathogens and their preventive measures in aquaculture of crustacea – Cellular stress and Immune responses – Defence and Detoxification systems – Wound healing - Apoptosis - Probiotics in health and growth of crustacean.

- V : GENETIC ENGINEERING AND BIOTECHNOLOGY OF CRUSTACEA

Molecular Cytogenetics of Crustacea –Isolation and Purification of DNA and RNA - Isolation and Purification of Enzymes and Hormones

-Recombinant DNA technology –Blotting techniques –PCR techniques –Gel documentation –Proteomics, Genomics and Bioinformatics of crustacea.

PAPER IV : 2.HUMAN GENETICS

UNIT – I

Identification of human chromosome – characterization. Various Banding techniques (G, C, Q, R). Designating structural chromosomal abnormalities by break points and band composition and sister chromatid exchange studies.

UNIT – II

Chromosomal syndromes; Autosomal abnormalities – Down syndrome, Edward syndrome, Patau syndrome, Cri-du-chat syndrome. Sex chromosomal syndrome; Klinefelter's syndrome, Turners syndrome, multiple XXX syndrome, XYY male. Prenatal diagnosis: Buccal smear test, Amniocentesis – Chorionic villi and fibroblast cultures.

UNIT – III

Human Biochemical Genetics - Inborn errors of metabolism – Amino acid metabolism, Phenylketonuria. Disorders of Purine metabolism: Lesh Nyhan syndrome. Disorders of carbohydrate metabolism – Galactosemia. Immunogenetics – Introduction to immune response –the cellular basis of immune responses – Immune deficiency disorders.

UNIT – IV

Endocrine Genetics - General principles of hereditary diseases: Gene action in Endocrine glands. Pituitary – Diabetes mellitus. Parathyroid
– Hypoparathyroidism. Adrenal –Congenital Adrenal Hyperplasia. Sexual development –Testicular feminization syndrome, Male Hypogonadism.

UNIT –V

Mutation: Types of mutations, Molecular basis of mutations. Genetic Engineering: gene manipulation – Techniques – Cutting and joining DNA molecules. Cloning in E.coli – Plasmids as cloning vehicle for use in E.coli of cloned DNA. Cloning in organisms other than E.coli –Cloning in Yeast. Application of recombinant DNA technology in biology and medicine.

PAPER IV : 3.POLLUTION BIOLOGY

UNIT – I

Environmental Xenobiotics –source – factors responsible for distribution – accumulation and their effects of plants and animals.

UNIT – II

Effect of environmental chemicals – species diversity – mutagenicity teratogenicity – carcinogenicity.

UNIT – III

Toxicology – synergism and antagonism of ions – Bioassay of toxicity using animals – effect of ecological factors of the aquatic medium on toxicity – toxic substances of aquatic medium.

UNIT – IV

Ecotoxicology of terrestrial organisms – Effect of ecological conditions of terrestrial environment on toxicity – Evaluation of terrestrial toxicity by using soil invertebrates.

UNIT –V

Methodological problems of aquatic and terrestrial toxicity –Toxicological statistics – Environmental risk assessment.

PAPER IV: 4. ENVIRONMENTAL PHYSIOLOGY

UNIT – I : ENVIRONMENT

Major biomes with reference to India -Renewable and non-renewable resources -Physico-chemical aspects of rivers, estuaries and terrestrial environments -Problems of water pollution in India.

UNIT – II: ENERGETICS

Plant animal interaction and stability of the environment -Ecological energetics: Food chain, food webs, energy transfer through trophic chains and ecological efficiencies in aquatic ecosystems.Plant microbial interaction - Physiological adaptations of animals to the limiting factors –oxygen, pressure, temperature and light.

UNIT – III: MONITORING OF POLLUTION

Solid, sewage, effluents – their sources, disposals and their treatments, recycling of waste water.Toxic inorganic and other constituents affecting water quality –such as colour, turbidity, BOD, COD, alkalinity, hardness, TSS, chlorinity – their estimations and their levels on monitoring water pollution. Exposure to pollutants and risk assessment, exposure assessment, etc. assessing carcinogenic and non - carcinogenic risks. Eutrophication and problems of weeds and their control.

UNIT – IV: DYNAMICS OF POLLUTANTS

Absorption, distribution and excretion of toxic substances. Biodegradation of organic compounds such as pesticides, heavy metals and toxic organics -Toxic effects of pollutants such as pesticides, heavy metals and toxic organics on biological systems. Food intoxication by pollutants and microbes; food spoilage, diseases, food preservation processes.

UNIT –V: INDUSTRIAL APPLICATIONS OF MICROBES

Microbes in the synthesis of amino acids, organic acids & antibiotics -Microbial insecticides, biopolymers and biosensors -Microbial role in bioleaching and recovery of minerals and metals Plant biomass to fuels - Biodeterioration management.

PAPER IV: 5. WILDLIFE ECOLOGY AND MANAGEMENT

UNIT- I: SYSTEMATIC BIOLOGY

Taxonomy; Species concept-theories, Speciation; New species description-assessment techniques, evaluation; importance of taxonomy; International Code for Zoological Nomenclature (ICZN).

UNIT- II: BIODIVERSITY

Biodiversity-kinds of biodiversity; Biogeography-continental shift, zoogeography, biodiversity hot spots, endemism; Biodiversity assessment; Endangered species-Indian Wildlife Protection Act 1972 and International Red list species criteria, concept and assessment.

UNIT III: FIELD SAMPLING TECHNIQUES

Population estimation-concept, line transect, quadrat sampling; Animal trapping techniques-pitfall, funnel, Sherman traps; marking and recapture techniques; use of indirect evidences in species inventory; Basic methods in behavioural and food habit studies; Wildlife management techniques.

UNIT IV: ECOSYSTEM SERVICES

Animal plant interactions-pollinators, seed dispersal, biological pest control, vector; Wildlife products-food, medicine, Germplasm, domestication; Ecological balance-prey predator relationships, herbivory and scavengers.

UNIT V: MAN AND BIODIVERSITY

Development projects- River valley, mine, power projects; impact assessment - methodology, GIS tools; ill effect of pesticides; bioaccumulation; biomarkers; Pollution Control Boards (PCBs), regulations, standards; Conservation laws -wildlife, forest and water.

PAPER –IV: 6. LIMNOLOGY

UNIT - I

- a. Origin of lakes, ponds and estuaries
- b. Classification of lentic and lotic environments

UNIT – II

- a. Physico - Chemical Character of ponds, lakes and rivers
- b. Characteristics of estuarine environment

UNIT – III

- a. Productivity and energy flow in the freshwater environment
- b. Cycling of nutrients in the freshwater environment

UNIT – IV

- a. Pollution of the Freshwater environment and its effects on organisms
- b. Water born pathogens and diseases

UNIT – V

- a. A general study of freshwater organisms (Plankton, Nekton & Benthos)
- b. Freshwater fisheries of India
- c. Major carps of India and recent trends in their culture practices

PAPER V: 1. ADVANCES IN INSECT BIOLOGY AND PEST MANAGEMENT

UNIT – I: Biology:

Overioles and testis follicles, their number in different orders and basic histomorphology: male & female accessory, glands, their secretion and modes of sperm transfer and reception (spermatophores & spermathecae) Viviparity & Viviparous insects –factors regulating parthenogenesis and polymorphism with special reference to homoptera: Isoptera and Hymenoptera.

UNIT – II Ecology:

Abiotic & Biotic factors in biology, Abundance & distribution of insects with special reference to diapause. Interspecific and intraspecific interactions with special reference to insect migration & pest out break. Insect life table and its application methods of assessing insect pest/populations – plant resistance.

UNIT – III: Chemical control of Insect Pests:

Classification of insecticides, modes of action of insecticides – Mechanism of insecticide resistance: Chitin inhibitors and their efficacy in pest management: recent trends in pesticide application technology.

UNIT IV: Non- chemical control and Insect pests:

Dynamics of prey-predator interaction and host -parasite/parasitoid inter-actions-1 genetic and semi-chemical bases of insect pest control –Neurophormone Juvenodids and Ecdysoids in insects pest management.

UNIT – V: Integrated Pest Management (IPM):

Principles of IPM programme its objectives, strategy and tactics ecological basis to pesticide application. Systems analysis. Recent trends in IPM.

PAPER – V : 2. INSECT PESTS CONTROL AND TOXICOLOGY

UNIT – I

Insect pests, Types of Damage to Plants by insects, Pest surveillance and forecasting pest Outbreak, Assessment of insect population, Estimation of damage caused by insect pests to crops.

UNIT – II

Insect pest control – Natural control – Biological methods, Microbial methods, Chemical methods, Chemosterilant, Insect attractants, repellents, Antifeedants, Integrated pest control.

UNIT – III

Insecticides, Insecticides formulation, Classifications, Mode of action, Inorganic insecticides, Organic insecticides, Insecticides of Plant Origin.

UNIT – IV

Principles of toxicology of insecticides, General Bioassay of pesticides, Insecticide residues, Resistance of insecticides, Factors influencing effectiveness of insecticides.

UNIT – V

Statistics of Toxicology: Median Lethal Dose –Behren's methods, Graphical method, Rapid approximate method by Huson, Finney's Method, Abbott's method.

PAPER – V : 4. ECO TOXICOLOGY

UNIT – I

Importance and scope of eco physiology –present environmental status – water, air and land pollution – Bioaccumulation – Bio magnification – Bio degradation. Biotransformation of pollutants
– Environmental mutagens and carcinogens –water borne pathogens and diseases.

UNIT – II

Water, soil and biological analyses for pollution study – insecticides -heavy metals – industrial effluents – sewage – mode of action of xenobiotics – entry, absorption, distribution excretion and metabolism.

UNIT – III

Toxicity of pollutants – safety evaluation –acute and chronic toxicity –Bioassays (LC50 / LD 50 determination) –selection of test animals
– probit analysis –Dose response –behavioral aspects –(Mouth patterns –Histe pathology with reference to toxicology.

UNIT – IV

Impact of pollutants on physiology of organisms – Feeding energetics (rate of food intake, digestion, absorption, assimilation and metabolism) haemopoiesis and hematology and oxygen consumption in fishes – Biochemical constituents – activity levels of different enzymes – xenobiotics and nervous system.

UNIT –V

Environmental monitoring of pollutants – Environmental pollution with special reference to inland fisheries – Techniques for residual analysis
– water quality standards and recycling procedures.

Paper - V : 4. AQUACULTURE AND FISHERIES

UNIT – I Basics of Aquaculture

Introduction - Indian and World Aquaculture - Role, Constraints, remedial measures and other related problems -Importance of Aquaculture – Fish products and by - products.

UNIT - II Capture fisheries

Major inland capture fishery resources in India - Lake and reservoir fisheries – Nursery system in Estuaries and Brackish water and its fishery resources in India - Marine major and minor fishery resources in India and World - fin and shell fishes.

UNIT- III Culture fisheries

Monoculture – Polyculture - extensive, intensive - Integrated fish farming – Paddy cum fish culture – fish and prawn culture in fresh water ponds –Fin fish and shell fish culture in Brackish water ponds –Ornamental fish culture.

UNIT-IV Live Feed Culture

Taxonomy of Live feeds – General collecting methods - Culture and Nutritional value of Rotifers, Artemia , Copepods and Daphnia
– Molluscan culture and its status - Culture of zooplankton –Seaweeds and their importance.

UNIT - V Recent Techniques in Aquaculture

Cryopreservation techniques for Live feeds – Bio-enrichment technique –Applied Genetics of cultivated fishes – Regulation of vitellogenesis in shell and finfishes.

Paper - V : 5. Proteomics and Molecular Cell Physiology

Unit I

Structural organization of Prokaryotic and eukaryotic cells with all cell organelles and their functions - Principle and applications of: Electron Microscopy - SEM, TEM and AFM; Multi-photon Confocal microscopy, Inverted Microscopy, Fluorescent microscopy and Immuno-histo chemistry. Basic Principles and applications of animal and microbial cell culture media types, preparation and their applications. Specimen preparation, collection, transport and maintenance. Current scenario of Stem cell Research.

Unit II

Outline of Chromosome, Genome, Gene and DNA –DNA as genetic material, DNA replication-DNA Damage-DNA repairing Mechanisms
–Gene Cloning Strategies. Transfer of animal gene into bacterial cell for over expression. Molecular cloning Vectors used in Animal Biotechnology and Overexpression system of prokaryotes (pET series). RNAi technology and its impact in medical sciences. Genetherapy and its application. DNA Micro array technology and its application.

Unit III

Comparison of Transcription and translational process between prokaryotes and eukaryotes. RNA Splicing mechanism – Principles and methods of Chromosomal and Plasmid DNA and RNA isolation and purification from bacteria and mammalian cells, Agarose gel electrophoresis and DNA sequencing methods - Molecular biology of Cancer: Types and Current status of cancer diagnostic tools and treatment strategies. Outline about Apoptosis.

Unit IV

Introduction to Bioinformatics and applications of bioinformatic tools in protein science. Proteomics – types and applications. Proteome of Normal and Cancer cells. Significance of Cancer proteomics, Pharmacoproteomics and Toxicoproteomics. Proteomics techniques : Principle, method and applications of SDS PAGE, Native gel electrophoresis, Immuno electrophoresis, Western blotting, Mass Spectrometry, MALDI TOF analysis, Peptide sequencing : Edman's methods. Applications of Amino acid analyzer.

Unit V

Proteomic Databases-type–Primary and secondary databases. Significance of protein sequence comparison in evolutionary studies. Prediction of secondary structure of protein and their related proteomic databases and packages. Proteome of Escherichia coli
And Homo sapiens. Current status of proteomic research in human health diseases.

PAPER - V : 6.CONSERVATION BIOLOGY

UNIT: I - SYSTEMATIC BIOLOGY

Taxonomy- Definition -Terms and History; Importance of Taxonomy- Species concept - Kinds of species. Zoological classification-Hierarchy of categories : Linear hierarchy, keys and higher taxonomy- Zoological nomenclature - Molecular taxonomy - bar coding.

UNIT: II - CONSERVATION BIOLOGY

Introduction to Conservation Biology – Ethical issues of Conservation Biology - The origin of Conservation Biology. Biodiversity – Species diversity - Genetic Diversity- Ecosystem diversity – Population Genetics - Loss of biodiversity - importance of biodiversity – Ethical role of biodiversity – Threats to biodiversity. Economics of biodiversity conservation –sustainable utilization

UNIT : III -CONSERVATION: TOOLS IN ANIMAL CONSERVATION

Conservation Methods - In situ and Ex situ conservation of Indian animals (Case studies) - Population management - Project Tiger and Elephant
- Captive breeding programme - peoples participation in conservation
- Successes and failures of conservation actions in India (Case study)
-Tools in Conservation: Interpretation of various data on wildlife – IUCN Redlist categories - GIS – Remote sensing - Landscape model –PVA and CAMP processes.

UNIT IV - ANIMAL LAWS AND POLICIES IN INDIA; ECONOMICS OF BIODIVERSITY CONSERVATION

Wildlife (Protection) Act of India (1972) - Protected Area network -forest policy – Prevention of cruelty to Animal Act - Convention on Biological diversity, International Trade in endangered species - Zoo policy - Laws and their applications in Zoological parks, wildlife sanctuaries and biosphere reserves – Wildlife management and Animal welfare
- Role of NGO's in Conservation.

UNIT V - TECHNIQUES IN CONSERVATION BIOLOGY

Ecological census - Basic Techniques – Shannon Weiner index to measure diversity of Animal species – Plotless sampling –Population indices -
Sampling methods for Invertebrates-Amphibians -Reptiles -Fishes -Birds -
Mammals -Environmental variables.