

Department of Zoology



Program: Ph.D. Zoology

Academic Session: 2021 - 2022

Program outcome/ Graduate attributes:

To provide leadership personality 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.

Transaction Mode:

- 1) Lecture
- 2) Demonstration
- 3) Lecture cum demonstration
- 4) Seminar
- 5) Group discussion
- 6) Field visit
- 7) Tutorial
- 8) Problem solving
- 9) Self-learning

Sr. No	Course Code	Course Title	L	T	P	Cr
Compulsory Core Course						
1	ZOL.701	Research Methodology, Biostatistics and Computer Applications	4	-	-	4
2	ZOL.751	Research and Publication Ethics	2	0	0	2
3	ZOL.752	Teaching Assistantship	0	0	2	1
4	UNI.753	Curriculum, Pedagogy and Evaluation	1	0	0	1
Elective Courses (Opt any two)						
3	ZOL.702	Advanced Cell and Molecular Biology	3	0	-	3
4	ZOL.703	Advances in Animal Sciences	3	0	-	3
5	ZOL.704	Advanced Research Techniques	3	0	-	3
6	XXX.XXX	Course from other Allied Departments	3	0	-	3
Minimum No. of Credits Required						14

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

L	T	P	Credits
4	-	-	4

ZOL.701: Research Methodology, Biostatistics and Computer Applications

<p>Learning Outcomes: After going through the course the learners will be able to</p> <ul style="list-style-type: none"> • Train the students for efficient execution of their research • Illustrate and analyze complex outcome of their results using biostatistical approaches in interpretation experimental data • Hands-on training to the use of computer applications during their research. 		
Unit	Syllabus	Lectures
1.	<p>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.</p>	15
2.	<p>Unit-II</p> <p>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.</p> <p>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),</p>	15

	TRIMS (Trade Related Investment Measures) and GATS (General Agreement on Trades in Services). Patents, Technology Development/Transfer Commercialization Related Aspects, Ethics.	
3.	Computer Application and Biostatistics: Spreadsheet, Presentation, Image processing and Reference Management software. Internet browsers, World Wide Web: Origin and concepts, internet and its application for quality literature collection and secondary data related to research work. Exploring websites, search engines and Cloud computing. Statistical packages and their applications (Graphpad, Prism, SPSS). Statistical tests: Student's t-test, Paired t-test, Mann-Whitney U-test, Wilcoxon signed-rank, One-way and two-way analysis of variance (ANOVA), Critical difference (CD), Fisher's LSD (Least significant difference), Kruskal-Wallis one-way ANOVA by ranks, Friedman two-way ANOVA by ranks, Chi-square test. Regression and correlation.	15
4.	Unit-IV Bioinformatics: Biological databases (DNA/RNA/Protein; Predicting features of individual residues), Alignment tools, BLAST, FASTA, multiple sequence alignment, Pathway and molecular interactions, Primers designing (degenerative and gene specific primers), Genome projects (human, <i>Arabidopsis</i> and other genome projects), NCBI, UCSC and other database searches. <i>In silico</i> approaches for drug designing, Virtual and Quantitative Screening, identification of cell types epitopes for vaccine designing.	15

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.

Course Code: ZOL.751

Course Title: Research and Publication Ethics

L	T	P	Credits
2	0	0	2

Total Hours: 30

Unit I Philosophy and Ethics

3 hours

- Introduction to Philosophy : definition, nature and scope, content, branches
- Ethics : definition, moral philosophy, nature of moral judgements and reactions

Unit II Scientific Conduct

5 hours

- 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

7 hours

- 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

Unit IV Open Access publishing**4 hours**

- 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.

Unit V Publication Misconduct**4 hours**

- Group Discussions: Subject specific ethical issues, FFP, authorship; conflicts of interest; complaints and appeals: examples and fraud from India and abroad
- Software tools: Use of plagiarism software like Turnitin, Urkund and other open source software tools

Unit IV Databases and Research Metrics**7 hours**

- 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

Course Code: ZOL.752**Course Title: TEACHING ASSISTANTSHIP**

L	T	P	Credit
0	0	2	1

Total Hours: 30**Learning Outcome:**

At the end of this skill development course, the scholars shall be able to

1. familiarize themselves with the pedagogical practices of effective class room delivery and knowledge evaluation system
2. 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 class room 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 class room 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).

Course Code: UNI.753

Course Title: CURRICULUM, PEDAGOGY AND EVALUATION

L	T	P	Credit
1	0	0	1

Learning outcomes:

Total Hours: 15

After completion of the course, scholars shall be able to:

- analyze the principles and bases of curriculum design and development
- examine the processes involved in curriculum development
- develop the skills of adopting innovative pedagogies and conducting students' assessment
- develop curriculum of a specific course/programme

Course Content

Unit I Bases and Principles of Curriculum

4 hours

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.

Unit II Curriculum Development

4 hours

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.

Unit III Curriculum and Pedagogy

3 hours

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

Unit IV Learners' Assessment

4 hours

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.

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 Readings

- 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-learningexcellence/Pages/Principles-of-a-Flipped-Classroom.aspx>
- <http://leerwegdialoog.nl/wp-content/uploads/2018/06/180621-Article-The-BasicPrinciples-of-Dialogue-by-Renate-van-der-Veen-and-Olga-Plokhooij.pdf>

Elective Courses (Opt any two):

L	T	P	Credits
3	-	-	3

ZOL.702: Advanced Cell and Molecular Biology

<p>Learning Outcomes: After going through the course the learners will be able to</p> <ul style="list-style-type: none"> • Define and demonstrate advanced aspects of cell and molecule biology. • Illustrate latest scientific breakthroughs and current research developments via research 		
Unit	Syllabus	Lectures
1.	Advance Cell biology : Membrane transport, Cytoskeleton, Cell cycle regulation, cell to cell junction and cell-matrix interactions, integrins and other cell adhesion molecules, extracellular matrix and its role in wound healing	11
2.	Advance Cell biology : Cell signaling, Inter- and Intra-cellular signaling, kinases and phosphatases, cell migration and its control mechanisms, cell death mechanisms, biology of stem cells and stem cell therapies.	12
3.	Advance Molecular biology : Chromatin remodeling and nucleosome modifications, alternative DNA structures: role in DNA damage, repair, and genetic instability; human genome project;	11
4	Advance Molecular biology : Epigenetic regulation and role in health and disease; genome editing: CRISPR-CAS technology; types of RNAs and non-coding RNAs; regulation of gene expression by non-coding RNA in various diseases; DNA and RNA binding proteins.	11
<p>Suggested Reading:</p> <ol style="list-style-type: none"> 1. Barciszewski, J. (2003) Non-Coding RNAs: Molecular Biology and Molecular Medicine, Springer Publisher. 2. 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. 3. Pecorino, L. (2012) Molecular Biology of Cancer: Mechanisms, Targets, and Therapeutics, Oxford Edition. 4. Alberts, B. (2008) Molecular Biology of the Cell, Garland Science 5. Cantley, L. C., Hunter, T., Sever, R. (2014) Signal Transduction: Principles, Pathways and Processes, Cold Spring Harbor Laboratory Press. 		

L	T	P	Credits
3	-	-	3

ZOL.703: Advances in Animal Sciences

<p>Learning Outcomes: After going through the course the learners will be able to</p> <ul style="list-style-type: none"> • Learn research usage and handling of animal models. • Illustrate signalling pathways relevant to human and animal systems. 		
Unit	Syllabus	Lectures
1.	Animal models of disease and research : Hydra as a model for regeneration and morphogenesis; <i>Drosophila</i> & <i>C. elegans</i> as models of genetics, development, drug discovery and neurobiology, Mosquito as model of disease transmission.	8
2.	Animal models of disease and research : Zebrafish as apoptotic and drug assessment model, Murine models (Knock-in, knock-out, knock-down, nude and SCID mice).	7
3.	Animal Transgenics & Vaccines: Transgenic animals (Transgenic mice, Transgenic livestock, Transgenic poultry); vaccines (subunit-, peptide-, attenuated-, DNA- and vector-based).	15
4.	Cell Signaling and Human Health: Cancer associated signaling pathways; Akt Signaling, MAP kinase signaling, PARP, apoptosis, p53 signaling, caspase signaling, NF- κ B signaling, JAK, STAT3 pathways, PTEN, mTOR signaling pathway, Wnt signaling pathway, VEGF signaling pathway, Toll-like receptor signaling pathway; Clinical trials & therapeutics.	15
<p>Suggested Reading:</p> <ol style="list-style-type: none"> 1. Molecular Biotechnology: Principles and Applications of Recombinant DNA by Bernard J. Glick, Jack J. Pasternak, Cheryl L. Patten, 4th edition 2. Principles of Gene Manipulation by Sandy B. Primrose, Richard Twyman, Bob Old Seventh edition 3. An introduction to genetic engineering, Third edition by Dr. Desmond S.T. Nicholl 4. Molecular cloning by R. Green and Joseph Sambrook, 4th Edition, CSHL Press 5. Essentials of Stem Cell Biology, Third Edition, Robert Lanza & Anthony Atala, Academic Press. 		

L	T	P	Credits
3	-	-	3

ZOL.704: Advanced Research Techniques

<p>Learning Outcomes: After going through the course the learners will be able to</p> <ul style="list-style-type: none"> • Illustrate advanced and versatile tools and techniques employed in life sciences. 		
Unit	Syllabus	Lectures
1.	Genomics: Chromatin-immunoprecipitation, DNA footprinting, EMSA: gel-shifts assay, Southern blotting, Northern blotting, whole genome sequencing, microarray technology, DNA & RNA sequencing methods, FISH technique.	15
2.	Proteomics (I): Gel electrophoresis techniques (2-dimensional, tricine and pulse-field), mass spectrometric analysis, immunoblotting and detection methods	8
3.	Proteomics (II): Polyclonal antibody production, approaches to posttranslational modification analysis, <i>in situ</i> and gel zymography	7
4.	High-resolution imaging techniques: Confocal laser scanning microscopy (CLSM), Z-stacking, time lapse microscopy, intravital microscopy, scanning and transmission electron microscopy, flow cytometry, live cell imaging, cryotomy.	15
<p>Suggested Reading:</p> <ol style="list-style-type: none"> 1. Brown, T. A. (2010). Gene Cloning and DNA Analysis: An Introduction. 6th Edition, Wiley-Blackwell Publisher, New York. 2. Goldsby, R. A., Kindt, T.J. and Osborne, B.A. (2008). Kuby Immunology. 6th Edition, W. H. Freeman & Company, San Francisco. 3. Gupta, P. K. (2005). Elements of Biotechnology. Rastogi Publications, Meerut. 4. Nelson, D. and Cox, M. M. (2009). Lehninger Principles of Biochemistry. W.H. Freeman and Company, New York. 5. Primrose. S. B. and Twyman, R. (2006). Principles of Gene Manipulation and Genomics. Blackwell Publishing Professional, U.K. 6. Sambrook, J. (2006). The Condensed Protocols from Molecular Cloning: A Laboratory Manual. Cshl Press. New York. 7. Sambrook, J. and Russell, D.W. (2000). Molecular Cloning: A Laboratory Manual (3 Vol-set). 3rd Edition, CSHL Press, New York. 8. Sawhney, S.K. and Singh, R. (2005). Introductory Practical Biochemistry. Narosa Publishing House, New Delhi. 9. 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.