DEPARTMENT OF ZOOLOGY

M.Sc. ZOOLOGY (PREVIOUS) SEMESTER – I

The examination shall comprise four theory papers and a practical test

Theory

Paper -I	Non-Chordata	50 Marks
Paper-II	Techniques and Tools in Biology	50 Marks
Paper-III	Biological Chemistry	50 Marks
Paper-IV	Cytogenetics : Classical and Molecular	50 Marks
Practical		100 Marks
	Total :	300 Marks

Candidate must obtain minimum pass marks in theory and practical examination separately.

PAPER I : NON-CHORDATA

Nutrition in Protozoa; Reproduction in Protozoa; Salient features of parasitism in helminthes; Life cycle patterns in helminthes parasites; Adaptive radiation in Polychaeta; Segmental organs in Annelida.

Origin of Metazoa; Organization and affinities of Porifera; Polymorphism in Coelenterata; Colony formation in Coelenterata; Coral reefs; Outlines of the ecology of soil nematodes.

PAPER II: TECHNIQUES AND TOOLS IN BIOLOGY

Principles and uses of analytical instruments:- Balances, Flame Photometry, Spectrophotometer, Spectroflurophotometer, Atomic Absorption Spectrophotometry; Microbial techniques:-Media preparation and Sterilization, Inoculation and growth monitoring, use of fermentations, Microbial assays.

Separation and identification of biomolecules by Chromatography:- Paper and thin layer chromatography (TLC), Gas Liquid Chromatography (GLC), Colum chromatography, Ion exchange chromatography, Gel exclusion chromatography, High Performance Liquid Chromatography (HPLC), Affinity chromatography; Separation of biomolecules by electrophoresis; Principles of differential and density centrifugation.

PAPER III : BIOLOGICAL CHEMISTRY

Chemical equilibrium- Law of Mass action; Elementary thermodynamic system; calculation of free energy change during biological redox reactions, acid, base, amphoteric, Zwitter ions; Kinetics of enzyme reaction- Kinetics of enzyme- catalyzed reactions, order of enzyme reactions, rate equations, two substrate reactions; Temperature Coefficient, Activation energy; Enzyme inhibition- Competitive and non- Competitive inhibitors; Application of enzyme inhibition techniques in pest control, Allosteric enzymes.

Structure and function of Vitamins and coenzymes; Aerobic and anaerobic energy production from carbohydrates lipids and amino acids (Glycolysis, HMP shunt, b-oxidation of fatty acids, deamination & transamination of amino acids Phenylalanine, tryptophan, aspartate, proline and threonine, Biosynthesis of amino acids (Phenylalanine, tryptophan, aspartate, proline and threonine), nucleotides, glycogen and urea; Immoblized enzymes and their applications.

PAPER IV- CYTOGENTICS: CLASSICAL AND MOLECULAR

Current status of Mendalism, Interaction of genes; Cytoplasmic inheritance; Environment and heredity; Lethal genes; Sex-linked inheritance; chromosome mapping; Sex chromosome, Sex determination; Multiple allelism; Numerical and structural chromosome aberrations and their significance.

DNA replication, Transponsable elements in prokaryotes and eukaryotes, Role of transposable elements in genetic regulation; Microbial genetics: Bacterial transformation, transduction, conjugation, Bacterial chromosome, Bacteriophages; Molecular cytogenetic techniques (FISH, GISH, DNA finger printing, Flow cytometry and chromosome painting), Elements of Eugenics, Imprinting of genes, chromosomes and genes, Gene theraphy.

Practical Syllabus

General survey and classification of the lower non-chordate phyla (Protozoa to Annelida) with the help of museum specimens and slides.

Protozoa : Vital staining and iodine preparation of *Euglena, Paramecium* and *Vorticella*- Study of cyclosis and trichocysts in *Paramecium*; differential counts of the various stages of Monosystis; Permanent preparation of *Ceratium, Noctiluca, Paramecium, Vorticella, Rectal ciliates* of frog and *Monocystis*.

Porifera : Permanent preparation of gemmules, spongin fibers and different kinds of spicules.

Coelenterata: Dissection (General anatomy) of Sea Anemone, study of Nematocysts of *Hydra*, Permanent preparation of *Hydra, Obelia* and other hydrozoan colonies and *Obelia* Medusa.

Helminths : Study of feeding mechanism and regeneration in *Planaria*, Permanent preparation of selected soil and plant Nematodes, *Planaria*, selected Helminths parasites of cattle and poultry and different larval stages of liver fluke.

Annelida: Dissection (General Anatomy) of *Nereis*, dissection of circulatory system and reproductive system of earthworm, Dissection of general anatomy , digestive system, excretory system, hemoceolomic system,

reproductive system and nervous system of Leech, Permanent preparation of Head reason, Jaws and Parapodia of *Nereis*, Ovaries, Nephridia, Blood glands and spermathecae of earthworm and Jaws, salivary and Nephradia of Leech.

Techniques and Tools: Basic principles and functioning of Microtomy, Spectrophotometry, Flame Photometry, Atomic absorption spectrophotometry, Paper and thin layer chromatography, Centrifugation.

Biochemistry: Isolation and colorimetric determination of the glycogen content of rat liver.

- Demonstration of the effect of epinephrine on the glycogen yield from the liver.
- Estimation of nucleic acids in testis of rat.
- Comparative estimation of protein content of the fat body of cockroach and the liver of fish, frog and rat.
- Quantitative estimation of the total free amino acids in the tissues of cockroach and paper chromatographic separation of these amino acids.
- Kinetic assay of the salivary amylase, and study of the effects of time, temperature and pH.
- Study of the effect of substrate concentration on urease activity.
- Inhibition of cholinesterase activity in rat brain by organophosphate.
- Estimation of total lipid in fat body of cockroach and liver of fish, frog and rat.
- **Cytogenetics :** Study of mitosis and meiosis in onion root tip, Sarcophaga and testis of grasshopper or any other insect with the acetocarmine squash method.
- Study of the salivary gland chromosomes of *Drosophila* and *Chironomus*.
- Study of the life cycle of *Drosophila*.

Statistics: Simple experiments on probability. Sampling of data for the frequency diagram and calculation of mean, median, mode variance and standard deviation. Sampling of data to demonstrate the application of tests of significance.

Distribution of Marks: Time : 6 Hours

Exercise	**Marks**
Dissection	15
Preparation	08
Technique/Instrumentation	10
Biochemistry exercise	20
Cytogenetics exercise	05
Spotting (12 Spots)	24
Viva-voce	10
Class Records	08
Total Marks-	100

M.Sc. (PREVIOUS) SEMESTER – II

The examination shall comprise four theory papers and a practical test

Theory

Paper -I	Higher Non-Chordata	50 Marks
Paper-II	Ecology and Environmental Biology	50 Marks
Paper-III	Comparative Animal Physiology	50 Marks
Paper-IV	Animal Behaviour	50 Marks
Practical		100 Marks
	Total :	300 Marks

Candidate must obtain minimum pass marks in theory and practical examination separately.

PAPER – I : HIGHER NON-CHORDATA

Organisation and affinities of Onychophora; Parasitism in Crustacea; Larval forms in Crustacea; Mouth parts of insects; Basic concept of insect pest management; Biology and control of *Lepisma; Pediculus, Cimex*;

Adaptive radiation in Mollusca; Torsion in gastropods; Larval forms in Echinodermata; Affinities of Echinodermata; Brief outlines of the structure and affinities of minor phyla with special reference to Ctenophora, Rotifera, Acanthocephala, Sipunculoidea and Echiuroidea

PAPER – II : ECOLOGY AND ENVIRONMENTAL BIOLOGY

Ecology : Concept of Ecosystem and their types; Marine shores and estuaries; Freshwater; terrestrial; Grassland; Forest, desert and parasitic habitat; Ecological adaptations, levels, mechanism and significance of body size; Concepts of homeostasis, Environmental stress and strain, acclimation and acclimatization; Conservation of natural resources; wetlands. Demography, life tables, generation time, net reproductive rate and reproductive volume; Life history strategies, evolutions of sex and mating systems, optimal size r and k selection population, dynamics and its regulation;

Environmental Biology : Pollution monitoring schemes with special reference to bio-indicators and prediction of ecological effects; Environmental diseases with special reference to carcinogenesis and radiation injuries; Management of Industrial and Biomedical Waste, Socio-economic aspects of environmental policies and practices; Ozone depletion, Global warming, Summits for control of green house gases (Earth summit, Kyoto Protocol (UNFCCC), Copenhagen summit), Challenges of climate change, Nuclear winter, Environmental laws with special reference to air, water and sound.

PAPER III : COMPARATIVE ANIMAL PHYSIOLOGY

Mechanism of conduction and transmission of nerve impulse: Nernst equation, ionic basis of resting and spike potential, synaptic transmission and neurotransmitters; Patterns of nutrition and digestion: origin of nutritive types, digestion and absorption of food; Poikilothermy; Circulation: Types of circulation, physiological categories of heart.

Osmotic conformity and regulation : Stenohaline, Euryhaline animals, Hypo and hyper environment and terrestrial life; General characteristics of stimulus and response reaction: Chemoreceptors, photoreceptors, phonoreceptors, mechnoreceptors, equilibrium reception; Respiration: Respiratory pigments, oxygen and carbon dioxide transport, Respiratory adaptation to low oxygen tension; Pattern of nitrogen excretion in different animals: Excretory products, Biosynthesis of urea and uric acid; Comparative study of endocrines organs and their secretion in non chordates and chordates.

PAPER - IV : ANIMAL BEHAVIOUR

Evolutionary and neurological basis of behaviour, Innate behavior, Stereotyped and acquired behaviour, Neural and hormonal control of behaviour, Orientation with special reference to insects, birds & bats; Instinct, Biological rhythms (Circadian & circanual rythms), Learning & memory (conditioning, habituation, insight learning, association learning reasoning cognitive skill).

Patterns of communication (Chemical, visual, light, audio, Species specificity of songs, evolution of language with respect to primates), Social behaviour with reference to insects and primates; Sexual behaviour: Courtship, sexual selection, mating patterns, parental care, migratory behaviour of fishes and birds; Territorial behaviour, Behavioural genetics.

Practical Syllabus

Higher Non-Chordata: (Arthropoda- Echinodermata) General survey and classification of structural organization of the higher non-chordate phyla and dissections and preparations of the principle animal types of these phyla.

Behaviour: Study of Taxis; Kinesis; Habituation; Trial and error learning; Visual discrimination; Feeding behavior; Pheromonal communication with reference to sexual/special behaviour.

Physiology: Comparative study of total count of the erythrocytes and leucocytes of fish, frog, bird and rat.Comparative study of the differential leucocyte counts of fish, frog, bird and rat. Colorimetric estimation of the haemoglobin content of blood, colour-index and mean corpuscular hemoglobin in fish, frog, bird and rat.Determination of haemetocrit in fish, frog. bird and rat.Determination of respiratory rate of rat in relation to size and sex; Fish at different temperatures; Cockroach as a function of temperature.Study of the functional properties of the cardiac muscles of frog by pharmacological methods, using acetylcholine and adrenaline.Studies on skeletal muscles of frog: Simple twitch; Threshold strength; Curation; to tetanus. Determination of the passage of food with the help of marker.

Ecology: Study of different structural adaptations to ecological conditions.Study of the micro and macro fauna of soil by froth floatation method.Comparative estimate of physico-chemical ecofactor in different localities: Temperature, pH, carbonate, sulphate, nitrate and turbidity in freshwater sample on; Moisture content in soil sample. Study of seasonal variation in plankton population.

Toxicology: Estimation of threshold and/or LC_{50} and/or other mortality measurement of selected toxicant for selected organisms. Study of TDS, COD, BOD caused by the effects of pollutants in water bodies.

Distribution of Marks: Time : 6 Hours

Exercise	**Marks**
Dissection	15
Preparation	08
Physiology exercise	15
Ecology exercise	10
Behaviour exercise	10
Spotting (12 Spots)	24
Viva-voce	10
Class Records	08

Total Marks- 100

M.Sc. (FINAL) SEMESTER - III

The examination shall comprise four theory papers and a practical test

Theory

Paper -I	Chordata	50 Marks
Paper-II	Animal Development and Morphogenesis	50 Marks
Paper-III	Biostatistics, Principles of Taxonomy & Evolution	50 Marks
Paper-IV	(a) Fishery Biology- Morphology, Physiology and Development of Fishes	50 Marks
	(b): Entomology - Insect morphology, physiology & development	50 Marks
	(c): Cell Biology- Cytological Techniques	50 Marks
Practical		100 Marks
	Total :	300 Marks

Candidate must obtain minimum pass marks in theory and practical examination separately.

PAPER - I : CHORDATA

Origin of Chordates; Interrelationship of Ostracoderms, Placoderms; General organization and affinities of Holocephali, Crossopterygii and Dipnoi; Origin of paired fins in teleosts; Rhynchocephalia.

Origin of tetrapoda; Neoteny in Amphibia; Origin and evolution of Reptiles, Birds, Mammals; Aerodynamics in birds; Birds are glorified reptiles, Adaptive radiation in Eutheria, Origin and evolution of Man.

PAPER - II : ANIMAL DEVELOPMENT AND MORPHOGENESIS

Gametes, structure and formation; Fertilization (pre- and post-fertilization events, Biochemistry of fertilization); Nature of eggs and their cleavage; Gastrulation; Organogenesis of vertebrate brain, eye and heart; Evolution of viviparity in mammals; Cellular and biochemical events in metamorphosis of insects and amphibians; Causes of fetal deformities.

Determination of polarity and symmetry; Pattern regulation in insect imaginal discs; Induction and organizer concept; Differentiation at the level of chromosomes; Regeneration and gradients in developing systems; Ageing and cellular death; Transgenic animals and knock outs (production, application, embryonic stem cell).

PAPER - III : BIOSTATISTICS, PRINCIPLES OF TAXONOMY & EVOLUTION

Biostatistics : Measures of central tendencies and variations in data, Tests of significance: t-test, analysis of variance, f-test ; Null hypothesis and Chi-square test; Distribution: Normal; Binomial and poison, correlation, regression and probability;

Principles of Taxonomy : Definition and basic concepts of Biosystematics & Taxonomy: Historical resume of systematics and its importance and application in biology; Trends in Biosystematics : Concepts of different conventional and newer aspects – chemotaxonomy, cytotaxonomy, ethotaxonomy, molecular taxonomy and numerical taxonomy; Dimensions of speciation and Taxonomic characters : Types of lineage changes, production of additional lineage, species concepts – species category, different species concepts, subspecies and infra-specific categories, theories of biological classification hierarchy of categories, taxonomic and non-taxonomic characters; Procedure in Taxonomy: Collection, preservation, identification, taxonomic keys – different kinds of taxonomic keys, their merits and demerits, systematic publications, different kinds of publications, type of concept– different zoological types, international code of zoological nomenclature (ICZN)– its operative principles, interpretation and application of important rules, zoological nomenclature, formation of scientific names of various taxa.

Evolution : Neo-Lamarckism, Neo-Darwinism and Synthetic theory of evolution, Isolation and speciation; Genes in population: Hardy Weinberg Law and Sewell Wright effect, Micro evolution, Macro evolution and Mega evolution, Evolution in action

PAPER - IV : (a) Fishery Biology- Morphology, Physiology and Development of Fishes

Morphology : Structure and Functions of – Ear-Air Bladder connection and Weberian Apparatus; Different types of caudal fins; Specialized organs in fishes; (Electric organs, Sound producing organs; Light producing organs, Poison glands, Nervous system and sense organs); Endocrine glands: (Hypophysis, Thyroid, Adrenal, Ultimobranchial body, Corpuscles of Stannius and urophysis).

Physiology : Physiology of digestion, Respiration, Osmoregulation, Excretion and Reproduction

Development : Gastrulation, Neurilation, Organ formation, Larval development, Metamorphosis

PAPER - IV : (b) Entomolgy - Insect morphology, physiology & development

Section – A : Insect morphology

The integumentary system: histology of the integument, physical property and chemical composition of cuticle, sclerotization, colouration and moulting, Morphology of the head : tentorium, antenna and mouth parts and their modification; Thorax : tergites, legs and their modifications, wing structure and venation, their modifications coupling mechanism and abdomen, pre-genital abdominal appendages, external genitalia, Nervous system : the

neurons, central visceral and peripheral nervous system; Sensory mechanisms : mechanoreceptors (tango reception, proprioception, sound perception), chemoreception, thermoreception, hygroreception and photoreception (compound eyes, image formation, stemmata, ocelli); Bioluminescence and sound production.

Circulatory system : dorsal vessel, accessory pulsating structures, sinuses and diaphragms, mechanism of circulation, composition and function of haemolymph; Development: post-embryonic development, metamorphosis, types of larvae and pupae, Exocrine Glands : structure and function, pheromones; Endocrine glands : structure and function of non-neural, neural and peptide hormones, regulation of general body function and metabolic activities, moulting, polymorphism and diapause.

Alimentary system **:** nutrition, feeding behaviour, morphology of the gut and physiology of digestion and absorption; Respiratory system : structure of tracheae, tracheoles, air-sacs, spiracles, physiology of respiration, respiratory adaptations of aquatic and parasitic insects; Excretory system : Malpighian tubules and its arrangements, physiology of excretion (nitrogenous excretion, salt and water balance); Reproductive system : male and female reproductive system;

PAPER - IV : (c) Cell Biology- Cytological Techniques

Elementary principles of phase, interference, polarization, fluorescence and electron microscope (transmission electron microscope, scanning electron and atomic force microscopy); Theory and application of freeze-drying, x-ray diffraction, radioautographs.

Methods of cell tissue culture; Chemical basis of fixation and cytochemical localization of proteins, lipids, glycogen, RNA, DNA, phosphatase, esterases and oxidases; Purification and fractionation of nucleic acids, Nucleic acid hybridization, Enzymatic application of DNA by PCR.

Practical Syllabus

- General classification and survey of the structure or organization of the Chordate phyla.
- Dissections and Preparations of the principal Chordate type.
- Experiments on artificial ovulation insemination in study of the life history stages of frog and insects.
- Mounting of egg's an embryos of snail .
- Study of hormonal control of amphibian metamorphosis.
- Incubation and mounting of chick embryo.
- Study of prepared slides of the embryology of frog, chick and mammals and mammalian placentation.
- Microtomy of embryonic stages.
- Application of window techniques insitu study of chick embryo with special reference to morphogenetic moments.
- Determination of the effect of temperature on the embryonic development of chick.
- Study of the development of selective organs through preserved specimen and prepared slides.
- Experiment on regeneration in *Planaria*; regeneration of tail and limb in amphibian larva and lizards

Distribution of Marks: Time : 6 Hours

Exercise	**Marks**
Dissection	25
Preparation	15
Microtomy	10
Embryology exercise	15
Spotting (10 spots)	25
Class Records	10
Total Marks-	100

M.Sc. (FINAL) SEMESTER – IV

The examination shall comprise four theory papers and a practical test

Theory

Paper -I	Comparative Anatomy of Vertebrates	50 Marks
Paper-II	Economic Zoology & Wildlife	50 Marks
Paper-III	(a): Fishery Biology- Taxonomy and ecology of Pisces	50 Marks
	(b): Entomology- Ecology, Evolution and Taxonomy	50 Marks
	(c): Cell Biology– Cellular organization and fundamental processes: Cell structure	50 Marks
Paper-IV	(a): Fishery biology- Applied Ichthyology	50 Marks
	(b): Economic Entomology- Beneficial and Harmful Insects, Insect Pest Management	50 Marks

(c) : Cell Regulations- Cell communication and differentiation — 50 Marks

Practical — 100 Marks

Total : 300 Marks

Candidate must obtain minimum pass marks in theory and practical examination separately.

PAPER - I : COMPARATIVE ANATOMY OF VERTEBRATES

Comparative anatomy of the following systems of vertebrates:
Integumentary system; Digestive system; Respiratory system; Skeletal system.
Circulatory system; Excretory system; Reproductive system.

PAPER - II : ECONOMIC ZOOLOGY & WILDLIFE

Economic Zoology : Prawn culture; Fish Culture, Pearl culture; Apiculture, Sericulture, Poultry and Lac-culture; Leather industry; Pharmaceuticals from animals, white revolution.

Wildlife : General study of wildlife; Endangered wild animal species; Wildlife conservation programmes, conservation of the Asiatic lion, 'Project Tiger; Project Crocodile, Project Hangul, Project Elephant, Wildlife Sanctuaries; National parks and biosphere reserves; Major organizations concerned with wildlife conservation and their activities and programmes, Wild life ecotourism management.

PAPER - III : (a) Fishery Biology- Taxonomy and ecology of Pisces

Taxonomy of fishes up to orders; Detailed taxonomic study of fishes of Uttar Pradesh and Bihar.

Adaptations to different modes of life with special reference to Hill stream and deep sea fishes; Relationship between fishes and their abiotic and biotic environment; Abiotic factors: density and pressure, temperature, salt contents in water, light, sound, electric currents, bottom deposits and particles suspended in water; Biotic factors- Inter specific, interrelationship among fishes with other organism; Intraspecific interrelationship among fishes and with outer organisms; Pollutants affecting fishery waters with special reference to oil spills, domestic pollutants, industrial water, Radio-active wastes, Sewage fed fisheries; Planktons in relation to fish production.

PAPER - III : (b) Entomology- Ecology, Evolution and Taxonomy:

Insects and the abiotic Environment: Effect of temperature, moisture and light on insect population; Insect Plant interactions: Plant and insect herbivore relationship, Primary and Secondary metabolic plant products, Host selection by insects, Chemical defence in plants, Allocation of protective chemicals, primary role of toxic chemicals, response of insects to chemical defence, temporal avoidance of chemical, semiochemicals.

Insect origin and evolution: Ancestry of insects, origin and evolution of insects, relationships between entognathous and ectognathous apterygotes.

Outline classification of insects; characters, classification and examples of following taxa:

Thysanura: Machilidae, Lepismatidae; **Collembola:** Sminthuridae, Entomobryidae; **Ephemeroptera:** Ephemeridae; **Odonata:** Zygoptera, Anisoptera, Anisozygoptera; **Orthoptera:** Schizodactylidae, Tettigoniidae, Gryllidae, Gryllotalpidae, Acrididae; **Phasmida:** Phasmidae, Phyllidae; **Dermoptera:** Forficulidae; **Dictyoptera:** Blattaria (Blattidae), Mantodea (Mantidae); **Isoptera:** Mastotermitidae, Kalotermitidae, Termitidae; **Pscocoptera:** Psocidae; **Mallophaga:** Philopteridae, Trichodactidae; **Siphunculata:** Haematopinidae, Pediculidae; **Hemiptera :** Homoptera, Coleorrhyncha, Auchenorrhyncha (Fulgoridae, Lophopidae, Cicadidae, Membracidae, Cicadellidae), Stenorrhyncha (Psyllidae, Aleyrodidae, Aphididae, Margarodidae, Lacciferidae, Pseudococcidae, Coccidae, Diaspididae); **Heteroptera :** Rediviidae, Cimicidae, Anthocoridae, Lygaeidae, Pyrrocoridae, Coreidae, Scutelleridae, Pentatomidae, Gerridae, Notonectidae, Belostomatidae, Nepidae; **Thysanoptera :** Terebrantia (Thritidae), Tubulifera; **Neuroptera:** Megaloptera, Planipennia (Chrysopidae); **Coleoptera :** Adaphaga (Carabidae, Cicindellidae, Dytiscidae, Gyrinidae), Polyphaga (Hydrophilidae, Lucanidae, Scaribaeidae, Buprestidae, Elateridae, Lampyridae, Dermestidae, Coccinelidae, Tenebrionidae, Meloidae, Cerambycidae, Chrysomelidae, Bruchidae, Curculionidae); **Siphonoptera :** Pulicidae, Ceratophyllidae; **Diptera:** Nematocera (Tipulidae, Psychodidae, Culicidae, Simulidae, Chironomidae, Bibionidae, Myctophillidae, Cecidomyidae), Brachycera (Tabanidae, Asilidae, Bombyliidae, Cyclorrhyncha (Syrphidae, Agromyzidae, Drosophilidae, Gasterophilidae, Muscidae, Calliphoridae, Tachinidae, Hippoboscidae); **Lepidoptera :** Monotrysia (Neplialidae), Ditrysia (Tineidae, Psychidae, Plutellidae, Gelechiidae, Torticidae, Cossidae, Pyrlalidae, Hyblacidae, Nymphalidae, Pieridae, Papilionidae, Geometridae, Bombycidae, Saturniidae, Sphingidae, Arctiidae, Nocxtuidae, Lymantriidae); **Hymenoptera :** Symphyta (Siricidae, Cephidae, Tenthredinidae), Apocrita (Ichneumonidae, Draconidae, Evaniidae, Cynipidae, Chalacidae, Aganonidae, Pteronalidae, Eulophidae, Trichogrammitidae, Scoliidae, Formicidae, Pompilidae,, Vespidae, Sphecidae, Negachilidae, Xylocopidae, Apidae) Collection and preservation of insects.

PAPER - III : (c) Cell Biology– Cellular organization and fundamental processes: Cell structure

The Nucleus (The nuclear envelop and traffic between the nucleus and cytoplasm), Internal organization of the nucleus, the nucleolus; Plasma membrane structure and chemical composition; movement of substances across the membrane; Protein shortening and transport: endoplasmic reticulum (the endoplasmic reticulum and protein secretion, the smooth ER and lipid synthesis, export of protein and lipids from the ER); The Golgi apparatus (organization of the Golgi, protein glycosylation within the Golgi, lipid and polysaccharide metabolism in the Golgi, protein sortening and export from the Golgi apparatus); Lysosomes (ultrastructure, lysosomal acid hydrolases, endocytosis and lysosome formation, phagocytosis and autophagy); Bioenergetics

and metabolism (mitochondria– organization and function, mechanism of oxidative phosphorylation, proxisomes –functions of peroxisomes); Ultrastructure and functions of ribosomes.
Chromosome morphodynamics and achromatic apparatus in cell division; Physiology of a dividing cell; Apoptosis and natural cell death.

PAPER - IV : (a) Fishery Biology- Applied Ichthyology

Marine, freshwater, estuarine reservoirs and coldwater fisheries of India; Fish culture-Nutritional require-ments of Carps, Siluroids and Murrels, Carp cultivation in India; Spawning, collection, hatcheries, rearing, stocking, transport and mortality of fish fry; Fertilization and management of Fishery pond; Preservation, processing, transport and marketing of fish, food value and flavour of different fishes; Larvivorous fishes and public health; Development of fisheries in India.
Composite fish culture, cage culture and culture of exotic fishes, induced breeding; Common enemies and symptoms, etiology and treatment of diseases of food fishes; Fish-based industry and their byproducts.

PAPER - IV : (b) Economic Entomology- Beneficial and Harmful Insects, Insect Pest Management

Beneficial Insects : Biology of beneficial insects (*Apis, Bombyx, Kerria*), insect products, use of insects in medicines, insects in biological research, pollination by insects, insects as consumers, scavengers and as food, forensic entomology; **Harmful insects :** Life history, mode of damage and control measures of following insects; **Pests of sugarcane:** *Aleurolobus barodensis*, *Pyrilla perpusilla*, *Tryporyza nivella*, *Chilotraea infuscatellus*, *Emmalocera depresella*, *Odontotermes* spp.; **Pests of cereal crops**: *Hispa armigera*, *Leptocorisa varicornis*, *Hieroglyphus* spp., *Nephotettix bipunctatus*, *Chilo zonellus*, *Pachydiplosis oryzae;* **Pests of fruits and fruit trees:** *Quadraspidiotus pernicious*, *Eriosoma lanigerum*, *Idiocerus atkinsoni*, *Oryctes rhinoceros*, *Papilio demoleus;* **Pests of vegetables:** *Rhaphidopalpa foveicollis*, *Epilachna* spp., *Leucinodes orbanalis*, *Phthorimoea operculella*, *Pieris brassiccae*, *Bactrocera cucurvitae*, *Earias vittella;* **Pests of oilseeds:** *Athalia proxima*, *Lipaphis erysimi*, *Bagrada picta*; **Pests of Fibre Crops :** *Helicoverpa armigera*, *Pectinophora gossypiella*, *Bemisia tabaci*, *Dysdercus koenigi*, *Diacrisia oblique;* **Pests of stored commodities :** *Sitophilus oryzae*, *Trogoderma granarium*, *Tribolium* spp., *Callosobruchus chinensis*, *Corcyra cephalonica*, *Sitotroga cerealella*; **Pests of livestock :** *Phlebotomus* spp., *Tabanus striatus*, *Hippobosca maculata*, *Xynopsylla cheopis*; Ticks and Mites of Economic Importance.
Components of Insect Pest Management; Physical and mechanical control, handpicking and crushing, use of sticky barriers, electrical grid, low and high temperature, radiation, destruction of crop residues, weeds and trash; Cultural control : Crop rotation, tilling the soil, destruction of places of breeding or over wintering refuge, destruction or provision of alternate hosts, time of planting and harvesting, trap crops, nutrient management; Chemical control: Insecticides– classification, properties, synergists, formulations, application (including appliances), Mode of action, repellents, attractants, development of insect resistance against insecticides; Herbal insecticides. Biological control: Inoculation, augmentation and conservation of natural enemies (Pathogens, predators and parasitoids), selection criteria of a promising natural enemy; Genetical control: Sterile-male technique, breeding, insect-resistant host plants; Legal (Regulatory) control: Enactment and enforcement of quarantines; Concept of integrated pest management (IPM) in agro-ecosystem.

PAPER - IV : (c) Cell Regulations - Cell communication and differentiation

Cell signaling: General principles of cell signaling, Forms of signaling. Classes of cell surface receptors protein, Signaling of steroid and thyroid hormones through intracellular receptors, Signaling via-G-Protein linked cell surface receptors; Interferon; **Cellular mechanisms of development :** Mechanism of cell diversification in the early animal embryo, Cell memory, cell determination and the concept of positional values; **Differentiated cells and their maintenance :** Maintenance of the differentiated state, Tissues with permanent cells, Renewal by simple duplication, Renewal by stem cells, epidermis, Renewal by pluripotent stem cells.
The cell division cycle : The general strategy of the cell cycle, Regulation of the cell cycle by cell growth and extracellular signals, Cell cycle check points, Regulation of cell cycle progression; **Cancer :** Cancer as a micro-evolutionary process, causes and types of cancer, Properties of cancer cells, Molecular diagnosis, prevention and treatment, Molecular genetics of cancer.
The immune system : The cellular basis of immunity, Antigen & Antibody interactions, The functional properties of antibodies, The fine structure of antibodies, Production & Synthesis of polyclonal & Monoclonal antibodies, T-cell receptors and subclasses, AIDS, MHC (Major Histocomptability Cells), Molecular and antigen presentation on to T cells, Cytotoxic T Cells, Helper T Cells and T Cell activation, Selection of the T cells repertoire; **Controlling gene expression :** An overview of gene control, promoter and operator genes, Hormone regulation or gene control, DNA binding motifs in gene regulatory proteins, Working of Genetic switches, Post transcriptional controls.

Practical Syllabus

Cell- Biology:

- Handling and use of phase contrast microscope.
- Quantitative estimation of DNA, RNA, alkaline phospahate.
- Cytochemical localization of phosphatases, RNA, DNA, proteins, lipids and glycogen.

- Study of chromosomal behaviour during cell division, using squash preparations of animal (testes of rat and grasshopper; bone marrow of rat) tissues and plants (onion root tip) tissues.
- Prepared slides of chromosomal behaviour during cell division.
- Study of salivary gland chromosomes of *Drosophila* and/or *Chironomous* larvae.
- Identification and study of mutant forms of *Drosophila*.
- *Drosophila* culture technique.
- Cytochemical localization of golgi complex, mitochondria, acids and alkaline phosphatases and glycogen.
- Supravital staining of Nissl bodies, mitochondria and cytoplasmic vacuoles.
- Study of prepared slides of various cytoplasmic organelles and inclusion.
- Study of prepared slides of various stages during mitotic and meitotic cell divisions.
- Bacterial culture techniques.
- Isolation of nuclic acids.

Distribution of Marks: Time : 6 Hours

Exercise	Marks
Cytochemical localization	20
Vital staining	05
Microtomy	05
Isolation of nuclic acids	05
Spotting (15 spots)	20
Dissertation + Seminar (25+10)	35
Class records	10
Total Marks-	100

Entomology:

- Detailed study of the external features of grasshopper.
- Dissections of different systems of; *Grylotalpa*; *Dysdercus*; Housefly/*Calliphora*; Moth/ Butterfly/ Larvae; Wasp/ Honey bee: Dung; Beetle/Water beetle.
- Permanent preparation of: Testis of cockroach; Salivary gland of *Dysdercus*; Ovary, spermatheca and accessory gland of housefly; Sting apparatus of wasp/ honey bee; Spiracles of a caterpillar and wing scales of a lepidopteran insect; Legs of terrestrial and aquatic insects showing special adaptations concerning locomotion.
- Study of prepared slides of: T.S./L.S. of integument and the various regions of gut, ovary, testis and brain; Whole mounts of thoracic/ abdominal spiracles, different types of antennae, legs, mouth parts, wings and sting apparatus of honeybee/wasp.
- Determination of pH of insect guts and haomolymph.
- Qualitative assay of free amino acids from haemolymph and fat body.
- Quantitative estimation of glycogen, protein and lipid.
- Qualitative determination of uric acid from fat body/malpighian tubules.
- Determination of the rate of passage of food through gut.
- Collection of different kinds of larvae and pupae of insects.
- Collection, preservation and identification of locally available insects.
- Permanent preparation of mouth parts, antennae, wings, legs, spiracles and external genitalia of insects from different groups.
- Identification of various insect pests, their life-histories and materials damaged by them.
- Study of various groups of insecticides and equipments used for insecticides application.
- To study histology demonstrate the presence of lipid and glycogen in microtomy sections of suitable material.
- Study of life- histories of beneficial insects and their products.

Distribution of Marks: Time : 6 Hours

Exercise	Marks
Major dissection	15
Minor dissection	05
Preparation	05
Taxonomy (Identification of two insects)	08
Physiology	08
Spotting (10 Spots)	20
Dissertation	25

Viva-voce	07
Class records	07
Total Marks-	100

Fish Biology:

- Study of organ system of *Scoliodon, Labeo* and *Wallago*.
- Study of accessory respiratory organs and their blood supply in *Heteropneustis, Clarias, Channa* and *Amphipnous.*
- Study of air bladder and ear connection in *Notopterus* and *Gudusia* or *Hilsa*.
- Morphology of olfactory organs and their inervation in teleosts.
- Preparation of a skelton and an alizarine mount of fish.
- Study of prepared microslides.
- Osteolosy of *Wallago*.
- Quantitative estimation of liver glycogen and blood glucose.
- Demonstration of colour change.
- Systematics of marine and freshwater fishes, with special reference to identification of local forms.
- Structural adaptations in fishes.
- Qualitative and quantitative study of freshwater plankton.
- Estimation of dissolved oxygen, free carbon dioxide and alkalinity in a local fish-pond.
- Oxygen consumption in local fishes of different habitats.
- Study of food and structural modifications due to feeding habits, gills and gill-rackers, mouth, eye, alimentary canal, olfactory organs etc.
- Study of age and growth in fishes.
- Study of amphibious, exotic, poisonous, venomous larvivorous and sound producing fishes.
- Study of common aquatic vegetation and aquatic insects.
- Study of fishing gears, with particular reference to Uttar-Pradesh.
- Soil factors.

Distribution of Marks: **Time : 6 Hours**

Exercise	Marks
Major dissection	10
Minor dissection	05
Preparation	05
Taxonomy (Identification of two fishes)	08
Physiology Exercise	06
Spotting (10 Spots)	20
Dissertation	25
Ecology Exercise	07
Viva-voce	07
Class records	07
Total Marks :	100

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