

Admission to Ph.D. Programme in Zoology
Zoological Survey of India, Kolkata
(Sister Institute of Department of Zoology, Calcutta University for PhD Program)

Applications are invited for admission to Ph.D. programme in Zoology from candidates having a Master's degree in Zoology with a minimum of 55% marks. The eligible candidates need to appear for the Research Eligibility Test (ZSI RET-2022) as per the following schedule:

Date of admission test: 2nd April, 2022 (Saturday) Time: 10 am to 12 noon
Date of interview: 7th April, 2022 (Thursday)
Venue: ZSI, New Alipore, Kolkata 700053

The list of candidates eligible for the written test will be announced on the ZSI website on 30th March, 2022. The list of shortlisted candidates for interview will be available by 5th April, 2022, on the ZSI website. No candidate will be intimated individually. The interview will be held on 7th April, 2022 (11:30 a.m. onwards) at the Zoological Survey of India, Prani Vigyan Bhavan, New Alipore, Kolkata. Candidates who have qualified M. Phil. /NET/GATE in any branch of Life Sciences are exempted from the written examination and will need to appear in the interview only.

Application forms are to be downloaded from the ZSI website and filled-in forms (in hard copy) to be submitted to the Head of Office, Zoological Survey of India, Prani Vigyan Bhavan, M- Block, New Alipore, Kolkata- 700053.

Last date of submission of the ZSI RET-2022 application form is 25th March, 2022 (Friday).

Candidates may note the following:

- (A) The syllabus for the written examination is available along with this notification.
- (B) The Ph. D degree will be awarded by the Calcutta University, Kolkata.
- (C) Number of vacancies is 40 (Forty)
- (D) The question paper will comprise of both MCQs and Short answer questions.
- (E) This RET is exclusively for Ph.D. registration in Calcutta University, Kolkata and ZSI will not be granting any fellowships to the qualified.
- (F) The policy of reservation will be as per Govt. of India rules.

Director
Zoological Survey of India



Zoological Survey of India
Government of India
Ministry of Environment, Forest & Climate Change



Application Form for the Admission Test of the Ph.D. Programme (ZSI RET)-2022

Name (in block letters) :

Date of Birth :

Father's Name :

Marital Status :

Whether SC/ST/OBC/EWS*

Physically Challenged* :

Nationality :

Address for Communication :

Phone No. :

E-mail ID :

Academic Qualification

Name of the Examinations	Year	Board/ University	Subject taken	Div./ Class	% of Marks
B.Sc.					
M.Sc. (Zoology)*					
M. Phil *					

Whether qualified NET/ GATE/ equivalent examination (Yes / No) Year:

Signature of the applicant with date:

*Copies to be attached: Certificate/Marksheet of M.Sc in Zoology, Certificate M.Phil /NET /GATE, Certificates for claiming reservation, if any.

All documents in original should be produced at the time of the interview.

SYLLABUS FOR PH.D ENTRANCE TEST (ZSI RET)-2022

ZOOLOGICAL SURVEY OF INDIA, KOLKATA

1. MOLECULES AND THEIR INTERACTION

- A. Composition, structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins).
- B. Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes.
- C. Conformation of proteins (Ramachandran plot, secondary structure, domains, motif and folds).
- D. Conformation of nucleic acids (A-, B-, Z-DNA, t-RNA, micro-RNA).
- E. Metabolism of carbohydrates, lipids, amino acids nucleotides and vitamins.

2. CELLULAR ORGANIZATION

- A. **Membrane structure and function:** Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes.
- B. **Structural organization and function of intracellular organelles:** nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes.
- C. **Organization of genes and chromosomes:** Operon, interrupted genes, gene families, structure of chromatin and chromosomes, unique and repetitive DNA, heterochromatin, euchromatin, transposons.
- D. **Cell division and cell cycle:** Mitosis and meiosis, their regulation, steps in cell cycle and control of cell cycle.

3. FUNDAMENTAL PROCESSES

- A. **DNA replication, repair and recombination:** Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons, DNA damage and repair mechanisms.
- B. **RNA synthesis and processing** (transcription factors and machinery, formation of initiation complex, transcription activators and repressor, RNA polymerases, capping, elongation, and termination, RNA processing, RNA editing, splicing, structure and function of different types of RNA, RNA transport.
- C. **Protein synthesis and processing:** Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, translational proof-reading, translational inhibitors, post-translational modification of proteins.
- D. **Control of gene expression at transcription and translation level:** Regulation of phages, viruses, prokaryotic and eukaryotic genes, role of chromatin in gene expression and gene silencing.

6. SYSTEM ANATOMY AND PHYSIOLOGY

- A. **Blood and circulation:** Blood corpuscles, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, immunity, haemostasis.
- B. **Cardiovascular System:** Comparative anatomy of heart structure, heart and circulation in foetal and neonatal mammal, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation of all above.

- C. **Respiratory system:** Respiratory pigments in animals, comparison of respiration in different species, ventilatory mechanisms in chordates, transport of gases, exchange of gases, waste elimination.
- D. **Nervous system:** Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture, neurotransmitters, neurohormones and neuromodulators.
- E. **Sensory system:** Receptor system and sensory perception in insects, phototransduction in compound and vertebrate eye.
- F. **Excretory system:** Excretory structure and functions in annelids and insects, Ultrastructure of kidney, Juxtaglomerular apparatus, comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance.
- G. **Thermoregulation:** Heat transfer between animal and environment, poikilothermy and homeothermy, physiological adjustment in extreme environmental conditions, acclimatization.
- H. **Digestive system:** Digestion, absorption, energy balance, BMR.
- I. **Endocrinology and reproduction:** Endocrine glands, basic mechanism of hormone action, hormones and diseases; reproductive processes, neuroendocrine regulation.
- J. **Animal Behaviour:** Pheromones in colonial interactions, foraging and mating.

7. INHERITANCE BIOLOGY

- A. **Mendelian principles:** Dominance, segregation, independent assortment, deviation from Mendelian inheritance.
- B. **Concept of gene:** Allele, multiple alleles, pseudoallele, complementation tests.
- C. **Extensions of Mendelian principles:** Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters.
- D. **Gene mapping methods:** Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, development of mapping population in plants.
- E. **Human genetics:** Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders.
- F. **Quantitative genetics:** Polygenic inheritance, heritability and its measurements, QTL mapping.
- G. **Mutation:** Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal versus somatic mutants, insertional mutagenesis.
- H. **Structural and numerical alterations of chromosomes:** Deletion, duplication, inversion, translocation, ploidy and their genetic implications.
- I. **Recombination:** Homologous and non-homologous recombination including transposition, site-specific recombination.

9. ECOLOGICAL PRINCIPLES

- A. **Habitat and Niche:** Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.
- B. **Population ecology:** Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection); concept of metapopulation- demes and dispersal, interdemic extinctions, age structured populations.
- C. **Species interactions:** Types of interactions, interspecific competition, herbivory, carnivory, symbiosis.
- D. **Community ecology:** Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones.

- E. **Ecological succession:** Types; mechanisms; changes involved in succession; concept of climax.
- F. **Ecosystem:** Structure and function; energy flow and mineral cycling (CNP); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, estuarine).
- G. **Biogeography:** Major terrestrial biomes; theory of island biogeography
- H. **Applied ecology:** Environmental pollution, eutrophication, acid rains, global warming; biodiversity-status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches.

10. EVOLUTION AND BEHAVIOUR

- A. **Emergence of evolutionary thoughts:** Lamarck, Darwin concepts of variation, adaptation, struggle, fitness and natural selection, Mendelism, spontaneity of mutations, the evolutionary synthesis.
- B. **Origin of cells and unicellular evolution:** Origin of basic biological molecules, abiotic synthesis of organic monomers and polymers, concept of Oparin and Haldane, experiment of Miller (1953), the first cell, evolution of prokaryotes, origin of eukaryotic cells, evolution of unicellular eukaryotes; anaerobic metabolism, photosynthesis and aerobic metabolism.
- C. **Molecular Evolution:** Concepts of neutral evolution, molecular divergence and molecular clocks; molecular tools in phylogeny, classification and identification; protein and nucleotide sequence analysis; origin of new genes and proteins; gene duplication and divergence.
- D. **The Mechanisms:** Population genetics- populations, gene pool, gene frequency; Hardy-Weinberg law; concepts and rate of change in gene frequency through natural selection, migration and random genetic drift; adaptive radiation and modifications; isolating mechanisms; speciation; allopatricity and sympatricity; convergent evolution; sexual selection; co-evolution.
- E. **Brain, Behavior and Evolution:** Approaches and methods in study of behaviour proximate and ultimate causation; altruism and evolution, group selection, kin selection, reciprocal altruism; neural basis of learning, memory, cognition, sleep and arousal; biological clocks; development of behavior; social communication; social dominance; use of space and territoriality; mating systems, parental investment and reproductive success; parental care; aggressive behavior; habitat selection and optimality in foraging; migration, orientation and navigation; domestication and behavioral changes.

11. METHODS IN BIOLOGY

- A. **Molecular biology and recombinant DNA methods:** Isolation and purification of RNA, DNA (genomic and plasmid) and proteins, different separation methods; analysis of RNA, DNA and proteins by one and two dimensional gel electrophoresis, isoelectric focusing gels; molecular cloning of DNA or RNA fragments in bacterial and eukaryotic systems; expression of recombinant proteins using bacterial and animal vectors; isolation of specific nucleic acid sequences; generation of genomic and cDNA libraries in plasmid, phage, cosmid, BAC and YAC vectors; in vitro mutagenesis and deletion techniques, gene knock out in bacterial and eukaryotic organisms; protein sequencing methods, detection of post-translation modification of proteins; DNA sequencing methods, strategies for genome sequencing; methods for analysis of gene expression at RNA and protein level, large scale expression analysis, such as micro array based techniques; isolation, separation and analysis of carbohydrate and lipid molecules; RFLP, RAPD and AFLP techniques.
- B. **Statistical Methods:** Introduction - Scope of biostatistics – Importance – Limitations. Statistical Terms and symbols. Population - Sample - Variable – Parameter; Monitoring

techniques: – Line Intercept Transect, Belt Transect, Quadrat methods; Descriptive Statistics: Mean, Median, Mode; Biodiversity measures - Species diversity indices, Margalef's diversity, Shannon-Wiener Index, Evenness index; Analysis of Variance (ANOVA) - Test of Significance; Correlation: Types - coefficient of correlation - Pearson's correlation; Tabulation - frequency distribution - cumulative frequency curves; Graphical representation: Types of samplings: Random - Stratified - Systematic; Graphs - bar diagram - histogram scatter plots - pie-chart

C. Microscopic techniques: Visualization of cells and subcellular components by light microscopy, resolving powers of different microscopes, microscopy of living cells, scanning and transmission microscopes, different fixation and staining techniques for EM, freeze-etch and freeze-fracture methods for EM, image processing methods in microscopy.

D. Methods in field biology: Methods of estimating population density of animals, ranging patterns through direct, indirect and remote observations, sampling methods in the study of behavior, habitat characterization-ground and remote sensing methods.

12. CLASSIFICATION OF ANIMAL KINGDOM

Organisation of coelom- Acoelomata, Psedocoelomata; Non-Chordates and Chordates: Different phyla- salient features and examples

13. PRINCIPLES AND PROCEDURES IN ANIMAL TAXONOMY

Relevance of Taxonomy to other disciplines like Biodiversity Conservation, Agriculture; Pest Management and Forensic Science; Bioprospecting; Biological Collections- different types of collections and their relevance; Type specimens and their relevance in Taxonomy; Different Approaches in Taxonomy; Taxonomic Hierarchy, Units and Ranking; Species Concepts: Biological, Evolutionary, Ecological, Nominalistic; Phylogenetic; Ethics in Taxonomy, ICZN(basics only), Principle of priority, Homonyms and Synonyms

14. ECONOMIC ZOOLOGY

Beneficial/ Harmful/ Medicinal/ Economically important animals.

15. ZOOGEOGRAPHY

Continental drift, Centre of Origin Hypothesis, Major Zoogeographical realms of the world, Animal Distribution -Geographic and Bathymetric Distribution, Patterns of Animal distribution with examples, Dispersal of animals- Barriers to dispersal and means for dispersal, Faunal affinities of animals in India, Species distribution models- Satpura Hypothesis, Hora Hypothesis, Vicariance theory

16. CONSERVATION AND MANAGEMENT

Global Biodiversity Hotspots, Biogeographic Zones, Biosphere Reserves and Protected Areas of India; Biodiversity- related Conventions (Fauna) -CITES, CMS, CBD and Ramsar Convention; IUCN and threatened categories (Indian fauna); Acts and regulations related to Biodiversity (Fauna) -Wildlife Protection Act (1971), The Biodiversity Act, 2002; Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, biosphere reserves), reasons for wildlife depletion in India, Stochastic perturbations- environmental, demographic, spatial and genetics to chasticity, minimum viable populations & recovery strategies for threatened species.