

SYLLABUS

M.Sc. Previous

Paper I: Non-Chordata

Section 'A' : Lower Non-Chordata

Nutrition in Protozoa; Reproduction in Protozoa; Origin of Metazoa; Organization and affinities of Porifera; Polymorphism in Coelenterata; Colony formation in Coelenterata; Coral reefs; Salient features of parasitism in helminthes; Life cycle patterns in helminthes parasites; Outlines of the ecology of soil nematodes; Adaptive radiation in Polychaeta; Segmental organs in Annelida

Section 'B' : 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 mollusca; 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: Environmental Biology

Section 'A' : 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; Ecosystem model with references to space travel;

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;

Section 'B': Environmental Contamination

Population related effects on population size and ecological genetics; Population monitoring schemes with special reference to bioindicators and prediction of ecological effects; Environmental diseases with special reference to carcinogenesis and radiation injuries; Environmental management: Major management issues relevant to management systems, environmental policies and practices; Socio-economic aspects of environmental policies and practices;

Paper III: Biological Chemistry

Chemical equilibrium- Law of Mass action; Elementary thermodynamics 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, β -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; Immobilized enzymes and their applications;

Paper IV: Comparative Animal Physiology

Mechanism of conduction and transmission 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; 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, Poikilothermy; Circulation: Types of circulation, physiological categories of hearts; 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 V: Cytogenetics and Biostatistics

Section 'A' : Cytogenetics

Current status of Mendalism Interaction of genes; Cytoplasmic inheritance; Environment and heredity; Lethal genes; Sex-linked inheretance; Linkage and crossing over, chromosome mapping; Sex chromosome, Sex determination; Multiple allelism; Numerical and structural chromosome aberrations and their significance; DNA replication, Transposable elements in prokaryotes and eukaryotes, Role of transposable elements in genetic regulation; Microbial genetics: Elements of Eugenics, Bacterial transformation, transduction, conjugation, Bacterial chromosome, Bacteriophages;

Section'B' : 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 poisson, correlation, regression and probability;

Paper VI: Animal Behaviour and Evolution

Section 'A' : Animal behaviour

Evolutionary and neurological basis of behaviour, Stereotyped and acquired behaviour: Orientation with special reference to insects, birds & bats; Instinct, rhythmic behaviour learning, Patterns of communication, Cooperation in animals with reference to insects and mammals; Sexual behaviour: Courtship, sexual selection, mating patterns, parental care, migratory behaviour of fishes and birds; Territorial behaviour, Behavioural genetics;

Section 'B' : Evolution

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

M.Sc. Final

Paper I: Chordata

Section 'A'

Origin of chordates; Interrelationship of Ostracoderms, Placoderms; General organization and affinities of Holocephali, Crossopterygii and Dipnoi; Origin of paired fins in teleosts ; Origin of tetrapoda; Neoteny in Amphibia; Origin and evolution of Reptiles, Birds, Mammals; Aerodynamics in birds;

Section 'B'

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

Paper II: Animal Development and Morphogenesis

Section 'A'

Gametes, structure and formation; 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.

Section 'B'

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;

Paper III : Biosystematics & Taxonomy, Economic Zoology & Indian Wildlife

Section 'A' : Biosystematics & 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.

Section 'B' : Economic Zoology

Prawn culture; Pearl culture; Apiculture, Sericulture and Lac-culture; Leather industry; Pharmaceuticals from animals.

Section 'C' : Indian Wildlife

General study of wildlife; Endangered wild animal species; Wildlife conservation programmes, conservation of the Asiatic lion, 'Project Tiger; wildlife sanctuaries; National parks and biosphere reserves; Major organizations concerned with wildlife conservation and their activities and programmes.

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

Section 'A' : 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);

Section 'B': Physiology

Physiology of digestion, Respiration, Osmoregulation and Excretion, Reproduction

Section 'C': Development

Gastrulation, Neurulation, Organ formation, Larval development, Metamorphosis

Paper IV (b): Entomology - Insect morphology, physiology & development

Section 'A'

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 : mechanoreception (tango reception, proprioception, sound perception), chemoreception, thermoreception, hygroreception and photoreception (compound eyes, image formation, stemmata, ocelli); Bioluminescence and sound production.

Section 'B'

Alimentary system : nutrition, feeding behaviour, morphology of the gut and physiology of digestion and absorption; Circulatory system : dorsal vessel, accessory pulsating structures, sinuses and diaphragms, mechanism of circulation, composition and function of haemolymph; 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; Development: post-embryonic development, metamorphosis, types of larvae and pupae, imaginal discs; 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.

Paper IV (c): Cell Biology - Cytological Techniques

Elementary principles of phase, interference, polarization and electron microscope; Theory and application of freeze-drying, x-ray diffraction, radioautographs, fluorescent antibody techniques and differential centrifugation; Methods of cell tissue culture; Theoretical basis of colorimetric and biochemical estimations of nucleic acids, proteins, monosaccharides and lipids; Chemical basis of fixation and cytochemical localization of proteins, lipids, glycogen, RNA, DNA, phosphatase, esterases and oxidases;

Paper V (a): Fishery Biology - Taxonomy and ecology of fishes

Taxonomy of fishes up to orders; Detailed taxonomic study of fishes of Bihar and Uttar Pradesh; 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 V(b): Ecology, Evolution and Taxonomy:

Section 'A'

Insect origin and evolution: Ancestry of insects, origin and evolution of insects, insect physiology, relationships between entognathous and ectognathous apterygotes; 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, use of secondary ,metabolic products by insects, semiochemicals, mutualism and co-evolution.

Section 'B'

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

Thysanura: Machilidae, Lepismatidae.

Collembola: Sminthuridae, Entomodryidae

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: Reduviidae, Cimicidae, Anthocoridae, Lygaeidae, Pyrrhocoridae, Coreidae, Scutelleridae, Pentatomidae, Gerridae, Notonectidae, Belostomatidae, Nepidae

Thysanoptera: Terebrantia (Thritidae), Tubulifera

Neuroptera: Megaloptera, Planipennia (Chrysopidae)

Coleoptera: Adaphaga (Carabidae, Cicindellidae, Dytiscidae, Gyrinidae), Polyphaga (Hydrophilidae, Lucanidae, Scarabaeidae, Buprestidae, Elateridae, Lampyridae, Dermestidae,

Coccinelidae, Tenebrionidae, Meloidae, Cerambycidae, Chrysomelidae, Bruchidae, Curculionidae)

Siphonoptera: Pulicidae, Ceratophyllidae

Diptera: Nematocera (Tipulidae, Psychodidae, Culicidae, Simuliidae, Chironomidae, Bibionidae, Mycetophilidae, Cecidomyiidae), Brachycera (Tabanidae, Asilidae, Bombyliidae, Cyclorhyncha

Lepidoptera: Monotrypa (Neplialidae), Ditrypa (Tineidae, Psychidae, Plutellidae, Gelechiidae, Tortricidae, Cossidae, Pyralidae, Hyblacidae, Nymphalidae, Pieridae, Papilionidae, Geometridae, Bombycidae, Saturniidae, Sphingidae, Arctiidae, Nocxuidae, Lymantriidae)

Hymenoptera: Symphyta (Siricidae, Cephidae, Tenthredinidae), Apocrita (Ichneumonidae, Draconidae, Evaniidae, Cynipidae, Chalcidae, Aganonidae, Pteromalidae, Eulophidae, Trichogrammatidae, Scolidae, Formicidae, Pompilidae, Vespidae, Sphecidae, Negachilidae, Xylocopidae, Apidae)

Collection and preservation of insects

Paper V (c): Cell Biology - Ultrastructure and Morphodynamics of Cell

The Nucleus (The nuclear envelope and traffic between the nucleus and cytoplasm), Internal organization of the nucleus, the nucleolus

Protein sorting 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 sorting 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, peroxisomes – functions of peroxisomes)

Ultrastructure and functions of ribosomes

Morphodynamics and chromosome and achromatic apparatus in cell division

Physiology of dividing cell

Apoptosis and natural cell death

Paper VI (a): Fishery biology -Applied Ichthyology

Marine, freshwater, estuarine reservoirs and coldwater fisheries of India.

Fish culture-Nutritional requirements of Carps, Silurids and Murrels, Carp cultivation in India-Spawning, collection, hatcheries, rearing, stocking, transport and mortality of fish fry.

Fertilization and management of Fishery pond.

Composite fish culture, cage culture and culture of exotic fishes, induced breeding.

Methods of fishing in India with particular reference to U. P.

Preservation, processing, transport and marketing of fish, food value and flavour of different fishes.

Larvivorous fishes and public health.

Common enemies and symptoms, etiology and treatment of diseases of food fishes.

Development of fisheries in India.

Fish-based industry and their products.

Paper VI(b): Economic Entomology - Beneficial and Harmful Insects, Insect Pest Management

Section 'A'

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*, *Chilo traea infuscatellus*, *Emmalocera depressella*, *Odontotermes* spp.

Pests of cereal crops: *Hispa armigera*, *Leptocorisa varicornis*, *Hieroglyphus* spp., *Nephotettix bipunctatus*, *Chilo zonellus*, *Pachytiplosis oryzae*

Pests of fruits and fruit trees: *Quadrastipidiotus perniciosus*, *Eriosoma lanigerum*, *Idiocerus atkinsoni*, *Oryctes rhinoceros*, *Papilio demoleus*

Pests of vegetables: *Rhaphidopalpa foveicollis*, *Epilachna* spp., *Leucinodes orbanalis*, *Phthorimoea operculella*, *Pieris brassicae*, *Bactrocera cucurbitae*, *Earias favia* 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 live stock : *Phlebotomus* spp., *Tabanus striatus*, *Hippobosca maculata*, *Xynopsylla cheopis*; Ticks and Mites of Economic Importance.

Section 'B'

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; 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 VI (c): Cell Regulations and Principles of Biotechnology

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.

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;

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 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 Histocompatibility 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;

Cancer : Cancer as a microevolutionary process, cause and type of cancer, Properties of cancer cells, Molecular diagnosis, prevention and treatment or control, Molecular genetics of cancer;

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.

