

Department of Zoology
Savitribai Phule Pune University
Syllabus for PET for PhD admission in Zoology
PART I: Research Methodology

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For Part I (Research Methodology), the question paper will consist of 50 MCQs (50 Marks) based on the following syllabus.

1. **Foundations of Research:** Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific methods, understanding the language of research, concept, construct, definition, variables. Research Process.
2. **Problem Identification & Formulation:** Definition and formulating the research problem, necessity of defining the problem, importance of literature review in defining a problem, research question/investigation question, measurement issues.
Hypothesis: Qualities of a good hypothesis. Generalization and Interpretation. Statistical hypothesis testing: logic & importance, null hypothesis & alternative hypothesis.
3. **Research Design:** Concept and importance of research design in Research, features of a good research design. Exploratory research design: concept, types and uses. Descriptive research designs: concept, types and uses. Experimental research design: Concept of independent & dependent variables. Ethics pertaining to human and animal experimentation. Bio-safety guidelines.
4. **Data Collection & Sampling:** execution of the research - observation and collection of data - methods of data collection, concepts of statistical population, sample, sampling frame, sampling error, sample size, non response. Characteristics of a good sample. Probability sample –simple random sampling, systematic sampling, convenience sampling, stratified random sampling & multi-stage sampling. Determining size of the sample – practical considerations in sampling and sample size.
5. **Qualitative and Quantitative Research:** Qualitative research, Quantitative research,

causality, generalization, replication. Merging the two approaches. Concept of measurement -what is measured? Problems in measurement in research – Validity and Reliability. Levels of measurement –Nominal, Ordinal, Interval, Ratio.

6. **Data Analysis:** Data preparation and presentation (frequency tables, bar charts, pie charts, histograms, etc.) –Univariate analysis, Bivariate analysis – Cross tabulations and testing hypothesis of association including Chi-square test, correlation and regression analysis.
7. **Interpretation of Data and Paper Writing:** Layout of a research paper, when and where to publish? Journals in Life-Sciences, Impact factor of journals indexing: Scopus, Web of Science etc. Ethical issues related to publishing, plagiarism and self plagiarism.
8. **Use of Literature:** Research articles, reviews, encyclopaedias, handbooks, and biological databases.
9. **Use of Tools / Techniques for Research:** Methods to search required information effectively, reference management software like Zotero/Mendeley/Endnote, Software for paper formatting like LaTeX /MS Office, software for detection of plagiarism.
10. **Reporting and Thesis Writing:** Structure and components of scientific reports, types of report, technical report and thesis, different steps in the preparation, layout, structure and language of typical reports, illustrations and tables, bibliography, referencing and footnotes. Oral presentation, planning, preparation, practice, making presentation, use of visual aids, importance of effective communications
11. **Application of Results and Ethics-** Environmental impacts, ethical issues, ethical committee, commercialization. Copy right, royalty, intellectual property rights and patents law, trade related aspects of intellectual property rights, reproduction of published material, citation and acknowledgement, reproducibility and accountability.
12. **Reasoning and Mental Ability:** Analogy, classification, series, coding-decoding, direction sense. Logical reasoning, inserting the missing character, number, ranking and time sequence test, eligibility test, number and symbol ordering, comprehension questions, statement and assumptions, statement and conclusions, statement and action.

Books recommended

1. Research Methodology-C R Kothari
2. Research Methodology: An Introduction-Stuart Melville and Wayne
3. Practical Research Methodology-Catherine Dawson
4. Research Methods for Science Michael P Marder
5. Research Methodology: Principle, Methods and Practices-Joshua O.Miluwi and Hina Rashid
6. Research Methodology: A Step by Step Guide for beginners- Ranjeet Kumar
7. How to Write and publish a Research Paper- Seventh Edition-Robert Day and Barbara Gastle
8. Introduction to Biostatistics and Research Methods- P S S Sunder Rao
9. Research Methodology and Scientific Writings- C George Thomas

References:

- 1) Garg, B. L.Karadia R. Agrawal, F. and Agrawal U. K., 2002. An Introduction to Research Methodology, RBSA Publishers
- 2) Kothati C. R.,1990. Research Methodology: Methods and Techniques New Age International 418p.
- 3) Sinha S. C. and Dhiman A. K., 2002. Research Methodology Ess Publications 2 Columes.
- 4) Trochim W. M. K., 2005. Research Methods: The Concise Knowledge Base Atomic Dog Publishing. 270P
- 5) Wadehra B. L., 2000. Law Relating to Patents, Trade Marks, Copyright Design and Geographical Indications, Universal Law Publishing

Additional reading

- 1) Anthony M. Graziano A. M. And Raulin M. L., 2009. Research Methods: A Process of Inquiry Allyn and Bacon
- 2) Carlos C. M., 2000. Intellectual Property Rights The WTO and Developing Countries: The Trips Agreement and Policy Options, Zed Books New Yorks
- 3) Coley S. M., and Scheinberg C.A., 1990, "Proposal Writing", Sage Publications
- 4) Fink A., 2009. Conduction Research Literature Reviews: From the Internet to Paper. Sage Publications
- 5) Leedy, P. D. and Ormrod J. E., 2004 Practical Research: Planning and Design, Prentice Hall
- 6) Satarkar S. V., 2000. Intellectual Property Rights and Copy Rights Ess Ess Publications
- 7) Website for guidelines on experimentation animals (Institutional Animal Ethics Committee as per CPCSEA): <http://cpcsea.nic.in>
- 8) Website for guidelines on Indian Biosafety Safety Rules & Regulations: <http://dbtbiosafety.nic.in/>
- 9) Website for guidelines on research using human subjects (Institutional Human Ethics Committee as per ICMR): http://www.icmr.nic.in/ethical_guidelines.pdf

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PART II: Subject (Zoology) Specific

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For Part II (Subject specific), the question paper will consist of 50 MCQs (50 Marks) based on the following syllabus.

A. Animal systematics, Biodiversity, Ecology and Evolution

Principles and methodologies of taxonomy, species concept, salient features of all major phyla of non-chordate and chordates with examples of representative animals and groups, Outline of classification (chordates and nonchordates upto classes), rare and endangered species, conservation strategies, adaptation and adaptive modifications, adaptive radiation, Biotic and abiotic components of ecosystem, species interaction, Biomes and characteristic fauna, environmental pollution and management, chemical origin of life, Oparin concept, Urey-Miller's experiment, Lamarckian-Darwinian-Neodarwinian concept, Post-Darwinian evolutionary thoughts, molecular evolution, isolating mechanism, speciation, allopatric and sympatric species, convergent and divergent evolution, co-evolution.

B. Developmental Biology

Basic concepts of determination and differentiation, cell fate, stem cells, gametogenesis, fertilization, types and patterns of cleavage, blastula, gastrulation; embryogenesis, morphogenesis and organogenesis (amphibian, chick and mammalian system), limb development and regeneration in vertebrates, neuronal differentiation, sex determination and regulation, aging and senescence.

C. Cell Biology

Membrane structure function, cell organelles and nucleus (structure and function), chromosomes and chromatin organization, cell division and cell cycle (including regulation), cell signaling, cellular communications, Programmed cell death.

D. Genetics

Mendelian principles, multiple alleles and sex-linked inheritance, deviation of Mendelian pattern/ ratios (epistasis, penetrance, expressivity), phenocopy, linkage and crossing over,

gene mapping methods (eukaryotic animals), pedigree analysis, genetic disorders and diagnosis, maternal inheritance, polygenic inheritance, heritability and measurements, types of mutations and causes, structural and numerical alterations of chromosomes, *Drosophila* as genetic models and genetic methodologies used in *Drosophila*, Polytene chromosomes and uses in genetics, genetic regulation of early embryogenesis in *Drosophila* and homeotic mutations, P-element and its applications, Genetic regulation of sex determination in *Drosophila* and mammals, dosage compensation, Concept of population genetics, Genetic drift, Hardy Weinberg principles.

E. Molecular Biology

Structure and types of DNA and RNA, c-value paradox, organization of genes (prokaryotic and eukaryotic), Central dogma, DNA replication and repair, RNA synthesis and processing, Protein synthesis and post translational modification, regulation of gene expression at transcriptional and translational levels.

F. Biochemistry

Biomolecules and properties, Biochemistry (structure-functional properties) of protein, carbohydrates, lipids, nucleic acids, Enzymes and enzyme kinetics, coenzymes, allosteric enzymes, basic concepts of metabolism and regulation of metabolic pathways, Carbohydrate metabolism, Glycolysis and citric acid cycle, pentose phosphate pathway, lipid metabolism and beta-oxidation.

G. Entomology

Arthropods and vectors of human diseases (mosquitoes, lice, flies, and ticks), Mode of transmission of pathogens by vectors, Chemical biological and environmental control of arthropod vectors, Biology and control of chief insect pests of agricultural importance, Plant host-insect interaction, insect-pest management: RNAi technology, Uses of sex attractants/ Repellents: Pheromones, Hormones, Chemosterilents, Useful insects: Lac insects, Honey bee and Silkworm, Insect Reproduction and development, Insect Taxonomy, Fat body – structure and function, Chemistry of insect hormones, Insect Sex determination, influence of biotic and abiotic factors on insect ecology.

H. Animal Physiology

Mammalian organ system, nutrition, digestion and absorption, circulation (open and closed), lymphatic system, blood components and functions, muscular system, excretion and osmoregulation, nerve conduction, major sense organs and receptors, physiology of reproduction, endocrine system and different types and functions of hormones.

I. Immunology

Innate and adaptive immune system, B and T cell, structure-function of antibody molecules, generation of antibody diversity, Immunogenetics, monoclonal antibodies, MHC molecules, Antigen processing and presentation, Autoimmunity, Hypersensitivity reactions, Immune responses to infectious agents, Vaccines, Antigen-antibody interactions.

J. Parasitology

Different types of parasitism, host and parasite interactions, protozoan and metazoan parasites (cell biology, life cycle and pathogenesis), salient features of genomes of protozoan and metazoan parasites.

K. Methods in modern Biology: Tools and Techniques

Separation techniques of biomolecules and purifications, analysis of Protein, DNA, RNA and detection techniques, different types of electrophoretic and chromatographic techniques, spectrophotometry, fluorescence recovery after photo bleaching (FRAP), centrifugation and subcellular fractionation, Cloning and recombinant DNA techniques, Gene knockout and silencing techniques, Western blotting, PCR, DNA and Protein sequencing methods, FISH, Immunotechniques (antibody generation, ELISA, Immunofluorescence and immunohistochemistry, immunoprecipitation, flow cytometry), Basic principles of microscopy, Types-components-principles of light and electron microscopes, Fluorescence microscopy and applications, Phase contrast and DIC microscopy, Histochemical techniques and stains, statistical methods, measures of central tendencies, probability, Test of significance, regression and correlation, analysis of variance, estimation of biodiversity indices in field biology.