

**BIOLOGY OF CHORDATES***Scheme of examination:***MM: 70**

1. Each theory paper is divided into FOUR units. There will be FIVE questions in all; each will be of 14 marks.
2. Q. No. 1 will be compulsory and will contain 7 very short answer type questions, each of **two** marks. Questions will be evenly distributed covering the entire syllabus.
3. Q. No. 2, 3, 4 and 5 will be from unit No. I, II, III and IV respectively. Two questions will be set from each unit. First question of the unit will be having two short notes of 7 marks each and second question will be of long answer type of 14 marks. The students may attempt either of the two questions from a unit.

**UNIT I**

- Origin and outline classification of the chordates.
- Salient features and Interrelationships of Hemichordate, Urochordata and Cephalochordata.
- Origin, evolution and adaptive radiation of chordates.
- Origin, evolution and general characters of Agnatha: Ostracoderms and Cyclostomes.
- The early Gnathostomes (Placoderms).

**UNIT II**

- A general account of the Elasmobranchii, Holocephali, Dipnoi and Crosspterygii.
- Adaptive radiation in bony fishes.
- Origin, evolution and adaptive radiation of Amphibia.
- Parental care in Amphibia
- Neoteny in Amphibia

**UNIT III**

- Origin and evolution of Reptiles: Seymouria and Cotylosauria.
- Skull of Reptiles.
- Venom in Ophidians.
- Dinosaurs.
- Living reptiles: a brief account of Rhynchocephalia, Chelonia, Crocodilia and Squamata.

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# UNIT IV

- Origin and evolution of birds.
- Origin of flight: Flight adaptations.
- Flightless Birds.
- Modifications of Beak, Feet and Palate in Birds.
- Origins of mammals: Primitive mammals (Prototheria and Metatheria).
- General account on adaptive radiations in Eutherian mammals.
- Evolution of man.

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## GENES AND DIFFERENTIATION

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### UNIT I

- Introduction to animal development: Potency, commitment, specification, induction and competence, determination and differentiation, morphogenic gradients, cell fate and cell lineages, Development in unicellular eukaryotes and metazoans
- Creating multicellularity - cleavage types, gastrulation, cell movement and formation of germ layer (drosophila, frog, chick and mouse)
- Early vertebrate development, neurulation and ectoderm, mesoderm and endoderm
- Progressive cell- cell interaction and cell specification fate

### UNIT II

- Body axes - genetics of axis specifications in drosophila
- Establishment of body axes in mammals and birds - homeobox concept in different phylogenetic groups, tetrapod limb development
- Hormones as mediators of development, amphibian metamorphosis, insect metamorphosis

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### UNIT III

- Environmental regulation and animal development. Environmental cues and effects, Malformations and disruptions. Changing evolution through development modularity, Developmental constraints.
- Biology of sex determination, Chromosomal sex determination - Drosophila and Mammals, Testis determination genes, ovarian development, Secondary sex determination in mammals. Environmental sex determination

### UNIT IV

- Embryonic stem cells – Totipotency & Pluripotency, Stem cells niches. Renewal by stem cells-epidermis, Skeletal muscle regeneration, Connective tissue cell family
- Hemopoietic stem cells - Blood cell formation. Stem cell disorders, Bone marrow transplants, Gene. *Therapy.*

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**ENTOMOLOGY: PHYLOGENY, TAXONOMY AND INSECT**  
**ECOLOGY**

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*MM: 70*

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**UNIT-I**

- Collection, preservation and methods of study of insects. Basis of insect classification. Phylogeny of Arthropoda and Hexopoda
- Detailed classification of important and selected super families and families of the following orders- Orthoptera, Isoptera, Hemiptera, Coleoptera, Lepidoptera, Diptera and Hymenoptera.

**UNIT-II**

- Social life in Isoptera and Hymenoptera.
- Life cycle of locusts and aphids.
- Origin and evolution of insects with special reference to fossil insects.
- Causes of success of insects.

**UNIT-III**

- Ecology of insects- (a) Effect of physical factors- viz. Temperature, light, relative humidity, (b) Intra and inter specific relations. (Biotic factors)(c) Insect plant interaction.

**UNIT-IV**

- Population ecology: Population dynamics, size, fluctuation, biogeography, community ecology, species interaction, community structure, diversity. Biochemical adaptations to environmental stress (metamorphosis, diapause, polymorphisms, swarms and migration).

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**ENTOMOLOGY: MORPHOLOGY, PHYSIOLOGY AND  
DEVELOPMENT OF INSECTS**

*Scheme of examination:*

**MM: 70**

1. Each theory paper is divided into FOUR units. There will be FIVE questions in all; each will be of 14 marks.
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3. Q. No. 2, 3, 4 and 5 will be from unit No. I, II, III and IV respectively. Two questions will be set from each unit. First question of the unit will be having two short notes of 7 marks each and second question will be of long answer type of 14 marks. The students may attempt either of the two questions from a unit.

**UNIT-I**

General organization of insect body –

- Integument
- Head: sutures and area of cranium, tentorium, gnathal appendages, antennae.
- Thorax: Legs and their modifications, wings and wing coupling.

**UNIT-II**

- Digestive system: Alimentary canal and its modifications, Physiology of digestion.
- Physiology of circulatory system
- Excretory system and its modifications
- Respiratory system and its modifications, adaptations for aquatic respiration.

**UNIT-III**

- Nervous system and its modifications.
- Morphology and physiology of neuroendocrine system.
- Sense organs: Mechanoreceptors, Chemoreceptor.
- Auditory organs, light producing organ, sound producing organ, visual organ (Compound eye and ocelli).
- Muscular system and distribution of muscles.

**UNIT-IV**

- Reproductive system. Morphology and physiology of male and female, reproductive system, its associated ducts and glands and external genitalia.
- Embryology: - Structure of e<sup>g</sup>, embryonic and post embryonic development.
- Types of larvae, pupae and metamorphosis.

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### UNIT III

- Structure and functions of the kidney: nitrogenous end products and pattern of their excretion, Water and electrolyte regulation in marine, freshwater and euryhaline fishes, Structure and functions of the swim-ladder.

### UNIT IV

- Nervous system: Structure and functions of the central. Peripheral and autonomic nervous systems; anatomy and function of the motor neurons.
- Structure and functions of the sense organs: Eye; visual pigments and vision.
- Chemoreceptors: Olfactory and gustatory, biological significance of chemoreception, Labyrinth, Mechanoreceptors (lateral line organs).

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**FISH & FISHERIES: PHYSIOLOGY***Scheme of examination:***MM: 70**

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3. Q. No. 2, 3, 4 and 5 will be from unit No. I, II, III and IV respectively. Two questions will be set from each unit. First question of the unit will be having two short notes of 7 marks each and second question will be of long answer type of 14 marks. The students may attempt either of the two questions from a unit.

**UNIT I**

- Structure and physiology of the endocrine organs and tissues: Pituitary, Thyroid, Gonads, Adrenal, Endocrine pancreas, Ultimobranchial, Caudal neurosecretory cells and urophysis, Pineal.
- Defense mechanism— integument and Immune system, development of immune system, cells and tissues of the fish immune system, modulators of fish immune responses, humoral and cell mediated immune defense, fish antibody molecules and their effector functions.

**UNIT II**

- Reproduction: Organs of reproduction; modes of reproduction viviparity, hormonal and environmental regulation of reproduction.
- Reproductive strategies: environmental and endocrine factors regulating reproductive cycles, hormonal and molecular mechanisms of oogenesis, spermatogenesis, oocyte - maturation and spermiation, fertilization, mechanism of sex determination, maternal factors in early development.

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### UNIT III

- Reproductive behaviour: Secondary sexual character. Nest building and parental care.
- Behaviour and cognition - patterns of migration, orientation and homing, schooling, feeding, background adaptations.

### UNIT IV

- Adaptations: Coloration, sound production, electric organs, luminescent organs (location, structure, physiology and biological significance).
- Adaptations in deep sea. Hill-stream and cave-dwelling fishes, freezing avoidance in arctic and Antarctic fishes.

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## ENVIRONMENTAL BIOLOGY AND ETHOLOGY

*Scheme of examination:*

*MM: 70*

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2. Q. No. 1 will be compulsory and will contain 7 very short answer type questions, each of two marks. Questions will be evenly distributed covering the entire syllabus.
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### UNIT I

- Ecological law of minimum and law of tolerance, Ecological niches , overlapping of niches , ecotone, Energy flow, food chain, food web and trophic levels, ecological pyramids
- Nutrient cycles in nature -carbon, nitrogen, phosphorus and water, Ecozones of India -habitat and fauna
- Population ecology: Characteristics of a population, Population growth curves, population regulation, Life history strategies (r and K selection)
- Environmental Pollution - air, water, noise and radiation(electromagnetic and ionizing) ; carbon foot print

### UNIT II

- Biodiversity: Species diversity, ecosystem diversity, genetic diversity and molecular Diversity, Alpha, Beta and Gamma Diversity
- Biodiversity indices. Measuring -species richness, species evenness Simpson's diversity Index and Shannon's diversity index
- Biodiversity act of India and Biodiversity hot spots in India (with special reference to Western Ghats and North east), UNESCO heritage sites (Kaziranga National Park)
- Ecological communities: (succession, zonation, environment, biota and adaptations) Terrestrial, Fresh water, Marine and estuarine
- Climatic Changes -El Nino and La Nina, Earth quacks and Tsunami.
- Elementary knowledge of: Wildlife acts and schedules, CITES, TRAFFIC, WWF, Ramser convention, IUCN, ZSI, ZAI, ENVIS, IGCMC, Project Tiger, Biosphere reserves, world heritage sites and hot spots.

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### UNIT - III

- Scientists and their works: Konrad Lorenz, Niko Tinbergen, Karl Von Frisch, Skinner B F and Harlow Harry, Richard Dawkins, EO Wilson, Desmond Morris Concepts of Ethology (SS, FAP, ASE, IRM), Flush Toilet model; Genes and behaviour; Evolution of behaviour, Development of behavior
- Neuroethology: Methods of studying brain and behaviour: neuroanatomical, neurophysiological and neurochemical
- Basic knowledge of EEG, LASER, PET, CAT, MRI and nuclear medicine imaging
- Mammalian Brain and Behaviour, Limbic system and hypothalamus
- Sleep - arousal and reticular formation
- Definition of Social behaviour, Properties and advantages of social grouping, social group of monkeys, Sociobiology-Darwinian fitness, individual fitness, kin selection, group selection, cooperation, reciprocation, altruism, reciprocal altruism, Proximate and Ultimate causations, home range, territory, core area and aggression, Human behaviour

### UNIT IV

- Feeding and sexual strategies in animals, Parental care in animals
- Communication in animals - vocal, tactile, visual and chemical
- Learning: Introduction and definition
- Types - Habituation, trial and error, conditioning, cognition and imprinting short- and long-term memory, neural mechanism of learning

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**TOOLS & TECHNIQUES***Scheme of examination:***MM: 70**

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**UNIT I**

- Principle, construction and application of microscopy
- Light Microscopy, Phase contrast Microscopy, Bright field and Dark field Microscopy, Fluorescence Microscopy, Electron Microscopy (TEM+SEM), Confocal and Atomic Force Microscopy

**UNIT II**

- Separation techniques
- Chromatography; Principle, construction, application and equipment used Various types such as; paper, TLC, GLC, HPLC, Ion-Exchange and affinity chromatography.
- Electrophoresis; Principle, construction, application and equipment used
- Various types such as; paper, agarose, PAGE, submerged DNA, Pulse chase, Isoelectric focusing points and capillary electrophoresis, Immuno electrophoresis.

**UNIT III**

- Colorimetry and Spectrophotometry; Principle, construction, application and equipment used Various types such as; fluorescence, UV, IR, Atomic Absorption Lambert-Beer's Law
- Principle and application of radiations in biology, Radiation Dosimetry and equipment used for it, Radioisotopes, types, characteristics and uses, Tracer techniques in biology, Scintillation techniques

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#### UNIT IV

- Histological Techniques
- Principle of cytological and cytochemical techniques, Fixation-chemical basis of fixation by formaldehyde, glutaraldehyde, chromium salts, mercury salts, osmium salts, alcohol and acetone, Chemical basis of Staining of carbohydrates, proteins, lipids and nucleic acids.
- Cell and Tissue Culture techniques, Design and functioning of tissue culture laboratory, Cell proliferation measurements, Cell viability testing, Culture media preparation and harvesting techniques.

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**ENTOMOLOGY: ECONOMIC ENTOMOLOGY***Scheme of examination:**MM: 70*

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**UNIT-I**

- Concept of pest. How and why insects have become pests?
- **Bionomics, distribution; mode of damage caused and management of major pests of Cash crops: sugar cane, tobacco and cotton.**

**UNIT-II**

- Bionomics, distribution; mode of damage caused and management of major pests of Cereal crops: wheat, paddy, millet, maize, sorghum, pulses.
- **Pest of oil seed crops.**

**UNIT-III**

- Pests of vegetables and fruits.
- Pests of medical and veterinary importance and role of WHO and UNICEF.
- Storage pests (stored grains and milled products).

**UNIT-IV**

- Forensic entomology with special reference to man and wild life.
- Beneficial insects (silk worm, honey bee, lac insect and industries related to them).

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**ENTOMOLOGY: INSECT TOXICOLOGY AND PEST CONTROL**

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**UNIT-I**

- Definition and history of various methods of insect pest control -1. Physical 2. Mechanical 3. Chemical 4. Cultural 5. Quarantine regulations.

**UNIT-II**

- Nomenclature and classification of insecticides: Concept of I<sup>st</sup>, II<sup>nd</sup> and III<sup>rd</sup> generation pesticides, Pesticides act of India, Selection of insecticides, their formulation and mode of action.
- Preventive measures and antidotes: Fumigants and appliances used for application of insecticides, Mechanism of insecticides resistance in insects. Insecticide synergists and antagonist.

**UNIT-III**

- Biological control: Definition, biological control agents
- Parasites: Parasitoids Predators Microbial pesticides, Mass production and distribution, Advantages and disadvantages of biological control.

**UNIT-IV**

- Integrated pest management (IPM): Definition, importance, Tools, basic principles, Evolutionary trends.
- Dynamics of environmental pollution.
- Pesticides: their impact on wild life, their impact on human health (bioaccumulation, biomagnification, biodegradation)

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**FISH & FISHERIES: ICHTHYOLOGY - AQUATIC RESOURCES AND  
THEIR CONSERVATION**

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**UNIT I**

- Riverine fisheries- important river systems and their hydrological conditions, flora and fauna with special reference to fisheries, dams and their impact on riverine fisheries; fish ladders, interlinking of rivers and likely impact on fisheries.
- Cold water fisheries - ecology of hill streams, biology of important cold-water fishes of India, recreational fishing.
- Lacustrine fisheries - origin of lakes and lake morphology, light, temperature and density relationship in the lacustrine ecosystems, heat energy and water movements, oxygen and other dissolved gases in lakes, pH and redox potential, fisheries profile and potential of major Indian lakes.

**UNIT II**

- Estuarine fisheries- major estuarine systems of India, hydrography, flora and fauna with special reference to fisheries.
- Marine fisheries – coastal and deep-sea fisheries, permanent and seasonal stratification, upwelling, the photic zone, control of primary production by light and nutrients availability, chemical properties of sea water, biology of important fishes (sardine, mackerel, tuna), marine protected areas.

**UNIT III**

- Integrated resources- coastal wet lands, mangroves, coral reefs, sea grasses and their conservation. Fishing techniques-- technologies for localizing catches- remote sensing, sonar, radar; crafts and gears.

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- Stock assessment and management-- Natural markers- morphological analyses, environmental signals, genetic analyses; Applied markers- marking and tagging, Stock identification data analysis - stock composition analysis, age and growth, fecundity estimation, application of statistical methods in fisheries.
- Fish conservation- fishing laws and regulation, permitting.
- Post-harvest technology-- Fish spoilage, rigor mortis, rancidity, enzymatic spoilage, microbial spoilage.

#### UNIT IV

- Fish preservation and processing- handling of fish at harvest/onboard, principles of fish preservations, methods of preservation, problems associated with fish preservations, quality control.
- Fish products and byproducts: Liver oil, body oil, meal, fish manure, guano. Glue. Isinglass, roe (caviar), tins and leather.
- Aquatic pollution- types and sources, impact of pollution on aquatic organisms, ecosystem analysis- bio-indicators, biomonitoring, environmental factors and fish health, xenobiotics.
- Waste management- national and international standards. Extension services - basic principles and emerging issues of extension, role of information and communication technology in fisheries extension.

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**FISH & FISHERIES: ICHTHYOLOGY – AQUACULTURE**

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**UNIT I**

- Culture technology– freshwater (carps, catfishes, murrels, prawns).
- Brackish water (asian sea-bass, milk fish, mullets, crabs, shrimps).
- Mariculture (mussels, oysters, sea weeds), fish food organisms (algae; *Artemia*; zooplankton).

**UNIT II**

- Water Quality Requirements for Aquaculture– Role of temperature, pH, salinity, dissolved oxygen, ammonia, nitrite, nitrate, phosphate, biological oxygen demand, Chemical oxygen demand. Integrated farming - fish-cum-livestock farming, paddy-cum-fish farming, aquaculture engineering- aquahouse, hatchery, ponds, race ways, recirculating system, cage, and pen.
- Fish seed technology - natural collection, bundh breeding, induced breeding, cryopreservation of gametes.
- Transport of finfish and shellfish- transport of eggs, fry, fingerlings and adults.

**UNIT III**

- Nutrition of aquatic animals - nutritional requirements of commercially important finfish and shellfish, dietary requirements of larvae and brooders, feed types, manufacture and ingredients, anti- nutritional factors in fish feed ingredients and their treatments, use of attractants and growth stimulants in fish feeds, alternative protein sources in aquaculture diets, feeding techniques, role of probiotics in nutrition.
- Setting up of display aquarium- freshwater and marine aquaria, selection of compatible species, breeding of aquarium fishes.
- Role of genetics in aquaculture– gynogenesis, androgenesis, triploidy, tetraploidy, hybridization, sex reversal and breeding, production of transgenic fish, impact of GMOs on aquatic biodiversity.

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UNIT IV

- Fish health- infection and diseases in fish, common fish pathogens, routes of pathogen entry in fish, methods of colonization and spread of pathogens, immune - evasion mechanisms of fish pathogens.
- Environmental impact of aquaculture- aquacultural wastes and future developments in waste minimization, environmental consequences of hypernutrification.
- Fish vaccines-strategy and use in aquaculture.

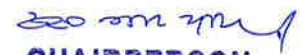
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Approved



**CHAIRMAN**  
Academic Council  
Raj Rishi Govt. Autonomous College  
Alwar (Rajasthan)



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