Ph.D. Course Work Syllabus

Department of Zoology,

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Ph.D. in Zoology

Program outcomes

- Acquired ability to review the literature, gap identification in relevant research areas, formulate research proposals.
- Expertised in various research techniques and strategic application in execution of research work.
- Skilled in data collection, computation, analysis, compilation and preparation of manuscripts.
- Acquired skills to disseminate research outcomes for societal welfares.

Course outcomes of Ph.D. Course Work

Paper I: Research Methodology I

1. Acquainted with basic computer operating software and application of MS office.
2. Skilled in data collection and applications of statistical tools for analysis.
3. Acquired knowledge about research ethics and intellectual property right.
4. Acquired skills for scientific writing and documentations.

Paper II: Research Methodology – II

1. Learned to review published literatures in relevant areas.
2. Skilled to write review based on literature survey.
3. Get acquainted with modern molecular techniques.
4. Learned designing the research plan and sampling methods.

Paper III: Advances in Zoology

1. Learned concept of biological diversities in relation to geographical distribution.
2. Acquired ideas about chemistry of proteins and enzymes.
3. Acquainted with ideas of cryopreservation techniques and captive breeding technology in fishes.
4. Learned neurosecretion and ecology of earthworm in relation with vermitechnology and Vermicomposting.
5. Learned molecular concept of hormone interactions and signalling cascades.

Paper IV: Seminar/Practical/Project and Assessment

1. Learned to conceptualize research project in relevant area of interest.
2. Learned to planning and execution of research project.
3. Acquired skill for computation of data and compilation of research outcomes.
4. Acquired expertise to preparation of data presentation and report writing.

Ph.D. Course Work Syllabus (Zoology)

Paper I: Research Methodology-I

(*4 Credits*: *100 Marks*)

The whole paper is divided into four units as follows:

Unit-1: Basic Computer Applications.

Unit-2: Quantitative methods, Statistics and application of Computer in statistics.

Unit-3: Research Ethics and IPR.

Unit-4: Documentation and Scientific writing.

DETAILED SYLLABUS FOR EACH UNIT:

Unit-1: Basic Computer Applications

Basic computer knowledge, Features and applications related to presentation of text in suitable format and saving the data for future applications. Use of word processing, Practical knowledge of MS Word to type the script, insert tables, figures and graphs, plotting of graphs in excel, Preparation of power point presentation based on the topic of research. Insertion of figures, graphs, charts in presentation. Use of spreadsheet and database software, preparation of scientific posters for presentations, internet and its applications: Email, WWW, Web browsing, acquiring technical skills, drawing inferences from data, Cloud computing.

Unit-2: Quantitative methods, Statistics and application of Computer in statistics

Measures of central tendency and dispersion. Probability distribution – Normal, Binomial and Poisson distribution. Parametric and Non-parametric Statistics. Confidence interval, errors. Quantitative techniques: Levels of significance, regression and correlation coefficient. Statistical analysis and fitting of data; Chi-square Test, Association of Attributes t-test Anova, standard deviation, co-efficient of variations. Open-source software for quantitative and statistical analysis.

Unit-3: Research Ethics and IPR

Environmental impacts- Ethical issues-ethical committees- commercialization- copyright-royalty – intellectual property rights and patent law- trade related aspects of intellectual property rights- reproduction of published material- plagiarism- citation and acknowledgement – reproducibility and accountability.

Unit-4: Documentation and Scientific writing.

Results and conclusion, Preparation of manuscript for publication of Research paper, presenting a paper in scientific seminar, Thesis writing. Structure and components of Research report, types of report: research papers, thesis, Research proposals, Research Project reports, pictures and graphs, citation styles, writing a review pf paper, Bibliography.

PAPER II: Research Methodology- II

(4 *Credits*: *100 Marks*)

I. Review and Critics of published Research in relevant field *2 Credits: 50 Marks*

Review of published research work from among the following areas:

(i) Systematics and biodiversity.
(ii) Ecology and biology
(iii) Invertebrate neuroendocrinology
(iv) Molecular endocrinology
(v) Proteins, enzymes and their genes in invertebrates.
(vi) Fisheries and aquaculture
(vii) Fisheries and Fish technology
(viii) Macroinvertebrate biology including insects and molluscs
(ix) Environmental pollutants and remediation techniques.
(x) Tropical diseases.

Each review will cover at least five original research articles published in last five years and are to be cited in the references.

AN OUTLINE PERFORMA OF THE REVIEW SHOULD BE GIVEN TO THE STUDENTS

II. **Methodology of Research marks** *2 Credits: 50 Marks*

(i) Sampling methods of terrestrial and aquatic animal's statistical methods.
(ii) Use of Phase Contrast and Fluorescent Microscopes.
(iii) Use of Electrophoresis system
(iv) Blotting Techniques
(v) DNA Barcoding and Phylogenetic analysis.
(vi) Research design and sampling methods.
(vii) Statistical methods in biology.

(ii) through (v) can be clubbed as molecular techniques in biology**.**

For the points vi and vii above, the following books should be considered strictly.

1. Zar JH. 1999. Biostatistical Analysis. IV edition. New Delhi, India: Pearson Education (Singapore) Pte. Ltd., Indian Branch,663p+appendix.
2. Holmes D, Moody P, Dine D.2006. Research methods for the biosciences., New York, USA: Oxford University Press377p**.**

Paper-III: Advances in Zoology

(*4 Credits: 100 Marks*)

1. **Biodiversity**
   - ❖ Importance, levels of biological diversity; Geographical scale of species diversity; methods of measuring biodiversity in space and time, worked examples.
2. **Proteins and Enzymes**
   - ❖ Structural organization in proteins.
   - ❖ Enzymes and mechanism of action, purification of enzymes.
   - ❖ Characterization of Proteins and enzymes.

3. **Fish physiology, Biochemistry and Biotechnology**
   - ❖ Triploid fish- definition, factors stimulating and suppressing, technology for development of triploid fish, Trans- genesis in aquaculture.
   - ❖ Cryopreservation of fish gametes, ex-situ methods of conservation of germplasm, applications in aquaculture, sperm cryopreservation, cryopreserved milt and fertilization of eggs, ultra-structural studies on damages in cryopreserved spermatozoa, cryopreservation of fish embryos and embryonic stem cells.
   - ❖ Captive breeding- Genetic basis for selection of fish for breeding, inbreeding effects, cross breeding and hybridization, selection and mating designs for select trait, selection for disease resistance, mono-sex, endocrine control of reproduction in fish, synchronization of spawning, brood- stock development and management, technology for preparation of aquaculture heap, care of fertilized egg, assessing stripping, induced normality and mortality; Carp fertilization and embryonic development- cleavage , blastula formation, gastrulation; Live feed development for larvae, larval feeding and maintenance, packaging and transport of carp post larvae, fry and fingerlings, nursery, rearing, pre-stocking technology for carp.

4. **Earthworm Biology and Ecology**
   - ❖ Biology of reproduction in earthworms with references to conjugation, cocoon formation and fecundity.
   - ❖ Neurobiology of tropical earthworms with references to neurosecretion.
   - ❖ Earthworm as ecosystem engineers, Role of earthworm in soil fertility; edaphic factors controlling distribution of earthworms in soil, Vermiculture and Vermicomposting; Principle, method and significance of vermicomposting, Effects of vermicomposting on soil fertility.

5. **Molecular Endocrinology**
   - ❖ Concept of hormone and types of hormone receptors
   - ❖ Signalling pathways: cAMP and MAPK signaling
   - ❖ Hormonal control of gene expression; molecular basis of hormone synergism and antagonism.

Paper IV: Seminar/Practical/Project and Assessment
(*4 Credits: 100 Marks*)

1. Project in the following area of zoology *2 Credits:50 Marks*

A. Taxonomy and biodiversity.
B. Ecology and biology
C. Invertebrate neuroendocrinology
D. Molecular endocrinology
E. Proteins, enzymes and gene expression
F. Fisheries and Fish Technology
G. Aquaculture

However, another topic of Zoology and related field can also be allowed so that the student enjoys the freedom to select the topic of choice. For future the same topic may be used by the candidate for the Ph.D. programme.

2. Submission of project report, PPT presentation and viva-voce.

2 Credits:50 Marks