

COURSES OF STUDIES
FOR
M.Phil. EXAMINATION
(With effective from 2019-2020)

ZOOLOGY
(Semester System)



DEPARTMENT OF ZOOLOGY
North Orissa University
Sriram Chandra Vihar
Takatpur, Baripada-757003

Semester-I

Course Code & Paper Code	Paper Name	Credit	Marks
ZO-601	Research Methodology-I	5	50
ZO-603	General Theory	5	50
ZO-605	Practical	10	100
	Total	20	200

Semester-II

Course Code & Paper Code	Paper Name	Credit	Marks
ZO-602	ZO-602 (Elective- Paper-I)	5	50
ZO-604	ZO-602 (Elective- Paper-II)	5	50
ZO-606	Dissertation	10	100
	Total	20	200

Programme Objectives

Preparing students to carry out their higher research programs like Ph. D programme.

Endowing the students with adequate knowledge to understand and appreciate the principles of research methodology, data presentation and its analysis both manually and with the aid of software.

To provide scope to understand the modern tools and techniques those can be applied for various experiments needed for achieving the objectives of the problem taken for research work in various field of Zoology.

Enable the students to collect and interpret the theories and principles written in the collected literatures related to research work.

Motivating and mentoring students to develop their writing skills to develop project proposals, write dissertation and thesis, report, research and review papers writing.

Programme Outcomes

Recognize and think critically towards the science curricula with sound knowledge and theoretical skills by questioning and plausible explanations.

Motivate themselves and develop an interest in planning and implementation of research

Handle equipments needed for material preparation, characterization and to analyze and interpret the data with theoretical background and software.

Practice the teaching-learning process by being the proponent in classroom and laboratory experience

Apply the scientific context to develop innovative ideas, products and methods for the benefits of biosphere

Adopt changes in the environment with high integrity and transpire ethical professionals

Recognize and integrate life-long learning skills to become pro-active in personal and professional live

DETAILED SYLLABUS SEMESTER-I

Paper: ZO-601 (Research Methodology - I)

50 Marks

Course Objective: To get a comprehensive knowledge on different methods used for carrying out research work in Animal Sciences

UNIT-I

- ❖ Principle and application of Chromatography. Electrophoresis. Spectrophotometry and Atomic Absorption Spectrophotometry, Blotting techniques and PCR.
- ❖ Sequencing of gene or DNA segment (Maxam and Gilbert's chemical depreation method. Sanger's dideoxy method and automatic sequencers).
- ❖ Histology and Histochemistry

UNIT-II

- ❖ Morphometry of animals.
- ❖ Wildlife census of birds, Lion, Elephant and crocodiles.
- ❖ Wildlife forensics: Scat analysis techniques for lion and tiger.

UNIT-III

- ❖ Nucleic acid sequence databases-Gene Bank/EMBL/DDBJ.
- ❖ Protein sequence databases-NBRF-PIR, PDB, Swissprot.
- ❖ The internet and its resources, World Wide Web associated tools.
- ❖ An overview of computer viruses.

UNIT-IV

- ❖ Computer applications (SPSS).
- ❖ Correlation and Regression analyses. Gt.
- ❖ Testing of hypothesis (Z, chi square, T and F- tests).
- ❖ ANOVA (one-way,two-way and multi-way).
- ❖ Sampling and experimental design.
- ❖ Principal component analysis.

UNIT-V

- ❖ Writing of Scientific paper, Review paper and Report writing.
- ❖ Developing a research project.
- ❖ Thesis and Dissertation writing.
- ❖ Publication Ethics, Violation of publication ethics
- ❖ Avoiding Plagiarism, Preparing documents for MoUs

Course Outcomes

1. Independently work in a research environment, consolidate the outcome of research and write technical papers.
2. Formulate a hypothesis and conduct research using appropriate tools and techniques.
3. Gain knowledge on the different bio-techniques and bio-instruments that can be used for the research.
4. Develop computational skills and apply statistical tools in their research.
5. Propose a research study, design an experiment and apply appropriate methodologies.
6. Carry out advanced research in specialized areas and transmit their knowledge to the society.

Recommended books:

1. Biophysics by M.P. Arora, Himalaya Publishing House, Mumbai
2. Environmental Analysis: Water, Soil and Air by M.M. Saxena, Agro Botanical Publication (India), Bikaner.
3. Laboratory Experiments in microbiology by M.G. Reddy et al., Himalaya Publ., House, Mumbai.

4. An introduction to Practical Biochemistry by D.T. Plummer, Tata McGraw Hill Publ. Co. New Delhi.
5. Statistical Methods in Biology by N.T.J. Bailey, Cambridge University Press; Cambridge.
6. Basic Biostatistics by G.B.N. Chainy et al., Kalyani Publishers, Cuttack.
7. How to write & publish a Scientific Paper by R.A. Day Cambridge University Press, Cambridge.
8. Molecular Cell Biology by H. Lodish. Et al., W.H. Freeman and Company, New York.

Paper: ZO-603 (General Theory)

50 Marks

Course Objective: To have an inclusive idea on molecular evolution, proteomics and genomics.

UNIT-I

- ❖ Biodiversity conservation.
- ❖ Biodiversity Hot spots of the World and India.
- ❖ Biological Rhythms (Circannual).
- ❖ Productivity concept in ecosystems and ecological energetics.

UNIT-II

- ❖ Molecular evolution: concept of neutral evolution, Molecular divergence and molecular clocks.
- ❖ Molecular tools in phylogeny, Classification and identification protein and nucleotide sequence analyses.
- ❖ Origin of new genes and proteins, Gene duplication and divergence.
- ❖ Gene splicing, RNA interference.

UNIT-III

- ❖ Organisation of Human Genome: Size and banding of Human Chromosomes. Distribution of tandems and interspersed repetitive DNA, Gene distribution and density in human nuclear genome, overlapping genes, genes within genes, Gene families, pseudo genes, translated genes and gene fragments.
- ❖ Recombinant DNA technology.
- ❖ Polygenic inheritance, heritability and its measurements, QTL mapping.

UNIT-IV

- ❖ Genomics and its application to health and agriculture, including gene therapy.
- ❖ Proteomics: Expression analysis and characterisation of proteins, Analysis of protein structure, Protein interaction.
- ❖ Molecular markers in Genome analyses: RFLP, RAPD, Mapping by using somatic cell by hybrids.

UNIT-V

- ❖ Control of Gene Expression: DNA-binding motifs in gene regulatory proteins, working of genetic switches, Molecular genetic mechanisms that create specialised cell types, Post-transcriptional controls.
- ❖ Homologous DNA recombination: Holliday junction, Meselson-Radding model and Double-strand break model
- ❖ Axes and pattern formation in Drosophila, amphibia and chick; organogenesis —vulva formation in Caenorhabditis elegans, eye lens induction, limb development and regeneration in vertebrates; differentiation of neurons, post embryonic development-larval formation, metamorphosis; environmental regulation of normal development; sex determination.

Course Outcomes

1. Gain knowledge on diversity of life on earth and assess biodiversity

2. Gain knowledge on gene and genome analysis, tissue engineering, transgenic biology and stem cell technology

Recommended books:

1. Biodiversity by E.O. Wilson, Academic Press, New York.
2. Concepts of Wildlife Management by B.B. Hosentti, Daya Publishing House, New Delhi.
3. Fundamentals of Ecology by M.C. Dash, Tata McGraw Hill, New Delhi.
4. Cell signalling by C.B. Power, Himalaya Publishing House, Mumbai.

Paper: ZO-605 (Practical)

100 Marks

Course Objective: To have a practical approach in the study of different biomolecules, instruments required for study of biomolecules, their working principles and application. A hand - on training on collection and preservation of animal for museum.

Related to theory papers ZO-601 and ZO-603

1. Spectrophotometric estimation of Protein, DNA and RNA of different samples.
2. Extraction and purification of protein by column chromatography.
3. Estimation of total free amino acids of different samples of animal origin.
4. Demonstration of antigen and antibody interaction.
5. Estimation of Vitamin-C from different samples.
6. Tools and techniques of Census.
7. Morphometric study of biological specimens.
8. Census techniques.
9. Taxidermy.
10. Instrumentation.
11. Analyses of nucleic acid and protein sequence databases using computer.
12. Problems related to statistical tests.
13. Restriction Mapping
14. Agarose Gel Electrophoresis
15. PAGE Gel Electrophoresis
16. Report Writing / Project Proposal Writing
16. Seminar Presentation.

Course Outcome:

1. To understand the methods of collection, identification and preservation of biological specimen.
2. To understand the technique of animal classification and evolution of chordates through specimen study.

3. Practical knowledge of performing molecular techniques to study DNA and protein like gel electrophoresis, chromatography, plasmid isolation and histology.

Recommended Books

1. Laboratory manual developed by the department
2. Molecular Cloning: A Laboratory Manual, by J. Sambrook, E.F. Fritsch and T. Maniatis.
3. Molecular Biology and Biotechnology: A Comprehensive Desk Reference, Ed. R.A.Meyers, VCH Publishers, Inc. New York.
4. Advance Practical Zoology, J. Sinha, A. K. Chaterjee , P. Chattopadhyay
5. Practical Physiology Geetha N.

SEMESTER-II

Elective: (Student shall have to opt for one of the electives)

- A- Herpetology
- B- Physiology, Biochemistry and animal Biotechnology
- C- Wildlife Biology

Paper: ZO-602 (Elective- Paper-I)

ZO-602 (A) Herpetology

50 Marks

Course Objective: To gain knowledge on classification, evolution, physiology, ecology and reproduction biology of Amphibia and Reptilia

UNIT-I Evolutionary History and Phylogeny

- ❖ Tetrapod relationships and evolutionary systematics.
- ❖ Anatomy of amphibians and reptiles in general.
- ❖ Evolution of amphibians and reptiles.
- ❖ Molecular and genomic evolution of amphibians.

UNIT-II Systematics and Taxonomy

- ❖ Classification of amphibians: Caecilians, Salamanders and Frogs.
- ❖ Classification of reptiles: Turtles, Crocodylians, Tuataras. Lizards and Snakes.

Unit-III Diversity of Amphibians and Reptiles

- ❖ Caecilians, Salamanders and Frogs.
- ❖ Turtles, Snakes, Lizards and Crocodyles.

UNIT-IV Behavioural and Physiological Ecology (Amphibia and Reptilia)

- ❖ Spacing, Movements and Orientation.
- ❖ Communication and Social behaviour.
- ❖ Foraging ecology and Diets.
- ❖ Defence and Escape.
- ❖ Thermoregulations.

UNIT-V Reproductive and Life Histories in General (Amphibia and Reptilia)

- ❖ Modes of reproduction.
- ❖ Parental care.
- ❖ Reproductive ecology and life histories.
- ❖ Energetics of reproduction.

Course Outcomes

1. Gain knowledge on the evolutionary history and phylogenetic studies of amphibia and reptiles
2. Gain knowledge for identifying and classifying a new species of amphibian and Reptilia
3. Acquire proficiency on the amphibian and reptilian diversity, physiological ecology and reproductive biology.

Recommended books:

1. Herpetology 3rd edition, Pearson Prentice Hall by Pough F. H., Andrews, R. M. Cadle J. E., Crimp, M. L., Savitsky, A. H. Wels K. D. 2004.
2. I herpetology, Introduction Biology of Amphibia and Reptiles by George R. Zung, LaurieJ. Vitt. Janalee P. Caldwell Academic Press, New York.
3. Biology of Amphibians by Duellman and Trueb, McGraw. Hill Book Co. New York
4. A Pocket Book on Indian reptiles: Crocodiles, Testudines, lizards and Snakes'. S. N. Murthy, nature Books India.
5. Amphibians and Reptiles of North East India: A photographic Guide: M. Firoz Ahmed, Abhijit 1) as and S. K. Dutta, Aranyak.

ZO-602 (B) Physiology, Biochemistry and Animal Biotechnology 50 Marks

Course Objective: To gain knowledge on Animal Physiology and biochemistry along with the study of genomics, transcriptomics and proteomics.

UNIT-I

- ❖ Protein localization: Synthesis of secretory and membrane proteins.
- ❖ Import of proteins into nucleus, mitochondria, chloroplast and peroxisomes, Receptor mediated endocytosis.

UNIT-II

- ❖ Extraction, purification and assay of enzymes.
- ❖ Immobilization of enzymes and its application.

UNIT-III

- ❖ Antisense and ribozyme technology and its applications: Molecular mechanism of antisense molecules, inhibition of splicing, polyadenylation, and translation, disruption of RNA structure and capping.
- ❖ Biochemistry of ribozyme. hammer head, hair pin and other ribozyme structures.

UNIT-IV

- ❖ Genome sequencing: Genome sizes, organelle genomes, genomic libraries, YAC and BAC libraries.
- ❖ Strategies for sequencing genome, packing, transfection and recovery of clones.
- ❖ Application of sequence information for identification of defective genes.

UNIT-V

- ❖ Free radicals, Reactive oxygen species (ROS) and Oxidative stress.
- ❖ Dietary antioxidants.
- ❖ Antioxidant defence system.

Course Outcomes

1. Gain knowledge on Protein synthesis, targeting, localization, purification, characterization and their downstream processing
2. Learn the ways of gene silencing through different methods for different purposes.
3. Describe the significance of gene and genome sequencing and construction of cDNA and genomic libraries with their significance.
4. Gain knowledge on stress physiology and role of antioxidants in stress management.

Recommended books:

1. General Enzymology by N.S. Kulkarni and M. S. Deshpande. Himalaya Publ. House, Mumbai.
2. Genomes-2 by T. A. Brown.
3. The Cell: A Molecular Approach by G.M. Cooper & R. E. Hausman. ASM Press. Washington D.C.
4. Molecular Biology of Cell by B. Albert et al. Garland Sc. Taylor and Francis Group. New York.
5. Text Book of Biochemistry with Clinical Correlation by T.M. Devlin, Wiley-Liss. New York.
6. Fundamentals of Biochemistry by J. L. Jain et al., S. Chand & Co. Ltd., New Delhi.
7. Biochemical Calculations by J. H. Segel, John Wiley and Sons, New Delhi.
8. Molecular Cell Biology by H. Lodish et al., W. H. Freeman & Company, New York.
9. Principles of gene Manipulation: An Introduction to Genetic Engineering, by R. W. Old and s. K. Primrose.
10. Oxidants and Antioxidants Ultrastructure and Molecular biology Protocols by Armstrong Donaly, Humana Press.

Course Objective: To learn about the different aspects of wildlife along with the conservation strategies both at national and international level.

UNIT-I

- ❖ International and national organisations in wildlife conservation: Government Organisations (CITES), Global Tiger Forum (GTF). Non-Government Organisations: Worldwide Fund for Nature (WWF), Bombay Natural History Society (BNHS), Wildlife Preservation Society of India (WPSI), Indian Board for Wildlife (IBWL). International Union for Conservation of Nature and Natural Resources (IUCN), Conservation Breeding Specialist Group (CBSG), Species Survival Commission (SSC), Population and Habitat Viability Assessment (THVA), Conservation Assessment and Management Plan (CAMP).

UNIT-II

- ❖ Biological basis of wildlife management: Density (Absolute, subsistence, optimum, security, tolerance). Saturation point. Migration. Dispersion (Emigration, immigration), Natality Fertility and Fecundity. Gregariousness and Shootable Surplus, Mortality, and Decimating factors (Wildlife diseases, adverse climate, accidents, poisoning, human interference, illegal hunting, stress, starvation, movement).

UNIT-III

- ❖ Environmental impact assessment (EIA): Aim, types, organisations responsible, contents, prediction of changes and impacts (on air, water, soil, noise, biological, cultural and socioeconomic environment), EIA in India, Components of EIA (Purpose, screening and IEE, scoping, preparation of terms of reference, EIA report, assessment of methodologies, review, impact, evaluation (audit), overall assessment).

UNIT-IV

- ❖ Biodiversity hotspots of the world.

UNIT-V

- ❖ Wildlife health monitoring procedures: Monitoring condition evaluation (Body condition evaluation of ungulates and elephant), Monitoring infection and disease (Observational methods and laboratory-based methods).
- ❖ Post-mortem procedures, collection background information (opening the carcass examination for abnormalities)

Course Outcomes

1. Gain an appreciation for the modern scope of scientific inquiry in the field of wildlife conservation management.
2. Develop an ability to analyze, present and interpret wildlife conservation management information.
3. Learn to solve the wildlife problems that drive for the depletion of wildlife.
4. Evaluate human influenced driver of our climate system and its applications.
5. Gain knowledge on biodiversity hotspots and their conservation
6. Gain knowledge on Wildlife health monitoring procedures

Recommended books:

1. Fundamentals of Wildlife Management by Rajesh Gopal, Justice House, Allahabad.
2. Wildlife Ecology and Management by W. L. Robinson & E. G. Bolen, McMillan Publication Company.
3. Wildlife Diseases in India by B. M. Arora, Periodical Expert Book Agency, New Delhi.
4. Procedures for Monitoring Wildlife Health and Investigating Diseases: A field Guide by N. V. K. Ashraf, Wildlife Institute of India, Dehradun.
5. Text Book of Wildlife Management by S.-K. Singh, IBD Distributing Company Lucknow.

Course Objective: To learn about the Developmental Biology of Herpetofauna

UNIT-I Morphology Morphometry of Herpetofauna

- ❖ Herpetofaunal sampling techniques.
- ❖ Morphology and morphometrics of frogs and their usefulness in anuran taxonomy, Amphibian population monitoring protocol.
- ❖ Bioacoustics signals.

UNIT-II Amphibian Larvae and Metamorphosis

- ❖ Larval types and identification.
- ❖ Laval physiology and ecology.
- ❖ Social behaviour.
- ❖ Metamorphosis.
- ❖ Evolutionary significance of larvae.

UNIT-III Egg and Development

- ❖ Structure of spermatozoa.
- ❖ Egg structure and composition (Egg yolk compounds, egg white compounds and egg shell compounds).
- ❖ Fertilisation and egg development.
- ❖ Hatching and Birth.

UNIT-IV Egg Shell Calcium Utilisation Pattern in Reptiles

- ❖ Calcium in egg components.
- ❖ Calcium and lipid metabolism during embryogenesis.
- ❖ Calcium binding, proteins.

UNIT-V Population and Community Ecology

- ❖ Population structure and growth.
- ❖ Community and geography of populations.
- ❖ Conservation biology.

Course Outcomes

1. Gain knowledge on Herpetofauna and Amphibian as well as Reptilian Ecology
2. Gain knowledge on Amphibia and Reptilian Reproduction Biology

Recommended books:

1. Herpetology, Introduction Biology of Amphibia and Reptiles by George R. Zung, LaurieJ. Vitt, Janalee P. Caldwell Academic Press, New York.
2. Herpetology 3rd edition, Pearson Prentice Hall by Pough F. H., Andrews, R. M. Cadle J. E., Crimp, M. L., Savitsky, A. H. Wels K. D. 2004.
3. Biology of Amphibians by Duellman and Trueb, McGraw. Hill Book Co. New York
4. A Pocket Book on Indian reptiles: Crocodiles, Testudines, lizards and Snakes: T. S. N. Murthy, nature Books India.
5. Egg and its Components.

Course Objectives: To gain knowledge on Animal Physiology and Biotechnology

UNIT-I

- ❖ Endogenous opiates (enkephalins, endorphins and dynorphins) and neuropeptides.
- ❖ Growth factors (nerve growth factors, epidermal growth factors and somatomedins).
- ❖ Assisted reproductive technology (IVF, ET, GIFT, TET and negative aspects of assisted reproductive technologies).

UNIT-II

- ❖ Origin of endocrine cells.
- ❖ Renin-angiotensin system.
- ❖ Influence of exteroceptive factors on mammalian reproduction: Light, temperature and olfaction (reproductive pheromones).

UNIT-III

- ❖ Neuroendocrine mechanisms in invertebrates with special reference to crustaceans and insects.
- ❖ Histone Proteins

UNIT-IV

- ❖ Vermitechnology.
- ❖ Cell communication and cell signalling pathway.

UNIT-V

- ❖ Stress biology with special reference to animals.
- ❖ Molecular basis of colour vision and Bioluminescence.

Course Outcomes

1. To get a thorough knowledge on cell physiology and endocrinology
2. To get knowledge on stress physiology and bioluminescence

Recommended books:

1. The cell: A Molecular Approach by G.M. cooper & R. E. Hausman, ASM Press, Washington D.C.
2. Molecular Biology of Cell by B. Albert et al, Garland Sc, Taylor and Francis Group, New York
3. Text Book of Biochemistry with Clinical (or clinical) I. M. Devlin. Wiley-Liss, New York.
4. Cell signalling by C.B. power. Himalaya Publishing House, Mumbai.
5. Endocrinology by M. E. Hadley, Pearson Education (Sirwapore): Delhi.
6. Mammalian endocrinology by B. N. Yadav, Vishal Yadav, Vishal Publication, Jalandhar.
7. General Endocrinology by Bagnara and Turner, W. B. Saunders

Course Objective: To get a clear idea on the classification and management of wildlife sanctuaries, national parks, biosphere reserves etc and to learn about wildlife forensics

UNIT-I

- ❖ Wildlife Sanctuaries, National Parks and Biosphere Reserves of India: In-situ and ex-situ conservation.
- ❖ Wildlife diversity in Orissa with special reference to Similipal Biosphere Reserve. Bhitarkanika National Park and Chilika.

UNIT-II

- ❖ Chemical restraints: Purpose, advantages, disadvantages, Drugs (classes, properties and action. pharmacological and biological considerations. estimation of drug dose and examples), drug delivery (oral. hand-held syringe, dart). Chemical restraints for large and small herbivores and wild carnivores.
- ❖ Post-capture medical care and treatment. Procurement of immobilization equipment and drugs.

UNIT-III

- ❖ Wildlife forensics: Scat analysis techniques for lion and tiger.
- ❖ Hair structure of some herbivores and other mammals.
- ❖ Preservation of specimens.

UNIT-IV

- ❖ Management of National parks and sanctuaries, Management measures (Wildlife habits, protection, biotic interference, forestry operation, use of fire, effect of silvicultural practices on the status of wildlife).
- ❖ National Park: future plan and strategy.

UNIT-V

- ❖ Conservation schemes: Project -Tiger (Initiation. finance, objective, management, status, and threats) Gir lion sanctuary Project (Threats, Management, Work Plan and achievements).
- ❖ Crocodile Breeding Project (Causes of depletion, work plan, and achievements).
- ❖ Project Elephant. Project Hangul.
- ❖ Conservation of Rhinoceros and Sea turtles in India.

Course Outcomes

1. To gain knowledge on different project and schemes for conservation of different endangered and threatened animals
2. To gain knowledge on different techniques related to wildlife forensics

Recommended books:

1. Biodiversity by E. O. Wilson, Academic Press, New York.
2. The Biology of Biodiversity by M. Kato, Springer, Stuttgart.
3. Concepts of Wildlife Management by B. B. Hosetti. Daya Publishing House, New Delhi.
4. Fundamentals of ecology by E. P. Odum. W. B. Saunders.
5. Fundamentals of Ecology by M. C. Dash. Tata McGraw Hill. New.: Delhi.
6. Chemical restraints for Wild Animals by Wild Life institute of India. Dehradun.
7. Procedures for Monitoring Wild Life Health and investigating Diseases: A field Guide by N. V. K. Ashraf Wild Life institute of India. Dehradun.

Course Objective:

Skill development with long term hands - on -training on various biotechniques, microbial, plant and animal tissue techniques along with data analysis software training for application of the research theme chosen for the Dissertation and further research and development in Industries, Institutes and Academics

Course Outcomes

1. To enable students to identify a problem and put relevant questions.
2. To enable students to survey relevant literature for a given problem.
3. To prepare students to design an experiment and execute it.
4. Skill development with long term hands - on -training on various biotechniques, microbial, plant and animal tissue techniques along with data analysis software training for application of the research theme chosen for the Dissertation and further research and development in Industries, Institutes and Academics