

# **COURSE CURRICULUM AND SCHEME OF EXAMINATION**

**Under  
Learning Outcomes-based Curriculum Framework  
(LOCF)**

**For Course Work of  
Ph.D. Programme in Zoology  
(Effective from the Academic Session 2022–2023)**

**Department of ZOOLOGY  
Chaudhary Devi Lal University  
Sirsa – 125 055**



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**As per Ph.D. ordinance, the research scholar has to clear minimum 12 credits**

Sr. No.	Course ID	Nomenclature	Credit	Contact Hours per week	Internal Assessment	External Exam	Max. marks	Exam Duration (Hrs)
1	PhD/ZOO/1/701	Recent Advances in Techniques in Animal Sciences	4	4	30***	70	100	3
2	PhD/ZOO/1/702	Toxicology and Aquaculture	4	4	30***	70	100	3
3	PhD/ZOO/1/703	Research Methodology/ MOOC*	4	4	30***	70	100	3
4	PhD/ZOO/1/704	Research and Publication Ethics/MOOC*	2	2	20**	30	50	3

**Grand Total=350 Marks**

\*Research Methodology (PhD/ZOO/1/703) and Research and Publication Ethics (PhD/ZOO/1/704) courses offered on Swayam Portal will be cleared by research scholar as per Ph.D. ordinance and MOOC guidelines. Internal assessment marks will not be awarded for these two above courses.

\*\*IA=20 Marks (10–Midterm examination; 5–Assignment hand written; 5–Attendance)

\*\*\*IA = 30 Marks (20–Midterm examination; 5–Assignment hand written; 5–Attendance)

**Note:**

1. Students are allowed to use single memory, non-programmable scientific calculator during exam, however, sharing of calculator is not allowed.



## Ph.D. (Zoology)

### PhD/ZOO/1/701- Recent Advances in Techniques in Animal Sciences

**Credits: 4**

**Time: 3 Hrs.**

**Marks: 100**

**Theory: 70**

**IA: 30**

**Course Objectives:** This course offers students an understanding to various tools and techniques used to gain insight into biological processes. It will also provide information about handling of biological samples and chemicals, life expectancy and precautions. Students will also learn about solutions preparation, storage, stability, precautions, uses and their mechanism of action. The focus is on studying the techniques used for imaging, isolation, purification and characterization of bio-molecules.

<b>Course outcomes:</b>	
<b>CO1</b>	Students would be able to develop basic appreciation of the underlying principles and practical strategy of the analytical and preparative techniques that are fundamental to study and understanding of life processes
<b>CO2</b>	Students would be able to develop basic concepts and practical aspects of various kinds of Microscopy, Spectroscopy and separation techniques.
<b>CO3</b>	Students would be able to understand the concept of molecular biology techniques and their applications in research.
<b>CO4</b>	Students would be able to understand the concept of acute and chronic toxicity and LC <sub>50</sub> estimation

**Note for the paper setter:** The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.

#### Unit-I

**Analysing the application of techniques in animal sciences research:** microtomy, biophysical methods: analysis of biomolecules using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy, structure determination using X-ray diffraction and NMR; analysis using light scattering, different types of mass spectrometry and surface plasma resonance methods.

#### Unit-II

Ultracentrifugation (Velocity and buoyant density), gel filtration, ion exchange & affinity chromatography, thin layer chromatography, gas chromatography, high pressure liquid chromatography (HPLC), ion exchange chromatography, electrophoresis (starch, agarose, PAGE), electrofocussing. Enzyme technology: animal protein/enzyme purification, application of biosensor development in different systems

### Unit-III

**Determination of toxicity:** acute and chronic toxicity testing, LC<sub>50</sub> estimation, nucleic acid hybridization and cot curves, sequencing of nucleic acids, Southern, Northern and South-Western blotting techniques, Polymerase Chain reaction (PCR), measuring nucleic acid and protein interaction. Flow cytometry, karyotyping: FISH & GISH, spirometry, animal tissue culture.

### Unit-IV

**Preparation of buffers and reagents,** immunological techniques including ELISA, immunoelectrophoresis and immune-fluorescence.

**Microscopy:** principle and application of light, stereo, phase contrast, interference, polarization, fluorescence and electron microscopy.

**Cloning:** Types, case study of Garima and Dolly, applications, ethical and policy issues

**Stem cells:** Characteristics, Kinds, types and applications.

**Intellectual Property Rights:** Introduction, History, Objectives, limitations and ethics.

#### Text/Reference Books:

1. Molecular cloning A Laboratory Manual 3rd edition Vol. 1, 2, 3- Sambrook and Russell, Churchill press, 2007.
2. Molecular Cell Biology, J. Darnell, H. Lodish and D. Baltimore Scientific American Book
3. Brown TA. 2007. Genome III. Garland Science Pub.
4. Campbell AM & Heyer L. 2004. Discovery genomics, Proteomics and Bioinformatics. Pearson Education.
5. Gibson G & Muse SV. 2004. A Primer of Genome Science. Sinauer Associates.
6. Kindt TJ, Goldsby RA & Osbrne BA. 2007. Kuby Immunology. WH Freeman.
7. Kun LY. 2006. Microbial Biotechnology. World Scientific.
8. Huffnagle GB & Wernick S. 2007. The Probiotics Revolution: The Definitive Guide to Safe, Natural Health. Bantam Books.
9. Sambrook & Russel DW. 2001. Molecular Cloning: a Laboratory Manual. CSH Lab. Press.
10. Twyman RM. 2003. Advanced Molecular Biology. Bios Scientific. Fuller R. 1997.

#### CO-PO-PSO mapping matrix for PhD/ZOO/1/701–Recent Advances in Techniques in Animal Sciences

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	2	1.5	1.75	3	1.5	2	3	3	2.5	2	2	3
CO2	2.5	1.5	2	3	1.5	2.5	3	3	2	2	2	3
CO3	2	1.5	2	3	1.5	2	3	2.5	2.5	2	2	3
CO4	2.5	1.5	1.75	3	1.5	2.5	3	2.5	2	2	2	3
Avg	2.25	1.5	1.87	3	1.5	2.25	3	2.75	2.25	2	2	3

**Ph.D. (Zoology)**

**PhD/ZOO/1/702–Toxicology and Aquaculture**

**Credits: 4**

**Time: 3 Hrs.**

**Total marks: 100**

**Theory: 70**

**IA: 30**

**Course objective:** This course offers students an understanding to toxicology and aquaculture. It will also provide information about handling of aquatic organisms and impacts of toxicants present in aquatic medium. Students will also learn about advances in aquaculture. The main focus is on research and innovations in the field of Toxicology and Aquaculture.

<b>Course outcomes:</b>	
<b>CO1</b>	To enable the students understands the basics of toxicology and impacts of toxicants on biodiversity. Determination of LD50 along with mode of action of toxicants.
<b>CO2</b>	To understand the identification of fishes, length weight relationship and feed formulation for best growth of fish.
<b>CO3</b>	This core elective paper will generate knowledge about applied genetics and its significance in fish breeding.
<b>CO4</b>	To enable the students with sex determination in fishes, molecular characterization of fish and conservation of endangered species.

**Note for the paper setter:** The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.

**Unit-I**

**Toxicology:** Definition of pesticides, history, types of pesticide and their functions. Toxicology of pesticides on aquatic organisms, Selection criteria of test organism for toxicological studies. Determination of LD50 and LC50, dose-response relationship, processing of tissue for light and electron microscopy. Mode of action on CNS and acetylcholinesterase. Toxicological symptoms of different pesticides. Next generation molecules to be used as safer pesticides for plant protection and their chemistry.

**Unit-II**

**Aquaculture:** Anatomy, morphology and developmental stages of important groups of Inland fishes. Study of Length-weight relationship and age and growth studies of fish using hard parts. Fish Nutrition: Digestion and growth, Intestinal enzymes, feed technology, Protein lipid and carbohydrate nutrition, Vitamin and mineral nutrition, Nutraceuticals and Nutrigenomics. Fish feed formulation, processing and Proximate analysis of fish, feed (determination of moisture, protein, fat, ash carbohydrate, fiber and energy).

### Unit-III

**Fish Reproduction:** Reproduction in Fishes, Induced breeding in fish and shell fish, Fecundity, GSI, HIS. Seed production and hatchery management for fish and shell fish. Applied Genetics in Aquaculture: Chromosome manipulation, Ploidy induction methods - triploidy and tetraploidy, advantages and disadvantages of polyploids, androgenesis and gynogenesis.

### Unit-IV

**Sex determination:** Sex differentiation and sex reversal in fishes, sex control and its role in aquaculture, transgenesis. Molecular characterization of fishes using genetic markers. Conservation genetics: Genetic resources of India and conservation, endangered species, cryopreservation of fish gametes. Fish pond preparation and their management practices.

#### Text/Reference Books:

1. Toxicology and Risk Assessment: A Comprehensive Introduction, Greim H., and Snyder, R. (ed), John Wiley and Sons, UK.
2. The Complete Book of pesticide management, Whitford, F., Wiley Interscience, John Wiley and Sons, UK.
3. Jhingran, V.G., Fish and Fisheries of India, Hindustan Publishing House (India), New Delhi (1991).
4. Aquaculture Production. FAO. Fisheries Circular No.815, No.4, Rev. FAO Rome (1998).
5. Mohan Joseph, M, Aquaculture in Asia, Asian Fisheries Society, Mangalore (1990).
6. Talwar, P.K., & Jhingran, A.G., Inland Fishes of India, Vols. I & II, P.K. Talwar & Jhingran, A.G., Oxford & IBH, New Delhi (1991).
7. Lagler Karl F., Freshwater Fishery Biology, Wm.C. Brown Company Publ., Dubuque, Iowa (1969).
8. Hynes, H.B.N., The Biology of Polluted Waters, Liverpool Univ. Press, Liverpool (1978).
9. Tandon, K.K. & Johal, M.S., Age and growth in Indian Freshwater Fishes, Narendra Publishing House, Delhi (1995). Johal, M.S., Aggarwal, S.C., Fishery Development, Narendra Publishing House, Delhi (1997).
10. Peter B. Moyle & Joseph J. Cedh, Fishes: An Introduction to Ichthyology, Prentice – Hall, Inc. Jersey, U.S.A. (1986).
11. Johal, M.S., and Tandon, K.K., Monograph on the Fishes of reorganized Punjab, Parts I & II. Punjab Fisheries Bulletin (1979, 1980).

#### CO-PO-PSO mapping matrix for PhD/ZOO/1/702– Toxicology and Aquaculture

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	2.5	2.5	2.5	2	3	3	2	2.5	3	2	2	2.5
CO2	2.5	2	2.5	2	3	3	2.5	2.5	3	2	2	2.5
CO3	2.5	2.5	2.5	2	3	3	2.5	2.5	3	2	2	2.5
CO4	2.5	2	2.5	2	3	3	2	2.5	3	2	2	2.5
Avg	2.5	2.25	2.5	2	3	3	2.25	2.5	3	2	2	2.5

**Ph.D. (Zoology)**  
**PhD/ZOO/1/703–Research Methodology**

**Credits: 4**  
**Time: 3 Hrs.**

**Marks: 100**  
**Theory: 70**  
**IA: 30**

**Course Objectives:** To understand the elements of research perspective and methodology in life sciences. To understand the research hypothesis formulation and testing along with research article/papers writing skills development.

<b>Course outcomes:</b>	
<b>CO1</b>	Students should be able to identify research problem, formulation of research hypothesis and writing of scientific document.
<b>CO2</b>	Students should be able to know data collection techniques and statistical analysis of data by various statistical tests.
<b>CO3</b>	Students will be familiar with the application of computer in research and statistical analysis of data.
<b>CO4</b>	Students will be familiar with various funding agencies, drafting of research project and planning and execution of research work ethical.

**Note for the paper setter:** The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.

**Unit – I**

**Research Methodology:** Selecting and defining the research problem, formulation of research hypothesis, Good lab practices.

**Scientific Writing:** Scientific document organization, different steps and precautions of writing a research paper, short communications, review articles, monographs, technical and survey reports, authored books, edited books and thesis, concept of plagiarism, types and consequences, online checking of plagiarism using available softwares.

**Unit – II**

**Statistical Analysis:** Data collection techniques, measures of central tendency and dispersion: Mean, mode, median, range, mean deviation and standard deviation, standard error (SE), Chi-square test, test of significance, analysis of variance (ANOVA), correlation co-efficient, regression co-efficient, concepts of sampling and methods of estimation. Statistical data analysis using MS – Excel, and SPSS, web based analysis tools.



### Unit – III

**Application of computer in statistical analysis.** Practical knowledge of MS office (Word, Excel and Power point), Important statistical tools/software and their uses in research. Preparation of graphs, histograms and charts. Preparation of scientific posters for presentations. Basic knowledge of organizing conferences, symposia, workshop, exhibition etc.

### Unit – IV

#### Research and Development Projects in Zoology

**Funding agencies:** National and international funding agencies for R & D projects (DST, DBT, ICMR, CSIR and UGC). **Drafting of research project:** Background, identification of gap areas in the subject, aim and objectives of the projects, possible outcome of the project, funds requirements and justification(s), significance of research problem (international, national or local level), materials and technique to be employed.

**Plan of Work:** Periodic planning, sequence of steps to be adopted, sorting of lab acquaintance with technique and their limitation. **Execution:** Standardization of research/ survey methods, sequence of experimentation (control, treatment and replicates), reproducibility and precautions.

#### Text/Reference Books:

1. Scientific and Technical Papers, by S.F. Tribcase, M.I.T. Press, Cambridge, London.
2. How to write and publish a scientific paper, by R.A. Day, IST Press, Philadelphia.
3. Sambrook & Russel 2001. Molecular Cloning: a Laboratory Manual. CSH Lab. Press.
4. Manual of Industrial Microbiology and Biotechnology by A. L. Demain and N. A. Solomon, American Society for Microbiology Press, USA.
5. Council of Biology Editors –1972. CRE Style Manual. 3rd Ed., Americal Institute of Biological Sciences, Washington D.C.
6. Effective writing for engineers, managers, scientists, by A.J. Tichy, Wiley, New York.
7. Ausubel FM, Brent R, Kingston RE, Moore DD, Seidman JG, Smith JA & Struhl K. 2002. Short Protocols in Molecular Biology. John Wiley.

#### CO-PO-PSO mapping matrix for PhD/ZOO/1/703–Research Methodology

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	2.5	2	1.5	1.5	1	2	2.5	2	2	1.5	3	2
CO2	2	2	1.5	1.5	1	2	2	2	1.5	1.5	2.5	2
CO3	2	2	1.5	1.5	1	2	2	2	2	1.5	3	2
CO4	2.5	3	1.5	1.5	1	2	2.5	2	1.5	1.5	3	2
Avg	2.25	2.25	1.5	1.5	1	2	2.25	2	1.75	1.5	2.87	2



**Ph.D. (Zoology)**  
**PhD/ZOO/1/704-Research and Publication Ethics**

**Credits: 2**  
**Time: 3 Hrs.**

**Marks: 50**  
**Theory: 30**  
**IA: 20**

**Course Objectives:** This course offers students an understanding of philosophy of ethics and scientific conduct of research. Students will also learn about publication ethics. Guide and mentor students in developing, completing, writing, and presenting a valid and ethical research report. To know about the University Grants Commission (UGC) has launched a Consortium of Academic and Research Ethics (CARE) to “identify, continuously monitor and maintain” UGC-CARE Reference List of Quality Journals across disciplines.

<b>Course outcomes:</b>	
<b>CO1</b>	Students will be familiar with the fundamental knowledge of basics of philosophy of science and ethics, research integrity, publication ethics and how to avoid plagiarism.
<b>CO2</b>	Students should know the scientific misconducts. Understand the importance of SCI impact factor, SNIP, SJR, IPP, h-index, g index, i10 index. Understand the major and authentic databases of reputed journals like Web of Science, Scopus, PubMed, ICI

**Note for the paper setter:** The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition, eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.

**UNIT-I**

**Introduction to philosophy:** definition, nature and scope, concept, branches, Ethics: definition, moral philosophy, nature of moral judgements and reactions, Ethics with respect to science and research, Intellectual honesty and research integrity, Scientific misconduct: Falsification, Fabrication, and Plagiarism (FFP), Redundant publication: duplicate and overlapping publications, salami slicing, Selective reporting and misrepresentation of data

**UNIT-II**

Publication ethics: definition, introduction and importance, Best practices standards setting initiatives and guidelines: COPE, WAME, etc., Conflicts of interest, Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types, Violation of publication ethics, authorship and contributorship, Identification of publication misconduct, complaints and appeals, Predatory publishers and journals, Open access publications and initiatives, SHERPA/ROMEIO online resource to check publisher copyright & self-archiving policies.



### UNIT-III

Software tool to identify predatory publications developed by SPPU, Journal finder/ Journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Suggester, etc., Subject specific ethical issues, FFP, authorship, Conflicts of interest, Complaints and appeals: examples and fraud from India and abroad, Use of plagiarism software like Turnitin, Urkund and other open source software tools

### UNIT-IV

Indexing databases; Citation databases: Web of Science, Scopus, Pubmed, ICI etc., Impact Factor of journal as per Journal Citation Reports. SNIP, SJR, IPP: Cite Score, Metrics: h-index, g index, i10 index, altmetrics.

#### Text/Reference Books:

1. Bird, A. (2006). Philosophy of Science. Routledge.
2. MacIntyre, Alasdair (1967) A Short History of Ethics. London.
3. P. Chaddah, (2018) Ethics in Competitive Research: Do not get scooped; do not get plagiarized, ISBN:978-9387480865
4. National Academy of Sciences, National Academy of Engineering and Institute of Medicine. (2009). On Being Scientist: A Guide to Responsible Conduct in Research: Third Edition. National Academies Press.
5. Resnik, D. B. (2011). What is ethics in research & why is it Important. National Institute of Environmental Health Sciences, 1-10. Retrieved from
6. <https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfm> Beall, J. (2012). Predatory publishers are corrupting open access. Nature, 489(7415), 179-179. <https://doi.org/10.1038/489179a>
7. Indian National Science Academy (INSA), Ethics in Science Education, Research and Governance (2019). ISBN:978-81-939482-1-7. <http://www.insaindia.res.in/pdf/Ethics Book.pdf>

#### CO-PO-PSO mapping matrix for PhD/ZOO/1/704– Research and Publication Ethics

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	1.5	2	1.5	1.5	2	2.5	2.5	1.5	2	1.5	2	2
CO2	1.5	2	1.5	1.5	2	2	2.5	1.5	2	1.5	2	2.5
Avg	1.5	2	1.5	1.5	2	2.25	2.5	1.5	2	1.5	2	2.25