Department of Zoology

Program: Ph.D. Zoology

Batch 2022

Graduate attributes

To provide leadership qualities in research and generate employable candidates for academia and industry. Individuals having innovative ideas and training to initiate start-ups in the field of interdisciplinary science.

Ph.D. Programme in Zoology

Course Structure of the Programme

Sr. No.	Course Code	Course Title	L	T	P	Cr
1	**ZOL.705**	Research Methodology, Biostatistics and Computer Applications	4	-	-	**4**
2	**ZOL.751**	Research and Publication Ethics (RPE)	2	-	-	**2**
3	**ZOL.752**	Teaching Assistantship	-	-	2	**1**
4	**UNI.753**	Curriculum, Pedagogy and Evaluation	1	-	-	**1**
5	**ZOL.702**	Trends in Modern Zoology	4	-	-	**4**
Minimum No. of Credits Required						**12**

L: Lectures; P: Practical; T: Tutorials; Cr: Credits

L	T	P	Credits
4		-	4

Course Title: Research Methodology, Biostatistics and Computer Applications
Course Code: ZOL.705

Course learning outcomes(CLO)
Students will be able to:
CLO 1: Critically analyse, interpret, and synthesize existing scientific knowledge based on literature review.
CLO 2: Identify the knowledge gap and formulate a hypothesis and design experimental/theoretical work.
CLO 3: Apply good laboratory practices and biosafety protocols.
CLO 4: Appreciate the crucial issues in research ethics, like responsibility for research, ethical clearance for experimental studies and scientific misconduct.
CLO 5: Perform hypothesis testing on small and large data samples.
CLO 6: Use correlation and linear regression methods to find a relationship and good of a fit for the given data.
CLO 7: Retrieve various biological data from the appropriate databases for analysis.
CLO 8: Compare protein structures and perform structure-based drug designing.

Unit/ Hours	Content	Mapping with CLO
I 15 hours	**General Principles of Research:** Meaning and importance of research, Critical thinking, Formulating hypothesis and development of research plan, Review of literature, Interpretation of results and discussion. Bibliographic index **Technical Writing:** Scientific writing, writing synopsis, Research paper, Poster preparation, oral presentations and Dissertations. Reference Management using various softwares such as Endnote, reference manager, Refworks, etc. Communication skills: defining communication; type of communication; techniques of communication, etc.	CLO 1 & CLO 2

II 15 hours	**Introduction and Principles of Good Lab Practices:** Good laboratory practices, Biosafety for human health and environment. Biosafety issues for using cloned genes in medicine, agriculture, industry, and eco-protection, Biological containment and physical containment, Biosafety in Clinical laboratories and biohazard management, Physical, Chemical & Biological hazards and their mitigation. Biosafety level/category of pathogens. Biosafety level of laboratories, WHO/CDC/DBT guidelines for biosafety. **Research Ethics:** Ethical theories, Ethical considerations during research, consent. Animal handling/testing, Animal experimental models and animal ethics. Perspectives and methodology & Ethical issues of the human genome project, ICMR guidelines for biomedical and health research. Intellectual property protection (IPP) and intellectual property rights (IPR), WTO (World Trade Organization), WIPO (World Intellectual Property Organization), GATT (General Agreement on Tariff and Trade), TRIPs (Trade Related Intellectual Property Rights), TRIMS (Trade Related Investment Measures) and GATS (General Agreement on Trades in Services). Patents, Technology Development/Transfer Commercialization Related Aspects, Ethics.	CLO3 & CLO4
III 15 hours	**Computer Applications and Biostatistics:** Introduction to spreadsheet, presentation tools. Reference Management software. Role of Cloud computing and HPC in life science research. Introduction to Big data in biology and big data analytics. Data types and sources – variables and types. Descriptive statistics of categorical data and continuous data. Estimation of parameters – hypothesis testing: tests of significance, type I and II errors, z test, t test, analysis of variance (ANOVA), chi-square goodness-of-fit test. Regression and correlation. Statistical packages and their applications.	CLO 5 & CLO 6
IV 15 hours	**Bioinformatics:** Biological data: sequence, structure, gene expression, pathways and molecular interactions. Primary Sequence and structure databases. GEO, KEGG Database. Introduction to Next generation Sequencing. Proteomics: Resources & repositories. Sequence analysis: Pair-wise sequence comparison, database searching methods-BLAST, FASTA, PHI-BLAST and Multiple sequence alignment. Molecular phylogeny-building phylogenetic trees.	CLO 7 & CLO 8

Introduction to Protein structure, Structure comparison and visualization, Structure based protein classification: CATH and SCOP. Introduction to structure-based drug designing. Structural genomics initiatives. Deep Learning in protein structure prediction and Biomedical Image analysis.	

Suggested Reading:

1.   Gupta, S. (2008). Research Methodology and statistical techniques. Deep & Deep Publications (P) Limited, New Delhi.
2.   Kothari, C. R. (2014). Research methodology (s). New Age International (p) Limited. New Delhi.
3.   Sahay, Vinaya and Singh, P. (2009). Encyclopedia of Research Methodology in life sciences. Anmol Publications. New Delhi.
4.   Kauda J. (2012). Research Methodology: A Project Guide for University Students. Samfunds literature Publications.
5.   Dharmapalan B. (2012). Scientific Research Methodology. Narosa Publishing
6.   Norman, G. and Streiner, D. (2008). Biostatistics: The Bare Essentials.3/e (with SPSS). Decker Inc. USA.
7.   Rao, P. P., S. Sundar and Richard, J. (2009). Introduction to Biostatistics and Research Methods. PHI learning.
8.   Christensen, L. (2007). Experimental Methodology. Boston: Allyn & Bacon.
9.   Fleming, D. O. and Hunt, D.L. (2006). Biological Safety: Principles and Practices. American Society for Microbiology, USA.
10.   Rockman, H. B. (2004). Intellectual Property Law for Engineers and Scientists.

L	T	P	Credits
2		-	2

Course Title: Research and Publication Ethics (RPE)
Course Code: ZOL.751

Course learning outcomes(CLO): After going through the course the learners will be able to **CLO1:** Familiarize with the ethics of research. **CLO2:** Illustrate the good practices to be followed in research and publication. **CLO3:** Judge the misconduct, fraud and plagiarism in research.

Unit/ Hours	Content	Mapping with CLO
	CLO4: Utilize various online resources and software to analyze their research output.	
I 3 hours	**Philosophy and Ethics** ● Introduction to Philosophy: definition, nature and scope, content, branches ● Ethics: definition, moral philosophy, nature of moral judgements and reactions	CLO1
II 5 hours	**Scientific Conduct** ● 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	CLO1 & CLO2
III 7 hours	**Publication Ethics** 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 behaviour and vice versa, types ● Violation of publication ethics, authorship and contributor ship ● Identification of publication misconduct, complaints and appeals ● Predatory publishers and journals	CLO2 & CLO3
IV 4 hours	**Open Access publishing** ● Open access publications and initiatives ● SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies ● Software tool to identify predatory publication developed by SPPU ● Journal finder/journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer, Journal Suggester etc.	CLO2
V 4 hours	**Publication Misconduct** ● Group Discussions: Subject-specific ethical issues, FFP, authorship; conflicts of interest; complaints and appeals: examples and fraud from India and abroad	CLO2 & CLO3

	● Software tools: Use of plagiarism software like Turnitin, Urkund and other open source software tools	
VI 7 hours	**Databases and Research Metrics** ● Databases: Indexing databases; Citation database: Web of Science, Scopus etc. ● Research Metrics: Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score; Metrics: h-index, g-index, i10 index, almetrics	CLO4

Suggested Reading:
1. Gupta, S. (2008). Research Methodology and statistical techniques. Deep & Deep Publications (P) Limited, New Delhi.
2. Kothari, C. R. (2014). Research methodology (s). New Age International (p) Limited. New Delhi.
3. Sahay, Vinaya and Singh, P. (2009). Encyclopedia of Research Methodology in life sciences. Anmol Publications. New Delhi.
4. Kauda J. (2012). Research Methodology: A Project Guide for University Students. Samfunds literature Publications.
5. Dharmapalan B. (2012). Scientific Research Methodology. Narosa Publishing
6. Norman, G. and Streiner, D. (2008). Biostatistics: The Bare Essentials.3/e (with SPSS). Decker Inc. USA.
7. Rao, P. P., S. Sundar and Richard, J. (2009). Introduction to Biostatistics and Research Methods. PHI learning.
8. Christensen, L. (2007). Experimental Methodology. Boston: Allyn & Bacon.
9. Fleming, D. O. and Hunt, D.L. (2006). Biological Safety: Principles and Practices. American Society for Microbiology, USA. 10. Rockman, H. B. (2004). Intellectual Property Law for Engineers and Scientists.
11. Wiley-IEEE Press, USA.
12. Shannon, T. A. (2009). An Introduction to Bioethics. Paulist Press, USA.
13. Vaughn, L. (2009). Bioethics: Principles, Issues, and Cases. Oxford University Press, UK.

Evaluation: Continuous assessment through tutorial, assignments, quizzes and group discussion with 50% weightage. The weightage of the final end semester examination of Research and Publication Ethics will be 50%. The duration of the final examination will be 03 hours (university vide notification: CUPB/CC/COE/2020/207).

L	T	P	Credits
-	-	02	1

Course Title: Teaching Assistantship

Course Code: ZOL.752

Course learning outcomes(CLO):
At the end of this skill development course, the scholars shall be able to:

CLO1: familiarize themselves with the pedagogical practices of effective classroom delivery and knowledge evaluation system
CLO2: manage large and small classes using appropriate pedagogical techniques for different types of content

Activities and Evaluation:

· The scholars shall attend Master degree classes of his/her supervisor to observe the various transaction modes that the supervisor follows in the classroom delivery or transaction process one period per week.

· The scholars shall be assigned one period per week under the direct supervision of his/her supervisor to teach the Master degree students adopting appropriate teaching strategy(s).

· The scholars shall be involved in examination and evaluation system of the Master degree students such as preparation of questions, conduct of examination and preparation of results under the direction of the supervisor.

· At the end of the semester, the supervisor shall conduct an examination of teaching skills learned by the scholar as per the following **evaluation criteria**:

· The scholars shall be given a topic relevant to the Master degree course of the current semester as his/her specialization to prepare lessons and deliver in the classroom before the master degree students for one hour (45 minutes teaching + 15 minutes interaction).

· The scholars shall be evaluated for a total of 50 marks comprising *content knowledge* (10 marks), *explanation and demonstration skills* (10 marks), *communication skills* (10 marks), *teaching techniques employed* (10 marks), and classroom interactions (10).

L	T	P	Credit
1	0	0	1

Course Title: Curriculum, Pedagogy and Evaluation
Course Code: UNI.753

Course learning outcomes:

After completion of the course, scholars shall be able to:
CLO1: Analyze the principles and bases of curriculum design and development
CLO2: Examine the processes involved in curriculum development
CLO3: Develop the skills of adopting innovative pedagogies and conducting students' assessment
CLO4: Develop curriculum of a specific course/programme

Unit/ Hours	Content	Mapping with CLO
I 4 hours	**Bases and Principles of Curriculum** 1. Curriculum: Concept and Principles of curriculum development, Foundations of Curriculum Development. 2. Types of Curriculum Designs- Subject centered, learner centered, experience centered and core curriculum. Designing local, national, regional and global specific curriculum. Choice Based Credit System and its implementation.	CLO1
II 4 hours	**Curriculum Development** 1. Process of Curriculum Development: Formulation of graduate attributes, course/learning outcomes, content selection, organization of content and learning experiences, transaction process. 2. Comparison among Interdisciplinary, multidisciplinary and trans-disciplinary approaches to curriculum.	CLO2
III 3 hours	**Curriculum and Pedagogy** 1. Conceptual understanding of Pedagogy. 2. Pedagogies: Peeragogy, Cybergogy and Heutagogy with special emphasis on Blended learning, Flipped learning, Dialogue, cooperative and collaborative learning. 3. Three e- techniques: Moodle, Edmodo, Google classroom.	CLO3
IV 4 hours	**Learners' Assessment**	CLO3 & CLO4

1. Assessment Preparation: Concept, purpose, and principles of preparing objective and subjective questions. 2. Conducting Assessment: Modes of conducting assessment – offline and online; use of ICT in conducting assessments. 3. Evaluation: Formative and Summative assessments, Outcome based assessment, and scoring criteria. *Activity: Develop curriculum for a course/programme related to the research scholar's discipline.*	

Transaction Mode

Lecture, dialogue, peer group discussion, workshop

Evaluation criteria

There shall be an end-term evaluation of the course for 50 marks for duration of 2 hours. The course coordinator shall conduct the evaluation.

 Suggested Reading:
● Allyn, B., Beane, J. A., Conrad, E. P., & Samuel J. A., (1986). *Curriculum Planning and Development.* Boston: Allyn & Bacon.
● Brady, L. (1995). *Curriculum Development.* Prentice Hall: Delhi. National Council of Educational Research and Training.
● Deng, Z. (2007). Knowing the subject matter of science curriculum, *Journal of Curriculum Studies,* 39(5), 503-535. https://doi.org/10.1080/00220270701305362
● Gronlund, N. E. & Linn, R. L. (2003). *Measurement and Assessment in teaching.* Singapore: Pearson Education
● McNeil, J. D. (1990). *Curriculum: A Comprehensive Introduction,* London: Scott, Foreman/Little
● Nehru, R. S. S. (2015). *Principles of Curriculum.* New Delhi: APH Publishing Corporation.
● Oliva, P. F. (2001). *Developing the curriculum* (Fifth Ed.). New York, NY: Longman
● Stein, J. and Graham, C. (2014). *Essentials for Blended Learning: A Standards-Based Guide.* New York, NY: Routledge.

Web Resources

https://www.westernsydney.edu.au/__data/assets/pdf_file/0004/467095/Fundamentals_of_Blended_Learning.pdf

https://www.uhd.edu/academics/university-college/centers-offices/teaching-learning-excellence/Pages/Principles-of-a-Flipped-Classroom.aspx

http://leerwegdialoog.nl/wp-content/uploads/2018/06/180621-Article-The-Basic-Principles-of-Dialogue-by-Renate-van-der-Veen-and-Olga-Plokhooij.pdf

L	T	P	Credits
4	-	-	4

Course Title: Trends in Modern Zoology

Course Code: ZOL.702

Course learning outcomes (CLO): After going through the course the learners will be able to

CLO 1: Define and demonstrate concepts and applied aspects of cell biology

CLO 2: Demonstrate applied aspects of molecular biology

CLO 3: Illustrate various applications of genomics and proteomics in health research

CLO 4: To learn research usage of various animal models towards health & disease knowledge, and vaccine development for human betterment.

Unit/ Hours	Content	Mapping with CLO
1/ 16 hours	**Concepts in Cell Biology:** Membrane structure and transport, Cell cycle regulation, cell-cell and cell-matrix interactions, cell adhesion molecules, extracellular matrix and their role in wound healing. Cellular signaling, role of kinases and phosphatases in human physiology and pathogenesis.	**CLO1**

2/ **16 hours**	**Concepts in Molecular Biology**: Chromatin remodeling and nucleosome modifications, alternative DNA structures: role in DNA damage, repair, and genetic instability; human genome project; epigenetic regulation and role in health and diseases; genome editing: CRISPR-CAS technology; Role of non-coding RNAs in various human diseases.	**CLO2**
3/ **14 hours**	**Concepts in Genomics and Proteomics:** Chromatin-immunoprecipiation, Gel-shift (EMSA), Southern blotting, Northern blotting, Next generation sequencing, Microarray, Fluorescence *in situ* hybridization, Confocal microscopy, Flow-cytometry, Isolation/Enrichment of cells and subcellular components through magnetic beads, Mass spectrometry, Post-translational modification analysis, Patch-clamp technique and Ca^{2+} signaling recordings, *in situ* and gel zymography applications in human health and disease research.	**CLO3**
4/ **14 hours**	**Animal Models in Human Health and Diseases:** Translational approaches in Transgenic animal models & human Vaccine development, understanding the gut-brain barrier, Transgenic livestock, Transgenic poultry; Polyclonal antibody production, vaccines (subunit-, peptide- attenuated- DNA- and vector-based); applications in clinical trials challenging human life.	**CLO4**

Suggested Reading:

1.   Slaby, O. (2012) MicroRNAs in Solid Cancer: From Biomarkers to Therapeutic Targets (DNA and RNA: Properties and Modifications, Functions and Interactions, Recommendations and Applications), Nova Science Publishers.

2.   Pecorino, L. (2012) Molecular Biology of Cancer: Mechanisms, Targets, and Therapeutics, Oxford Edition.

3.   Cantley, L. C., Hunter, T., Sever, R. (2014) Signal Transduction: Principles, Pathways and Processes, Cold Spring Harbor Laboratory Press.

4.   Molecular Biotechnology: Principles and Applications of Recombinant DNA by Bernard J. Glick, Jack J. Pasternak, Cheryl L. Patten, 4th edition

5.   Principles of Gene Manipulation by Sandy B. Primrose, Richard Twyman, Bob Old Seventh edition

6.   Brown, T. A. (2010). Gene Cloning and DNA Analysis: An Introduction. 6th Edition, Wiley-Blackwell Publisher, New York.

7.   Nelson, D. and Cox, M. M. (2009). Lehninger Principles of Biochemistry. W.H. Freeman and Company, New York.

8.   Primrose. S. B. and Twyman, R. (2006). Principles of Gene Manipulation and Genomics. Blackwell Publishing Professional, U.K.

9.   Sambrook, J. (2006). The Condensed Protocols from Molecular Cloning: A Laboratory Manual. Cshl Press. New York.

10.   Wilson, K. and Walker, J. (2006). Principles and Techniques of Biochemistry and Molecular biology. 6th Edition, Cambridge University Press India Pvt. Ltd., New Delhi.

Examination Pattern

End-Term Exam (Final): Based on long descriptive type (10 questions) test (100 Marks)

The course work shall be a minimum of 12 credits (as recommended by the 3rd school board meeting). A student may opt any relevant Ph.D. course(s) being offered across the Life Sciences as per the requirement and recommendations of the departmental doctoral research committee (DRC) to a maximum of 16 credits (also as prescribed by the UGC regulations-2016); and the student also has to undertake 80 research credits (as per CUPB's guidelines) for the award of Ph.D. degree in Zoology.