Scheme of Course Work of Ph.D. Programme in Zoology

(w.e.f. session 2020-21)

Paper No.	Paper Name	Max. Marks	Credits	Examination Time
Zoo-PhD-1 (Core)	**Research Methodology**	**100**	**4**	**3 hrs.**
Zoo-PhD-II (Elective) Any one option	**(i) Reproductive Physiology** **(ii) Animal Behaviour and Wildlife Conservation** **(iii) Fish and Fisheries** **(iv) Cell Biology**	**100**	**4**	**3 hrs.**
Zoo-PhD-III	**(a) Research and publication Ethics**	**50**	**2**	**3 hrs**
	(b) Seminar in thrust area + Literature review Assignment	**50 (25+25)**	**2 (1+1)**	**-**

COURSE WORK FOR PH.D. PROGRAMME IN ZOOLOGY

Paper: Zoo-PhD-I

Paper Name: Research Methodology (Core)

Total marks: 100

Time: 3 Hrs

Note: Nine questions will be set in all. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory.

1. **Information collection and retrieval:** Review of published work in related field from printed/electronic resources. Keeping own record/reference cards etc. retrieval of research manuscript. Writing of Review of Literature and bibliography. Different methods of writing references.
2. **Drafting of research project:** Background, information, significance of research problem (international, national or local level), materials and technique to be employed, expected duration. Funding agencies (DST, DBT, ICMR, CSIR and UGC).
    a. **Plan of Work:** Periodic planning, sequence of steps to be adopted, sorting of lab acquaintance with technique and their limitation.
    b. **Execution:** Standardization of research/ survey methods, sequence of experimentation (control, treatment and replicates), reproducibility and precautions.
3. **Writing of research manuscript:** Technique of preparation of research manuscript, introduction, Review of Literature, Materials and Methods, Results, Discussion, Conclusion, Summary, Bibliography, Appendices, Figures, Tables, Plates (ideal materials for photography and their use, magnification etc.), legends, format of typing proof reading (editing). Online submission of Research manuscript; online checking of similarity/plagiarism using available softwares.
4. **Data recording, processing and elementary biostatistics:** Date collection techniques, Honesty, accuracy and precision in recording observations and results, mean, mode, median, standard deviation (SD), standard error (SE), Parametric and Non-parametric statistic test, Chi-square test, test of significance, analysis of variance, correlation co-efficient, regression co-efficient, concepts of sampling and methods of estimation.
5. **Application of computer in statistical analysis**. Practical knowledge of MS office (Word, Excel and Power point), Important statistical tools/softwares 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.
6. **Microscopy:** Principle and application of Light, Stereo, Phase contrast, Interference, polarization, fluorescence and electron microscopy.
7. **Molecular techniques in biology:** Immunohistochemistry, Electrophoresis, Centrifugation techniques, PCR, and blotting techniques, DNA barcoding, Flow cytometry, DNA damage assay.

Paper: Z00-PhD-II (i)

Paper Name: Reproductive Physiology (Elective)

Total marks: 100

Time: 3 Hrs

Note: Nine questions will be set in all. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory.

1. *In-vitro* culturing of cells and tissues: Basic requirements, Culturing medias, types, procedures and precautions. Short term and long term cell culture.
2. Physiology, biochemistry and molecular biology of follicular growth.
3. Reactive oxygen species and ovarian function: Reactive oxygen species; ROS in the follicle and oocyte; ROS in corpus luteum.
4. Mitochondria and Ageing Ovary: mitochondrial DNA; mitochondria and oogenesis; mitochondria and reproductive ageing.
5. Testicular Physiology: Morphology, Differentiation, function and regulation.
6. Morphometric, biochemical and viability assay in semen.
7. Molecular biology of apoptosis in testicular and ovarian tissue.
8. Oocyte maturation: Nuclear maturation, meiotic competence, cytoplasmic maturation, coordination of nuclear and cytoplasmic maturation, *in-vitro* fertilization and transgenesis.
9. Follicular atresia; causes, regulation and significance
10. Cloning techniques and applications; Stem cells, stem cell markers, techniques and Applications.

Paper: Zoo-PhD-II (ii)
Paper Name: Animal Behaviour and Wildlife Conservation (Elective)
Total marks: 100
Time: 3 Hrs

Note: Nine questions will be set in all. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory.

1. Wildlife: Concept, significance and Bio-geographical/wildlife zones of India.
2. Protected Area Systems: Concept, categories, management and present scenario. IUCN categories of Endangered Wildlife Species and their criteria, Red data book.
3. Study of signs and symptoms in field observations. Bio-telemetry, Ageing and Sexing techniques in animals. Sexual Dimorphism and migratory behavior in birds. Age class criteria of herbivores species. Identification of Birds and Mammals.
4. Social behavior in animals: Aggregations and society; Advantages of group living; Types of social organization in animals; Group selection, kin selection, altruism, reciprocal altruism; Territoriality and parental care; and Habitat selection.
5. Planning a wildlife census, methods of wildlife census: sample count, block count, roadside counts, pugmark census, water-hole census.
6. Pugmark analysis of small and large sized mammals (glass sheet method, POP method).
7. Measure of biodiversity: Diversity indices, Methods of estimation of population density, CMR method of determination of population density of rodents and birds.
8. Statistical software used in ecological studies, PAST and FLOCKER software uses. Theory and practice of Digital camera, DSLR camera and Binocular use. Estimation of Longitudes, latitudes and Altitudes.
9. Methods to avoid human wildlife conflict: electric, fencing, trench design, line trapping, mist netting, pocket netting, chemical capture (e.g. ungulates, elephants, rhinoceros, and large carnivores.
10. National Projects: Project Tiger, Project elephant, Project Rhinoceros, Project Crocodiles, Project Hangul, Manipur Brow Antlered Deer.

Paper: Zoo-PhD-II (iii)
Paper Name: Fish and fisheries (Elective)
Total marks: 100
Time: 3 Hrs

Note: Nine questions will be set in all. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory.

1. Anatomy, morphology and developmental stages of important groups of Inland fishes.
2. Study of Length-weight relationship and age and growth studies of fish using hard parts.
3. Toxicology: determination of LC_{50}, processing of tissue for light and electron microscopy.
4. Fish Nutrition: Digestion and growth, Intestinal enzymes, feed technology, Protein lipid and carbohydrate nutrition, Vitamin and mineral nutrition, Nutraceuticals and Nutrigenomics
5. Fish feed formulation, processing and Proximate analysis of fish, feed (determination of moisture, protein, fat, ash carbohydrate, fiber and energy).
6. Fish Reproduction: Reproduction in Fishes, Induced breeding in fiah and shell fish, Fecundity, GSI, HSI
7. Seed production and hatchery management for fish and shell fish
8. Applied Genetics In Aquaculture: Chromosome manipulation, Ploidy induction methods - triplody and tetraploidy, advantages and disadvantages of polyploids, androgenesis and gynogenesis., Sex determination: Sex differentiation and sex reversal in fishes, sex control and its role in aquaculture., transgenesis .
9. Molecular characterization of fishes using genetic markers
10. Conservation genetics: Genetic resources of India and conservation, endangered species, cryopreservation of fish gametes.
11. Fish pond preparation and their management practices

Paper: Zoo-PhD-II (iv)
Paper Name: Cell Biology (Elective)
Total marks: 100
Time: 3 Hrs

Note: Nine questions will be set in all. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory.

1. Cell Culture - Introduction, lab safety, aseptic techniques, contamination types,
2. Use of antibiotics, Cell lines, culture environment, animal cell morphology, culture and sub-culture of adherent and suspension cells, Troubleshooting
3. Introduction to 5-major proteolytic systems (Calpain, Cathepsin, Ubiquitin-proteasome, Caspases, autophagy)
4. Introductory Overview of the DNA Bar-coding Concept, Specimen collection, DNA extraction, preparations of sample for sequencing
5. Tools: PAGE, SDS-PAGE, Western blot, Zymography, PCR, real time PCR, Enzymatic assays, Immunocytochemistry
6. DNA isolation by organic and salting method.
7. Molecular markers and their applications.
8. Cell cycle and its regulation
9. Cancer biology
10. Microarrays and applications

Paper: Zoo-PhD-III (a)
Paper Name: Research and Publication Ethics (RPE)
Total marks: 50
Time: 3 Hrs

Note: Nine questions will be set in all. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory.

Syllabus in detail

THEORY

1: PHILOSOPHY AND ETHICS

i. Introduction to philosophy: definition, nature and scope, concept, branches
ii. Ethics: definition, moral philosophy, nature of moral judgements and reactions

2: SCIENTIFICCONDUCT

i. Ethics with respect to science and research
ii. Intellectual honesty and research integrity
iii. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP)
iv. Redundant publications: duplicate and overlapping publications, salami slicing
v. Selective reporting and misrepresentation of data

3: PUBLICATION ETHICS

i. Publication ethics: definition, introduction and importance
ii. Best practices / standards setting initiatives and guidelines: COPE, WAME, etc.
iii. Conflicts of interest
iv. Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types
v. Violation of publication ethics, authorship and contributorship
vi. Identification of publication misconduct, complaints and appeals
vii. Predatory publishers and journals

PRACTICE

4: OPEN ACCESS PUBLISHING

i. Open access publications and initiatives
ii. SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies
iii. Software tool to identify predatory publications developed by SPPU
iv. Journal finder / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.

5: PUBLICATION MISCONDUCT

i. Subject specific ethical issues, FFP, authorship
ii. Conflicts of interest
iii. Complaints and appeals: examples and fraud from India and abroad

iv. **Software tools :**Use of plagiarism software like Tumitin, Urkund and other open source software tools

6: DATABASES AND RESEARCH METRICS

6.1 Databases

i. Indexing databases
ii. Citation databases: Web of Science, Scopus, etc.

6.2 Research Metrics

i. Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score
ii. Metrics: h-index, g index, i10 index, altmetrics

References

Bird, A. (2006). *Philosophy **ofscience.*** Routledge.

MacIntyre, Alasdair (1967) *A Short History ofEthics.* London.

P. Chaddah, (2018) Ethics in Competitive Research: Do not get scooped; do not get plagiarized, ISBN:978- 9387480865

National Academy of Sciences, National Academy of Engineering and Institute of Medicine. (2009). On *Being*
a Scientist.' A Guide to Responsible Conduct in Research: Third EditfOn. National Academies Press.

Resnik, D. B. (2011). What is ethics in research & why is it important. *National Institute ofEnvironmental Health Sciences,* 1-10. Retrieved from httos://www.nieiys.nih. ov/research/resources/bioethics/whatis/index.cfm Beall, J. (2012). Predatory publishers are comipting open access. Nature, 489(7415), 179—179. https://doi.org/10.1038/489179a

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

Paper: Zoo-PhD-III (b)
Paper Name: Review Writing and seminar
Total marks: 25+25