Zoology Ph.D. Syllabus

Under New Education Policy (NEP) System

DEPARTMENT OF ZOOLOGY
INDIRA GANDHI NATIONAL TRIBAL UNIVERSITY
(A Central University)
Amarkantak - 484887 (M.P.)
India

Department of Zoology

Indira Gandhi National Tribal University, Amarkantak (MP)

Ph.D. Course Work

Course code	Title of the course	Credits
PZCC- 1101	**Research Methodology**	4
PZCC- 1102	**Computer Applications**	4
PZRP-1103	**Research & Publication Ethics**	2
Discipline Specific Elective-1		
PZDS- 1104	**Instrumentation and Techniques for Research**	4
Discipline Specific Elective-2		
PZRS- 1105	**Toxicology**	2
OR		
PZRS- 1106	**Hormones and Diseases**	2
OR		
PZRS- 1107	**Neurobiology**	2
OR		
PZRS- 1108	**Genetics and Disease Biology**	2
OR		
PZRS- 1109	**Behaviour Ecology of Insects and Biocontrol**	2
PZRS-1110	**Aquatic Pollution**	2
PZRS-1111	**Fish & Fisheries**	**2**
	Total	**16**

Ph.D. ZOOLOGY

COURSE WORK

Title of the Paper	Credits	Contact Hrs./ Week	Maximum Marks	Sessional Marks 40		End Semester Examination Marks	Min. Pass Marks in EndSem. Exam
				10x2 test average	20 (10 assignment+ 10attendances)		
PZCC- 1101, Research Methodology	4	4 hrs.	100	20	20	60	24
PZCC- 1102, Computer Applications	4	4hrs	100	20	20	60	24
PZRP-1103, Research & Publication Ethics	2	2 hrs	50	-	-	50	20
DSE I- PZDS- 1104 Instrumentation andTechniques for Research	4	4 hrs.	100	20	20	60	24
DSE-II- PZRS- 1105- Toxicology	2	2 hrs.	50	-	-	50	20
DSE-II PZRS- 1106- Hormones and Disease	2	2 hrs.	50	-	-	50	20
DSE-II PZRS- 1107 Neurobiology	2	2 hrs.	50	-	-	50	20
DSE-II PZRS- 1108 Genetics and Disease Biology	2	2 hrs.	50	-	-	50	20
DSE-II PZRS- 1109 Behavioural Ecology of Insects and Biocontrol	2	2 hrs.	50	-	-	50	20
DSE-II PZRS- 1110 Aquatic Pollution	2	2 hrs.	50	-	-	50	20
DSE-II-PZRS-1111 Fish & Fisheries	2	2 hrs	50	-	-	50	20
Total	**16**		**400**			**280**	

PZCC-1101

RESEARCH METHODOLOGY

(Credits- 04; Contact hour- 60h; maximum marks – 100)

Unit-I

An overview of research methodology
Research concept, steps involved, identification, selection and formulation of research problem, justification, hypothesis; literature collection- textual and digital resources (internet)

Unit-II

Research design, data collection and interpretation
Research design; sampling techniques, collection and documentation, presentation, analysis and interpretation of data

Unit-III

Scientific writing: Forms of scientific writing- Article, notes, reports, review article, monographs, dissertations, popular science articles, bibliographies,

Unit-IV

Formulation of scientific communication
Outline preparation, drafting title, sub titles, tables, illustrations; Formatting tables- title, body footnotes; figures & graphs- structure, title and legends, Impact factor, citation indices, plagiarism

Unit-V

Elementary Biostatistics: Standard deviation/error; Correlation coefficient, types of correlation, regression equation, biological significance of correlation and regression; Test of significance, chi-square test, analysis of variance.

SUGGESTED READINGS

- Research Methodology - Methods & Techniques, CR Kothri CR (1990), Vishva Prakashan, New Delhi.
- Research Methodology & Statistical Techniques, S Gupta (1999) Deep & Deep Publications, New Delhi.
- Research Methodology for Biological Sciences, N Gurumani (2007), MJP Publishers, Chennai.
- Introduction to Biostatistics, L Forthofer (1995), Academic Press, New York.
- Biostatistical Analysis, JH Zar (2006), Prentice-Hall.
- Research Design: Qualitative, Quantitative & Mixed Method Approaches, John W. Creswell (2009), Sage Publication, USA.
- Experimental Design & Data Analysis for Biologists. PQ Gerry & JK Michael (2002), Cambridge University Press.
- Choosing & Using Statistics: A Biologists Guide, D Calvin (2003), Blackwell Publisher.

PZCC-1102:
COMPUTER APPLICATIONS

(Credits- 04; Contact hour- 60h; maximum marks – 100)

Unit I-Fundamental of Computer:

Characteristics of Computers, Evolution of computers, computer generations, Basic computer organization; System software, Application software, Application packages, I/O devices, computer memory, introduction of operating system and characteristics, Windows, Mac etc.

Unit II Computer Hardware basics and Software Installation:

PC Boot Process and BIOS, Description of Different parts of a Computer, personal computer configuration, performing installation of operation system and other application, Usage of relevant tools and recovery using various tools/ software, Perform cabling, connecting, and configuring of a peer to peer network (Wi-FI/ Broadband), Use of identifying different Desktop Icons. My Computer, My Documents, Changing Desktop Backgrounds, Mouse Pointer, Screen Saver and Notepad, WordPad, MS Paint, Operating System Installations and Procedures/ Booting Procedures, Windows Configurations & Adding Device Drivers.

Unit III-Introduction to Internet, WWW and Web Browsers:

Basic of Computer networks; LAN, WAN; Concept of Internet; Applications of Internet; connecting to internet; What is ISP; Knowing the Internet; Basics of internet connectivity related troubleshooting, World Wide Web; Web Browsing software (s), Search Engines; Understanding URL; Domain name; IP Address; Basics of Electronic mail; Getting an email account; Sending and receiving emails; Accessing sent emails; Using Emails; Document collaboration; Instant Messaging; Netiquettes. Using e-governance website, website for journal access, website for research applications: Shodhganga, ShodhGangotri, Research Gate, SWAYAM, NPTEL, UGC-CARE etc.

Unit IV-ICT Tools for Documentation of Research Work:

Various format of e-research paper, e-book and e-document: .cbr, .cbz, .cb7, .cbt, .cba, .djvu, .doc, .docx, .epub, .fb2, .html, .ibook, .cdr, .inf, .azw, .lit, .prc, .mobi, .exe, .pkg, .pdb, .txt, .pdb, .pdf, .ps, .tr2, .tr3, .oxps, .xps; Various useful Software for image to text, .pdf to .doc/docx, Voice to text/docx, text to image, , .pdf to jpeg/png, .doc/.docx to image and other type of conversation; E-document Conversation Tools Compatible with Multiple Formats, Plagiarism Checker software and its utilization.

Unit V-Research Writing Tools and Software:

General Purpose Software Package: REF-N-WRITE, Microsoft office: Word, Power Point, Excel; Software for Writing Your Dissertation: LaTeX, LyX, Scrivener; Referencing Tools and Reference Management Software: Zotero, Mendeley, Docear etc; Grammar Checkers and Sentence Correction Tools: MS Word Spelling & Grammar checker S/W: Grammarly Desktop Apps and Online Grammar checking sites; Image and Video editing software.

Text Books

1. Grotenhuis, Manfred te, and Matthisjissen, Anneke. Basics SPSS Tutorial. United States, SAGEPublications, 2015.

2. Raubenheimer, Jacques. Mendeley: Crowd-sourced Reference and Citation Management in the Information Era. United Kingdom, True Insight Publishing, 2014.

3. Goel, Anita. Computer Fundamentals. India, Pearson Education, 2010.

4. Maidasani, Dinesh. Learning Computer Fundamentals, MS Office and Internet & Web Tech.. India, Laxmi Publications, 2005.

Reference Books

1. Wishnietsky, Dan H.. Internet Basics: An Educator's Guide to Travelling the Information Highway. United States, Phi Delta Kappa Educational Foundation, 1997.

2. McCormick, Keith, and Salcedo, Jesus. SPSS Statistics for Data Analysis and Visualization. Germany,Wiley, 2017.

PZRP-1103

RESEARCH & PUBLICATION ETHICS

(Credits- 02; contact hours - 30h; maximum marks - 50)

Unit I: Philosophy & Ethics (3h)

Introduction to philosophy: definition, nature and scope, concept, branches.

Ethics: definition, moral philosophy, nature of moral judgements and reactions.

Unit II: Scientific Conduct (5h)

Ethics with respect to science and research; intellectual honesty and research integrity; scientific misconducts – falsification, fabrication and plagiarism (FFP); redundant publications – duplicate and overlapping publications, salami slicing; selective reporting and misrepresentation of data.

Unit III: Publication Ethics (7h)

Publication ethics – definition, introduction and importance, best practices/standard setting initiatives and guidelines – COPE, WAME; conflicts of interest; publication misconduct – definition, concept, problems that led to unethical behavior vice-versa, types; violation of publication ethics -, authorship and contributionship; Identification of publication misconducts, complaints and appeals; predatory publishers and journals.

Practices –

Open Access Publishing (4h)

Open access publications and initiatives; SHERPARoMEO online resource to check publishers copyright & self-archiving policies; software tool to identify predatory publications developed by SPPU; journal finder/journal suggestion tools viz., JANE; Elsevier Journal Finder; Springer Journal Suggester etc.

Publication Misconduct (4h)

Group discussions – subject specific ethical issues, FFp, authorship; conflicts of interest; complaints and appeals - examples from India and abroad (**2h**).

Software tools – use of plagiarism tools like Turnitin, Urkund and other open source software tools (**2h**).

Databases and Research Matrices (7h)

Databases – Indexing databases; citation databases – Web of Science, SCOPUS etc**(4h).**

Research matrices – Impact factors of journals as per Jurnal Citation Reports, SNIP, SJR, IPP, cite score; Matrices – h-index, g-index, i10 index, altmetrics**(3h).**

Suggested Readings:

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 a Scientist: A Guide to Responsible Conduct in Research: Third Edition. National Academics 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 https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfm
6. Beall, J. (2012). Predatory publishers are corrupting open access. Nature, 489(7415), 179-17. https://doi.org/10.1038/489179a
7. Indian National Science Academy (INSA), Ethics in Science Education, Research and Govermance(2019), ISBN:978-81-939482-1-7. http://www.insaindia.res.in/pdf/EthicsBook.pdf

DSE-I PZDS- 1104

INSTRUMENTATION AND TECHNIQUES FOR RESEARCH

(Credits- 04; contact hours - 60h; maximum marks - 100)

Unit-I Microscopic Techniques

Types of microscopes and their biological applications, Bright-field, microscope, numerical aperture, limit of resolution, types of objectives, ocular and stage micrometers, Dark-field, Phase-contrast, Differential interference contrast, Fluorescence, Confocal, Atomic force, Transmission and scanning electron microscopy

Unit- II Cell culture techniques

Introduction to course and lab safety; Cell culture: Introduction to sterile cell culture technique. Counting viable cells and subculture into multi-well plates. Cell counting using hemocytometers.Cell attachment (adhesion) and growth. Cell attachment (adhesion) and growth. Cell staining techniques: Culturing of primary cells, preparation of human chromosome, Application of primary cell culture techniques. Isolation of chromosomal DNA, Preparation of cellular extract, isolation of nuclear extract and cytoplasmic extract

Unit-III Bioinformatics & Biochemical Techniques

Basics of Computer, Introduction and Scope of Bioinformatics, Computer Networking, Archiving and retrieval of information, Search Engines Data Bases, Access to molecular biology data bases, Sequence alignment and phylogenic trees

Centrifugation: Basic principle, Types of rotors, Clinical, high speed and ultracentrifuge

Electrophoresis: Agarose- and polyacrylamide gel, Two-dimensional, Iso-electrofocussing

Spectroscopy: Beer-Lambert's law, molar extinction coefficient and calculation, Spectroscopy, Absorption spectrum, Colorimeter and UV-Vis, Spectrophotometer, CD, Fluorescence, NMR, Spectrofluorometry

Chromatography: Paper and thin layer chromatography, Column chromatography, Gelfiltration, Ion-exchange, HPLC, FPLC, MALDI (TOF), Affinity purification

Unit- IV-Molecular Biology Techniques

Microbiology: Culture of bacterial cells, recombinant techniques, transformation, restriction, ligation and cloning

Detection, Identification, and expression of nucleic acids and proteins:

Southern and northern blotting, Western blotting, ELISA, PCR, FACS, *In situ* hybridization, FISH, RISH, immunostaining, Microarray, ELISA, FACS, DNA protein Interaction methods, EMSA, South Western, Protein-protein interaction methods, Pull down assay, Far western Blot, FRET-FREM, Yeast two hybrid system

SUGGESTED READINGS

- Principles and techniques of Biochemistry and Molecular Biology, 7th Ed: K. Wilson, J. Walker, Cambridge Univ. Press. UK
- An Introduction to Practical Biochemistry, 3rd Ed : D. T. Plummer, Tata-McGraw Hill
- Modern Experimental Biochemistry and Molecular Biology 2nd Ed: R. Boyer
- Benjamin/Cumin
- Physical Biochemistry, 2nd Ed: D.M. Freifelder, Freeman Press.
- Analytical Biochemistry, 3rd Ed. D. Holme, J. Peck, Tata McGraw Hill.
- Experimental Biochemistry, 3rd Ed: R. L. Switzer, L.F. Garrity, Freeman Press

DSE-II PZRS 1105

TOXICOLOGY

Unit- I

Introduction to Toxicology

Definition, History and scope and relationship to other branches of science, Doseresponse relationship

Unit -II

Classes of toxic chemicals

Air pollution, Soil and water pollutants, Food additives and contaminants, Occupational toxicants, Pesticides, Animal Toxins, Plant Toxins, Microbial Toxins, Metals, Solvents, Drugs

Unit-III

Absorption, Metabolism and Elimination of Toxicants

Mechanism of absorption, Rates of penetration, Routes of absorption, and Distribution of Toxicants, Phase -I Reaction and Phase-II metabolism of Toxicants, Elimination of Toxicants

Unit-IV

Toxicity Testing

In vitro and short term tests in eukaryotic and prokaryotic system, DNA damage and repair, Chromosomal Aberration, In vivo tests: Acute, Sub-chronic, Chronic, Teratogenecity

SUGGESTED READINGS

- Hodgston and Levi's, A Textbook of Modern Toxicology. 3ed. Willey & Sons, 2004
- Casarett & Doull's, Essentials of Toxicology, 3ed. The McGraw Hills Company-2015
- John Timbrell's Introduction to Toxicology, 3rd Edition, Taylor & Francis, 2002

DSE-II PZRS- 1106

HORMONES & DISEASES

Unit- I

Introduction
Scope of endocrinology, Endocrine glands

Unit -II

Endocrine Glands
Pituitary gland: Introduction, Dwarfism, Gigantism, Acromegaly, Diabetes insipidus
Thyroid gland: Introduction, Goiter, Myxoedema, Cretinism
Parathyroid gland: Introduction, Osteoporosis, Tetany
Islets of Langerhans: Introduction, Diabetes mellitus
Adrenal gland: Introduction, Addison's disease, Cushing's syndrome

Unit- III

Gonads and Hormones
Testis: Origin and cause of male sterility, Azoospermia&oligozoospermia, Oligospermia, Varicocoele, Cryptorchidism
Ovary: Overview of regulation of menstrual cycle, Ovarian dysfunctions (premature ovarian failure, ovarian agenesis and luteal insufficiency), Polycystic ovarian syndrome, Endometriosis

Unit- IV

Hormones and Diseases
Hormones and cancer
Hormones and stress
Obesity

SUGGESTED READINGS

- Mac E. Hadley: Endocrinology, Prentice Hall, International Edition, 2000
- Wilson and Foster, Williams Text Book of Endocrinology 8th edition, W.B .Saunders Company Philadelphia, 1972.

DSE-II PZRS- 1107

NEUROBIOLOGY

Unit- I

Organization of the Nervous System

Brain structure, Cerebrospinal fluid, Cells and connection of the nervous system, Neurons, Glial cells, Synapses, Neural network, Blood-brain barrier, Neurotransmitters and Neuropeptides

Unit -II

Learning and Memory

Types, Molecular basis

Unit -III

Brain and Behavior

Motivation, Sleep, Brain aging

Unit -IV

Neuropathology

Strokes, Epilepsy, Alzheimer's disease, Huntington's disease, Parkinson's disease

Brain Imaging, Techniques to identify diseases

SUGGESTED READINGS

- Longstaff: Neuroscience, Viva Books Pvt. Ltd., 2002
- Shepherd: Neurobiology, Oxford Univ. Press
- Ganong: Review of Medical Physiology (21st Ed.), Lange Medical Publ., 2003
- Guyton & Hall: Textbook of Medical Physiology (10th Ed.), WB Saunders, 2001.

DSE-II PZRS - 1108

GENETICS AND DISEASE BIOLOGY

Unit -I

Population Genetics

Hardy-Weinberg Law (statement and derivationof equation, application of law to human Population); Evolutionary forces upsetting H-W equilibrium; Genetic Drift (mechanism, founder's effect, bottleneck phenomenon)

Unit -II

Genetic Polymorphism

Natural selection (concept of fitness, selection coefficient, genetic load, types of selection, density-dependent selection, heterozygous superiority, kin selection, adaptive resemblances, sexual selection
Chromosomal polymorphism, Allozyme polymorphism

Unit -III

Epidemiology

Concept, Application, Disease origin, Progression, Risk Assessment, Application of Bayes' Theorem, Probability of an Outbreak, Expected Duration of an Epidemic, Allele Frequency in Population

Unit- IV

Disease modeling

Disease modeling in Epidemiology, Demographic Stochasticity, Seasonal Forcing, Contact Rates, Exposed periods, Herd Immunity, The Inter-epidemic Period, Epidemic Approach to the Endemic Equilibrium, Case study

SUGGESTED READINGS

- Anderson RM & May RM. Infectious Diseases of Humans. Dynamics and Control. Oxford Science Pubs.
- Clayton D, Hills M. Statistical Models in Epidemiology. Oxford University Press
- Giesecke, J. Modern Infectious Disease Epidemiology. Edward Arnold 2nd edition
- Kelsey JL, Whittemore AS, Evans AS, Thompson WD. Methods in Observational Epidemiology. Oxford Univ Press (2 nd Edition)

DSE-II PZRS-1109

BEHAVIOURAL ECOLOGY OF INSECTS AND BIOCONTROL

Unit-I

Introduction to Insects

Origin of and evolution of insects, Phylogeny of insect orders, Naming and describing insects, Classification and identifying characters of Apterygota, Exopterygota and Endopterygota

Insect anatomy and physiology

Insect body plan, Integument, Respiration, Digestive system, excretory system, Circulatory System and Thermoregulation, Reproductive system, Sound and light producing organs

Unit-II

Insect embryology and Endocrinology

Insect eggs, embryonic development, Viviparity, Polyembryony, Parthenogenesis, Pedogenesis and metamorphosis, Types of larva and pupae, Molting and diapauses physiology, Types of hormones in insects and their functions

Insect Ecology

Dynamics of insect life systems, Insect life tables and its application, Effects of environment in insect development, Regulation of insect populations, insect as ecological indicator: insect outbreak, insect monitoring and forecasting, Insect communities in aquatic and terrestrial systems, Patterns of insect distribution, Global patterns of insects richness, body weight, range size, species richness, sex ratio and abundance, biogeography of insect, Effect of global change in insects distribution and range shift, Global change and insect diversity and Morphological, physiological, anatomical and reproductive adaptation of insects, Prey-predator dynamic and species interactions

Unit-III

Insect Behavior

Sexual selection, Basic responses and patterns of behavior, nervous system and behavior, hormones and behavior, genetic control of behavior, behavioral periodicity and clocks, oriental navigation and homing. Host selection and feeding behavior, defence behavior, foraging behavior, resting behavior, communication behavior, epigamic behavior, mating and reproductive behavior, parental care, presocial behavior, eusocial behavior, leadership behavior

Unit-IV

Biocontrol of Pests: IPM, Classical, Inoculative, Inundative, Conservative/Augmentative, Biocontrol agents, Limitations of Biocontrol, Mistakes and Misunderstanding about biocontrol, Future of Biocontrol.

Research Methodology for Insects

Tools and techniques of insect collection & preservation, Research design (lab & field), Insect collection & sampling techniques, General techniques for insects rearing, Biostatics tools

Suggesting Books:

1. Chapman, R.F. 1998. The insects structure and function 4th edition. Cambridge University Press.
2. Fox, R.M. and Fox, J.W. 1966. Introduction to comparative entomology. Reinhold Publishing Corporation, New York.
3. Walter, G.H. 2008. Insect Pest Management and Ecological Research. Cambridge University. Press. 400 pp.
4. Atkins, M.D. 1980. Introduction to Insect Behaviour. MacMillan Publishing Co. Inc. New York.

DSE-II PZRS- 1110

AQUATIC POLLUTION

Unit I

Introduction – Aquatic pollution- sources, its impact on biota, ecosystem analysis- bio-indicators, biomonitoring, environmental factors and fish health, aquaculture research and Scope.

Unit II

Ichthyology -Systematics, morphology, anatomy, physiology, biochemistry and behaviour of freshwater fish, Indian major and minor carps, Exotic Carps, Catfishes, Murrels, Aquaculture-Water quality management, diseases control.

Unit III

Toxicity and Metabolism: Bioavailability and uptake, metabolism of toxic substances by aquatic organisms, Acute and accumulative toxicants; bioaccumulation and biomagnification, biotransformation.

Unit- IV Toxicity evaluation – Duration of exposure, mechanism of action, acute, subacute, and chronic toxicity, Systemic effects of toxic metals, pesticides, LC_{50} (Lethal Concentration), Dose response relationship, Toxicological Testing.

References-

1. The Physiology of Fishes, Evans, D. H. and Claiborne, J. D., Taylor and Francis Group, CRC Press, UK
2. Fish & Fisheries K. Pandey, & J.P. Shukla, Rastogi Publication, Meerut, New Delhi
3. Biology of Fishes, Bone, Q. and Moore, R., Taylor and Francis Group, CRC Press, U.K.
4. Aquatic Environment and Toxicology, Kumar A. (Ed.). Daya Publ. House.
5. Aquatic Toxicology and Hazards Evaluation, Mayer H. ASTM Publ.
6. Fundamentals of Aquatic Toxicology, Rand GM & Petrocelli SR. Hemisphere Publ. Corp.
7. Fundamentals of Toxicology, K P Pandey, J.P. Shukla & S. P. Trivedi, New Central Book Agency, Kolkata

DSEII -PZRS-1111
Fish & Fisheries

Unit - I

Basics of Ichthyology – Morphology and morphometric measurement and measure of central tendency as tools for Taxonomy of fishes.

Unit - II

Icthyodiversity in lotic and lentic habitat of upper stretch and lower stretch of different orders of M.P.(India).

Unit - III

Physicochemical characterization and hydrobiology of different aquatic bodies of M P,with special reference to phytoplankton, zooplankton & ichthyodiversity.

Unit - IV

Aquatic Toxicological aspects on fishes with special reference to the effect of metallic pollutants, Industrial wastes, Pesticides etc. on various tissues of freshwater fishes.

Unit - V

Endocrinology of fish under stress of different pollutional sources and Ichthyo-parasitology with special reference to Protozoan, Fungal, Bacterial, Helminth and Viral diseases.

Suggested Readings.

1. Fish and Fisheries by K Pandey and J P Shukla- Rastogi Publication, Merrut and New Delhi.
2. Fishes by M. Chandy- National Book Trust India.
3.Ichthyology by Lagler- John Wiley and Sons, New York.
4.. Fish and Fisheries of India by V G Jhingran- Hindustan Publication Corporation India.
5. Fish Physiology by Hoar and Randell- Academic Press, New York.
6. An Introduction to the study of fishes by A.Gunther, Black Edinburgh Press.