SCHEME OF EXAMINATION

For

Choice Based Credit System
M.Sc.Zoology

(w.e.f. 2021 – 2022)

KALINGA UNIVERSITY
RAIPUR

FACULTY OF SCIENCE
Kalinga University, Atal Nagar
Chhattisgarh

Kalinga University, Raipur					
M.Sc Zoology					
w.e.f 2021-22 session					
Semester I					
Code No.	**Paper**	**Credits**	**External Marks**	**Internal Marks**	**Total Marks**
MZOO101	Biosystematics andTaxonomy	4	70	30	100
MZOO102	Cell and Molecular Biology	4	70	30	100
MZOO103	Structure and Function of Invertebrates and Vertebrates	4	70	30	100
MZOO104	Biochemistry & Endocrinology	4	70	30	100
	(GE-1) Choose Any One 105A/105B	4	70	30	100
MZOO105A	Research Methodology				
MZOO105B	Science Journalism				
MZOO106-P	**Lab Course I**	2	30	20	50
MZOO107-P	**Lab Course II**	2	30	20	50
	Total	**24**	**470**	**230**	**700**

Kalinga University, Raipur					
M.Sc Zoology					
w.e.f 2021-22 session					
Semester II					
Code No.	**Paper**	**Credits**	**External Marks**	**Internal Marks**	**Total Marks**
MZOO201	Evolution and Biostatistics	4	70	30	100
MZOO202	Principles of Ecology	4	70	30	100
MZOO203	Animal Physiology	4	70	30	100
MZOO204	Comparative Anatomy of vertebrates	4	70	30	100
	(GE-2) Choose Any One 205A/205B	4	70	30	100
MZOO205A	Entrepreneurship				
MZOO205B	Intellectual Property Rights				
MZOO206-P	**Lab Course III**	2	30	20	50
MZOO207-P	**Lab Course IV**	2	30	20	50
	Total	**24**	**410**	**190**	**600**

Kalinga University, Raipur					
M.Sc Zoology					
w.e.f 2021-22 session					
Semester III					
Code No.	**Paper**	**Credits**	**External Marks**	**Internal Marks**	**Total Marks**
MZOO301	Genetic	4	70	30	100
MZOO302	Immunology	4	70	30	100
MZOO303	Developmental Biology	4	70	30	100
	(DSE-1) Choose Any One 304A/304B	4	70	30	100
MZOO304A	Techniques in Biology				
MZOO304B	Hormone Receptors, And Signaling Mechanisms				
	(DSE-2) Choose Any One 305A/305B	4	70	30	100
MZOO305A	Wild Life and Conservation Biology				
MZOO305B	Animal Behavior				
MZOO306-P	Lab Course V	2	30	20	50
MZOO307-P	Lab Course VI	2	30	20	50
	Total	**24**	**410**	**190**	**600**

Kalinga University, Raipur					
M.Sc Zoology					
w.e.f 2021-22 session					
Semester IV					
Code No.	**Paper**	**Credits**	**External Marks**	**Internal Marks**	**Total Marks**
MZOO401P	Dissertation and Viva-voice	24	450	150	600
	Total	**24**	**450**	**150**	**600**

***Project Dissertation 200**
***Presentation 100**
***Viva Voce 100**
***Scientific Paper 50**

Preamble

Zoology is a major subject of Basic Sciences which deals with all aspects of animalbiology. It includes an interesting range of highly diverse topics. The advancements in biological Sciences demands, a zoology student to be a master of many areas in the subject. This Postgraduate degree program has been designed by the Board of Studies in Zoology of Kalinga University with a tangible understanding of what is needed from zoologists and what zoologists need to pursue as a skilled career. It emulates closely the Benchmark Statement for Biosciences and the guidelines laid down by the University Grants Commission, New Delhi. This Newly designed Curriculum is an appropriate blend of the classical aspects in Zoology which has been the "backbone"knowledge required for all zoologists and the recent and specialized areas. The flexibility in the Curriculum allows the students to choose their areas of interest leading to enhanced employability. Students will be provided sufficient number of hours for their skill development through the Lab Courses and the Project component. The lab courses have differing flavours and priorities to make a good zoologist. This degree offers specialization in areas like Genetics, Animal Physiology and Animal Behaviour along with a range of core courses like Biochemistry,Molecular Biology,Comparative AnimalPhysiology, Developmental Biology etc. Various cross cutting issues relating to Environmental biology have been aptly included to develop the students' sense towards human wellbeing. The field trip/surveys and study tours are included to gives the student an enticing taste of what life is specially outside the walls of the classroom. On successful completion of the programme, the students are expected to understand the key life processes of human and other animal groups, the functioning of molecules, cells, tissues, organs and systems. Also, the students will gain increased confidence to use initiative and judgement to make decisions in complex and changeable situations and reflect critically and analytically on personal experience and make informed decisions about further study, training and employment opportunities. The Master of Science (M.Sc.) in Zoology is a Postgraduate program under the Faculty of Science and Technology of Kalinga University. The curriculum designed encompasses subjects like Physiology, Behaviour, Genetics, Cell Biology, Developmental Biology, Endocrinology, Biochemistry, Molecular Biology, Freshwater Zoology, Environmental Biology etc. Both classical and applied subjects of Zoology have been rightly blended to offer holistic understanding of the subject.

The Choice Based Credit System (CBCS) will be implemented through this curriculum. This curriculum would certainly felicitate students to develop a strong base of the fundamentals and specialize in the desired area of their fondness and abilities. The students pursuing this program would get a privilege to select optional subjects of their choice. A total of 240 hours for theory lectures and 120 hours for laboratory work have been prescribed in each semester including a dissertation to inculcate the research culture amongst students. This newly designed curriculum will allow students to acquire the skill in handling scientific instruments planning and performing in the laboratory and exercising critical judgement, independent thinking and problem-solving skills.

Program outcomes (POs): After successfully completing the M.Sc. Zoologyprogram students will be able to:

PO-1. Apply the knowledge of Zoology, Life Sciences and alliedsubjects to the understanding of complex life processes and phenomena.

PO-2. Understanding the evolutionary processes through origin of life from acellular animal (Protozoa) to multicellular organisms (from dinosaur to humans), history of phylum etc.Identify, review research literature, and analyse complex situations of living forms.

PO-3. Design processes/strategies that meet the specified needs with appropriate consideration for the public health and safety, and the cultural,societal, and environmental considerations.

PO-4. Conduct investigations of complex problems: Use research-based knowledge andresearch methods including design of experiments, analysis and interpretation of data, andsynthesis of the information to provide valid conclusions in real situations.

PO-5. Demonstrate, solve and an understanding of major concept of all physiological activities in various disciplines of Zoology such as Entomology (study of insects) Ichthyology (detailed study of fishes including their habit and habitat) Ornithology (study of birds including migration of birds which fascinates the students).

PO-6. To inculcate the scientific temperament in the students and people outside the scientific community through field visits for better understanding of the industrial processing, biodiversity, bird watch etc.

PO-7. Create an awareness of the impact of Zoology on the environment, society, and development outside the scientific community. To study the ecological phenomenon from ecosystem to protection of endangered species by in-situ and ex-situ conservation. The process of survival in different environment via adaptation. Knows the concept, process, physiology, and molecular basis of animal development. Identify a range of invertebrates and vertebrates and justify their conservation.

PO-8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the work/research practice.

PSO-1. Students would sufficiently be skilled and empowered to solve the problems in the area of Zoology and its allied areas.

PSO-2. Gain the knowledge of Zoology through theory and practical.

PSO-3. Understand the testing of hypothesis and different behavior patterns of animals.

PSO-4. Use modern Zoological tools, Models, Charts and Equipment.

PSO-5. They would have plethora of job opportunities in the education, environment, agriculture-based, and health related sectors.

PSO-6. Understand good laboratory practices and safety.

PSO-7. The bright and ignited mind may enter into research in the contemporary areas of Zoological/Biological Sciences.

PSO-8. The broad skills and the deeper knowledge in the field would make them highly successful and excellent researcher in advanced areas of research in the biological sciences.

M. Sc. ZOOLOGY SEMESTER - I

MZOO 101: BIOSYSTEMATICS AND TAXONOMY

Course Objectives:
The primary objective of the course is to impart knowledge about animal classification. Understanding the basic process of taxonomy, different procedures of collection, preservation and curating. The course is also to impart appreciation for different life forms on earth and drive home the relationship between different living forms both at the genetic and the ecological level.

Unit – 1

1. Definition, basic concept of biosystematics.
2. Definition, basic concept of Taxonomy
3. Trends in biosystematics: Chemotaxonomy, cytotaxonomy and molecular taxonomy
4. Different types of taxonomic characters and types

Unit – II

1. Taxonomic Characters and different kinds.
2. Taxonomic procedures-
    a. Taxonomic collections
    b. Taxonomic preservations
    c. Taxonomic curating

Unit –III

1. Different species concepts, subspecies and other infraspecific categories.
2. Mechanism of speciation
3. Theories of biological classification: hierarchy of categories.
4. Concepts of panmictic and apomictic species

Unit – IV

1. Concepts of taxonomic keys
2. Different kinds of taxonomic keys
3. Merits and demerits of taxonomic keys
4. Process of typification and different Zoological types

Unit- V

1. International code of Zoological nomenclature (ICZN)
2. Evaluation of biodiversity indices.
3. Evaluation of Shannon Weiner Index.
4. Evaluation of Dominance Index.

Course Outcomes: Knowledge of taxonomy would facilitate in the evolutionary relationship and their taxonomic aspects. They will be aware of the standards followed globally for naming any newly discovered species. The students would be able to address issues related to diversity assessment in future.

Books recommended

1. Principles of Systematic Zoology by Ernst Mayr
2. Principles of Systematic Zoology by ErntsMayr& Peter D. Ashlock
3. Principles of Animal Taxonomy by G. G. Simpson
4. Animal Taxonomy by H. E. Goto
5. International Code of Zoological Nomenclature official publication

UNIT NO.	Course learning outcome	Teaching and learning Activity	Assessment Task
I	Enrichment about the basic concepts of biosystematics	Lecture & Student presentations Case study.	Evaluation of students on the basis of class test I and other Written preparation exercises
II	Detailed knowledge of taxonomic characters	Discussions,use of audio, visuals, video,Students as Teachers.	Evaluation of students on the basis of Oral presentations, Seminars,Assignments.
III	Knowledge of species concept	Narrated or recorded lectures,Videoclips,Case studies and other problem-solving activities	Evaluation of students on the basis of power point presentation given by students.
IV	Knowledge of taxonomic keys	Lecture,presentation, Expert talks,	Evaluation of students on the basis of class seminar.
V	Effective knowledge of biodiversity indices	Lecture &presentation. Research paper related with topics.	Evaluation of students on the basis of class test II. CaseStudies and assignments.

MZOO 102: CELL AND MOLECULAR BIOLOGY

Course Objectives:
This course will provide knowledge about the complex organisation in the eukaryotic cell and the molecular mechanisms of the cellular processes that exist in all cell types. It will also make them understand the relationship between the physiological processes at the cellular and organismic levels.

Unit - I

1. Cell membrane
2. Transport of biomolecules across the membrane
3. Structure and function of cell organelle.
4. Cytoskeleton

Unit – II

1. Extracellular matrix.
2. Cellular junctions.
3. cell cycle and Check point
4. Mechanism and regulation of Apoptosis

Unit- III

1. Protein structure type and function.
2. Protein synthesis
3. Enzyme: Structure and classification
4. Enzyme function

Unit- IV

1. Nucleotide, nucleic acid
2. Chromosome: structure and function
3. DNA Structure and type
4. Nucleosome structure and function

Unit –V

1. DNA Metabolism
2. RNA metabolism
3. DNA Fingerprinting
4. Replication of DNA

Course Outcomes: The students will be able to understand how the cell functions as a unit of life. They will gain knowledge about the techniques and experiments that contributed to the understanding of molecular mechanisms of the cellular processes. Appreciate the importance of cell-cell adhesion and the extracellular matrix in the evolution of multicellular organisms.

Books recommended

1. Karp Gerald (2010) Cell Biology. 6th Edition, John Willey & Sons (Asia) Ltd.
2. Cooper Geoffrey M. The Cell: A Molecular Approach. ASM Press, Washington D.C., U.S.A.
3. Sadava David E. Cell Biology – Organelle Structure and Function. Jones &Barlett Publishers, Boston, London.
4. Hardin Jeff, Gregory Bertoni and Lewis J. Kleinsmith (2012) World of the Cell. 8th Edition, Pearson Education, Inc., San Francisco, U.S.A.
5. Alberts B., A. Johnson, J. Lewis, M. Raff, K. Roberts and P. Walter (2008) Molecular Biology of the Cell. 5th Edition, Garland Science, New York, U.S.A.
6. Lodish H., D. Baltimore, A. Berk, L. Zipursky, M. Matsudaira and J. Darnell (1995) Molecular Cell Biology. Eds. 3, Scientific American & W. H. Freeman, New York.
7. De Robertis E. D. P. and De Robertis E. M. E. (1987) Cell and Molecular Biology. 8th Edition, Lea and Febiger, Philadelphia.

UNIT NO.	Course learning outcome	Teaching and learning Activity	Assessment Task
I	Enrichment about the basic concepts of cell structure	Lecture & Student presentations Case study.	Evaluation of students on the basis of class test I and other Written preparation exercises.
II	Detailed knowledge of cell interaction	Discussions,use of audio, visuals, video,Students as Teachers.	Evaluation of students on the basis of Oral presentations, Seminars,Assignments.
III	Knowledge of protein and enzyme synthesis and function	Narrated or recorded lectures,Videoclips,Case studies and other problem-solving activities	Evaluation of students on the basis of power point presentation given by students.
IV	Knowledge of nucleic acids	Lecture,presentation, Expert talks.	Evaluation of students on the basis of class seminar.
V	Effective knowledge of nucleic acid metabolism	Lecture &presentation. Research paper related with topics.	Evaluation of students on the basis of class test II. Case Studies and assignments.

MZOO 103: Structure and Function of Invertebrates and Vertebrates

Course Objectives:
The student will understand about the structure of non-chordate and chordate, their external as well as internal characters. To study the distinguishing characters of non-chordates and chordates. Understand the evolutionary modification of various systems from lower organisms to higher complex organisms. Comprehend the influence of abiotic conditions and community interactions on success of invertebrate and vertebrate species. The significance of organisms for human in terms of parasitic, symbiotic and mutualistic association.

Unit 1:

1. Protozoa: Nucleus and reproduction;
2. Origin of metazoans;
3. Porifera: Canal system;
4. Cnidaria: Polymorphism in Siphonophora.
5. Annelida: Adaptive radiation in polychaetes,
6. Trochophore larva.

Unit 2:

1. Mollusca: Torsion in gastropods, larval forms;
2. Arthropoda: Evolutionary significance of Trilobites;
3. Crustacean larvae and their significance;
4. Echinodermata: larval forms and their significance;

Unit 3:

Salient features and affinities of

a. Placozoa
b. Mesozoa
c. Rotifera
d. Phoronida
e. Sipuncula
f. Hemichordata

Unit 4:

1. Characteristic features and affinities of Protochordata and Cyclostomata;
2. Origin of the Fish, Amphibian,
3. Special character of amphibian: Parental care

Unit 5:

1. Characteristic features and affinities of Reptile, Bird, Mammal,

2. Adaptive radiations in vertebrates: Aquatic, Terrestrial, Aerial, Arboreal, Fossorial.
3. Special characters: Venom in ophidians,
4. Poisonous and Non-poisonous snakes
5. Biting mechanisms of snakes
6. Migration in birds, Flightless birds.

Course Outcomes:

The students will appreciate evolutionary changes and environmental adaptations in different taxa of animal kingdom. They will be able to demonstrate comprehension of invertebrate evolution beginning with the ancestral protozoans and going upto top order organism like mammals. Differentiate organisms into invertebrate & vertebrate phyla and classes based on the morphology, physiology, reproduction, development, behaviour and habitat. Correctly identify representative species of animal kingdom from select phyla.

Books Recommended

1. Barrington E.J.W. – Invertebrate structure and function. 2nd edn. ELBS/Nelson 1973.
2. Meglitsch P.A. & Schram F.R – Invertebrate Zoology. 3rd edn. Oxford University Press 1991.
3. Ruppert E.E. & Barnes, R.D.- Invertebrate Zoology. 6th edn. Harcourt Asia 1994.
4. Pough F.H., Janis C.M. &Heiser J.B. – Vertebrate Life. 6th edn. Pearson 2003.
5. Young J.Z. – Life of Vertebrates. 3rd edn. Oxford 1982
6. Hildebrand M. – Analysis of Vertebrate Structure. John Wiley 1974.
7. Jordan, E. L. and Verma, P. S., Chordate Zoology. S. Chand & Company Ltd, 1998.
8. Kotpal, R. L. The Birds, 4th edition, Rastogi Publications, Shivaji Road, Meerut, 1999.
9. Marshall, A. J., Biology and Comparative Physiology of Birds, Volume I & II, 1960.

UNIT NO.	Course learning outcome	Teaching and learning Activity	Assessment Task
I	Enrichment about the basic concepts of protozoan	Lecture & Student presentations Case study.	Evaluation of students on the basis of class test I and other Written preparation exercises
II	Detailed knowledge of invertebrates	Discussions,use of audio, visuals, video,Students as Teachers.	Evaluation of students on the basis of Oral presentations, Seminars, Assignments.
III	Knowledge of minor phylum	Narrated or recorded lectures,Videoclips,Case studies and other problem-solving activities	Evaluation of students on the basis of power point presentation given by students.

IV	Knowledge of chordate	Lecture,presentation,Expert talks.	Evaluation of students on the basis of class seminar.
V	Effective knowledge of vertebrates	Lecture &presentation. Research paper related with topics.	Evaluation of students on the basis of class test II,**Case** Studies and assignments.

MZOO 104: BIOCHEMISTRY AND ENDOCRINOLOGY

Course Objectives:

The course is designed to develop deep understanding about the biological & chemical mechanism of endocrine physiology. The aim of this course is to provide a comprehensive understanding of relationship of central nervous system with peripheral endocrine system and controlled functions in higher vertebrates.

Unit -1

1. Structure of carbohydrate
2. Classification of Carbohydrate
3. Carbohydrate synthesis
4. Carbohydrate metabolism

Unit – II

1. Structure of lipid
2. Classification of lipid
3. Lipid biosynthesis
4. Lipid metabolism

Unit – III

1. Structure of proteins.
2. Metabolism of proteins.
3. Functions of protein, Mechanism of protein function.
4. Vitamins and amino acids.

Unit –IV

1. Introduction to endocrine glands.
2. Thyroid and Parathyroid gland
3. Hypothalamus and Pituitary gland
4. Adrenal gland

Unit – V

1. Hormone Classification
2. Action mechanism of hormone.
3. Gonadal cycle.
4. Endocrine diseases.

Course Outcomes:

At the end of the course, the students should be able to understand the basic organization of the vertebrate brain, and the interaction of hypothalamus with the pituitary and pineal gland. Learn basic principles of important techniques applied to neuroendocrine research. Understand

neuroendocrine regulation of physiological processes. Develop the ability of appreciate the complex mechanism regulating the biology in animals.

Books Recommended:

1. Berg et al.: Biochemistry (5th Ed.), Freeman, 2001
2. Nelson et al: Lehninger Principles of Biochemistry (3rd Ed.), Pearson, 2004
3. Mathews et al.: Biochemistry (3rd Ed.), Benjamin/Cummings Publuishing, 1990.
4. Wilson and Walker: Practical Biochemistry (3rd Ed.), Cambridge Univ. Press, 2000.

UNIT NO.	Course learning outcome	Teaching and learning Activity	Assessment Task
I	Enrichment about the basic concepts of carbohydrate	Lecture & Student presentations Case study.	Evaluation of students on the basis of class test I and other Written preparation exercises
II	Detailed knowledge of lipids	Discussions,use of audio, visuals, video,Students as Teachers.	Evaluation of students on the basis of Oral presentations, Seminars,Assignments.
III	Knowledge of proteins	Narrated or recorded lectures,Videoclips,Case studies and other problem-solving activities	Evaluation of students on the basis of power point presentation given by students.
IV	Knowledge of endocrine glands	Lecture, presentation,Expert talks.	Evaluation of students on the basis of class seminar.
V	Effective knowledge of Hormones	Lecture &presentation. Research paper related with topics.	Evaluation of students on the basis of class test II. **Case** Studies and assignments.

MZOO105A RESEARCH METHODOLOGY

Course Objective: To familiarize Students with basic of research and the research process.

To enable the participants in conducting research work and formulating research synopsis and report.

To impart knowledge for enabling students to develop data analytics skills and meaningful interpretation to the data sets so as to solve the business/Research problem.

Course Learning Outcomes: After completion of these courses students will be able to understand-

CO-I: Develop understanding on various kinds of research, objectives of doing research, research process, research designs and sampling.

CO-II: Have basic knowledge on qualitative research techniques

CO-III:. Have adequate knowledge on measurement & scaling techniques as well as the quantitative data analysis

CO-IV: Have basic awareness of data analysis-and hypothesis testing procedures

CO-V: Undestand about research tools.

Unit I

Foundations of Research: Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method – Understanding the language of research – Concept, Construct, Definition, Variable. Research Process

Unit II

Problem Identification & Formulation – Research Question – Investigation Question – Measurement Issues – Hypothesis – Qualities of a good Hypothesis –Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic & Importance , Research Design: Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables.

Unit III

Qualitative and Quantitative Research: Qualitative research – Quantitative research – Concept of measurement, causality, generalization, replication. Merging the two approaches. Measurement: Concept of measurement– what is measured? Problems in measurement in research – Validity and Reliability. Levels of measurement – Nominal, Ordinal, Interval, Ratio. Sampling: Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non Response. Characteristics of a good sample. Probability Sample – Simple Random Sample, Systematic Sample,

Stratified Random Sample & Multi-stage sampling. Determining size of the sample – Practical considerations in sampling and sample size.

Unit IV

Data Analysis: Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association. Interpretation of Data and Paper Writing – Layout of a Research Paper, Journals in Computer Science, Impact factor of Journals, When and where to publish ? Ethical issues related to publishing, Plagiarism and Self-Plagiarism.

Unit V

Use of Encyclopedias, Research Guides, Handbook etc., Academic Databases for Computer Science Discipline. Use of tools / techniques for Research: methods to search required information effectively, Reference Management Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office, Software for detection of Plagiarism

Learning Outcomes:

1. Students will understand a general definition of research design.
2. Students will know why educational research is undertaken, and the audiences that profit from research studies.
3. Students will be able to identify the overall process of designing a research study from its inception to its report.
4. Students will be familiar with ethical issues in educational research, including those issues that arise in using quantitative and qualitative research

Assessment Tools:

Written examinations, Case study discussions, Viva examinations.

Books Recommended:-

1. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition
2. Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press.
3. Research Methodology – C.R.Kothari

MZOO105B SCIENCE JOURNILISM

Objectives

- Students will learn the mechanics of science writing, including research, sourcing, and generating story ideas; interviewing, note-taking, and organization; fact-checking, editing, writing for story, structure, and formatting.

- Students will practice writing for multiple public, academic, and professional audiences and contexts using writing strategies, conventions, genres, technologies, and formats to communicate effectively.

UNIT 1 Science communication at the end of the Enlightenment and the importance of notions of the public in the origin of modern science - development of new audiences for science in the Nineteenth century and the emergence of new science communication media (e.g. mechanics' institutes, science journalism, public museums and zoos) - advent of the figure of the scientist as public expert and the debate about 'Two Cultures' – difference between science journalism and science communication

UNIT 2 Introduction of Western science in India through missionaries, travelers, army and civilian army of the East India Company– science in the 18th and 19th century –emergence of Indian pioneer scientists – science teaching–- developments during post-Independence period – emerging areas of science and technology – convergence in study of science

UNIT 3 Institutions of science in India - the role of the Asiatic Society – Bose Institute – Indian Institute of Science - Council of Scientific and Industrial Research (CSIR) – Indian Space Research Organization (ISRO) – Indian Science Congress organizations for popularization of science – NCSTC and Vigyan Prasar – noted science societies at state level – Science and Technology Academies – awards for science communication and popularization.

UNIT 4 The boom in new media during the twentieth century and their impact on science journalism - role of a science page editor – popular science magazines in the west – science magazines in India – the ideal science reporter - scope of science journalism on radio & television in developing countries – science serials on radio and television – Bharat ki Chaap on Doordarshan – Science serials on All India Radio - tech news - understanding present market trends.

UNIT 5 Science as an essential element in political, corporate and community news – major issues in science journalism – environmental pollution – genetically modified crops – research for disease prevention and eradication – nuclear power – disaster mitigation – scientific knowledge for effective governance – the North-South divide in science research and scientific development.

Learning Outcomes

- They will appreciate the digital landscape within which science journalism exists today by learning: blogging in science journalism (honing your craft, developing a voice); how to get work (pitching and staying relevant); the value of social networks for science journalism (sharing stories, finding stories, joining discussions and finding sources); digital strategies employed by major news organizations (data visualization, multimedia, community building).
- Students will analyze and learn about the structure of several types of data including numbers, texts and documents. Students will learn the skills to examine, evaluate, and critique those data,

extract patterns, summarize features, create visualizations, and provide insights, while learning to be sensitive to ethical concerns associated

Assessment Tools: Written examinations, Case study discussions, Viva examinations.

Reference Book:

1. Mass Communication: A Critical analysis, Keval J Kumar
2. Professional Journalism, M V Kamat
3. Theory and Practice of Journalism, B N Ahuja
4. Professional Journalist, John Hohenberg
5. Understanding Media, Marshall McLuhan 6. Journalism in India,Nadig Krishnamurthy, Mysore University Press
6. Barbara Gastel, Presenting Science to the Public.
7. Blum, Deborah, Knudson, Mary & Marantz Henig, Robin. A Field Guide for Science Writers: The Official Guide of the National Association of Science Writers. (2005)
8. D. Perlman, Science and the Mass Media.
9. Elise Hancock, Ideas into Words: Mastering the Craft of Science Writing. Baltimore and London: Johns Hopkins, 2003.
10. N Corcoran (Ed.). Communicating health: strategies for health promotion. Sage. (2013).
11. O.P. Jaggi, A Concise History of Science including Science in India.
12. R. Sundara, Popular Science in Mass Media.
13. Renata Schiavo, Health Communication: From Theory to Practice. John Wiley & Sons. 2013
14. Sharon, M. Friedman, Sharon, Woody, Carlol, L. Rogers (Ed) : Scientists and Journalists, Reporting Science as News.
15. Warren Burkett, News Reporting : Science Medicine and High Technology

MZOO 106P:
Lab course I:

1. Identification, classification and study of distinguishing features of important representatives from various groups (Protozoa to Hemichordata).
2. Study of biodiversity among various invertebrates and vertebrates (Listing of all the animals found in and around your house and also try to find out their Zoological names).
3. Visits to a local animal park or zoo to identify and study the captive fauna and preparation of report.
4. Taxonomic key formation and conversion.
5. Study of biodiversity in grassland and pond water by using Shannon -Weiner index
6. To study the different characters and classification of Invertebrate specimens
7. Dissection; Reproductive, Excretory, nervous and systems of leech.
8. Dissection Mouth parts and reproductive system of cockroach;
9. Study of sections of the arm of a starfish;
10. Collection of various insect species.

Practical Outcome:
Students will be aware of the standards followed globally for naming any newly discovered species. They will be able to demonstrate comprehension of invertebrate evolution beginning with the ancestral protozoans. Differentiate between the various invertebrate phyla and classes based on morphology, physiology, reproduction, development, behaviour and habitat.

MZOO 107P:
Lab Course II:

1. Isolation of DNA/RNA
2. Study of mitochondria from buccal epithelium by staining with supravital stains.
3. Culture of amoeba, paramecium, euglena.
4. Study of cell division mitosis/meiosis by squash and smear preparation of root tip and cockroach/ grasshopper testis.
5. Study of giant chromosome in the salivary gland of Chironomus larvae or Drosophila.
6. Study of Barr body and human chromosome.
7. Culture and study of drosophila.
8. Estimation of RBC, haemoglobin, haematocrit/PVC,
9. Estimation of blood group, Rh factor and blood clotting time.
10. Determine the blood pressure of man.
11. Demonstration of osmosis.
12. Study of histology of endocrine glands in different animal types through permanent slides and microtomy.

Practical Outcome:

They will gain knowledge about the techniques and experiments that contributed to the understanding of molecular mechanisms of the cellular processes. Understand neuroendocrine regulation of physiological processes.

M. Sc. ZOOLOGY SEMESTER - II

MZOO 201: EVOLUTION AND BIOSTATISTICS

Course Objectives:

This course will impart knowledge about the evolution and how from small microorganisms a fully grown human being developed. The course is designed in such a way that the students get the confidence to use computer programs for the daily design of experiments, data collection, and analysis of results.

Unit –I

1. Organic Evolution
2. origin of life
3. Origin of earth Vs origin of life
4. Evidences of organic evolution

Unit-II

1. Evidences from Taxonomy
2. Evidences from palaeontology
3. Evolution from Genetics
4. Fossils and time scale

Unit- III

1. Evolution of man
2. Micro and Macroevolution
3. Variation
4. Theories of evolution (Lamarckism, Darwinism)

Unit- IV

1. Speciation & Isolation
2. Research methodology (Graphic representation of the data)
3. Measurement of Central tendency (Mean, mode, median dispersion, Test of significance – Standard error, standard deviation)
4. ANOVA

Unit-V

1. t-test and Chi square-test, Z test
2. Sampling theory
3. Correlation &regression
4. Basic Computer knowledge (MS Office, MS word, MS excel, PPT)

Course Outcomes:

Students studying this course will be able to perform the data analysis using the statistical tools available on any computer such as excel as well the programs for big and complex data. They will be able to handle high proteomic and genetic data. They will be able to understand the maintenance of computers, server and big data files. This course will make them suitably knowledgeable to undertake the computer jobs in the offices in the hospitals, scientific academies, funding agencies in addition to the teaching institutions.

Books Recommended:

1. Strickberger M. W. (2000): Evolution. Jones and Bartlett.
2. Nei M. and Sudhir Kumar (2000): Molecular Evolution and Phylogenetics. Oxford.
3. Li Wen-Hsiung and Dan Graur (1991): Fundamentals of Molecular Evolution. Sinauer.
4. Strickberger M. W. (2000): Evolution. Jones and Bartlett.

5. Bruning J.L. and B. L. Kintz (1977) Computational Handbook of Statistics, Scott, Foresmaln and Company.
6. Daniel W.W. (2000) Biostatistics: A Foundation for Analysis in Health Sciences, John Wiley.
7. Milton J.S. and J.O. Tsokos (1983) Statistical Methods in the Biological and Health Sciences, McGraw Hill Book Co.
8. Quinn G.P. and Keough M.J. (2002) Experimental Design and Data Analysis for Biologists, Cambridge Univ. Press.
9. Snedecor G.W. and W.G./ Cochran (1968) Statistical Methods Oxford & IBH Pub

UNIT NO.	**Course learning outcome**	**Teaching and learning Activity**	**Assessment Task**
I	Enrichment about the basic concepts of evolution	Lecture & Student presentations Case study.	Evaluation of students on the basis of class test I and other Written preparation exercises
II	Detailed knowledge of evolutionary evidences	Discussions,use of audio, visuals, video,Students as Teachers.	Evaluation of students on the basis of Oral presentations, Seminars, Assignments.
III	Knowledge of micro, macro, mega and human evolution	Narrated or recorded lectures, Videoclips, Case studies and other problem-solving activities	Evaluation of students on the basis of power point presentation given by students.
IV	Knowledge of speciation	Lecture, presentation, Expert talks.	Evaluation of students on the basis of class seminar.
V	Effective knowledge biostatistics	Lecture &presentation, research paper related with topics.	Evaluation of students on the basis of class test II, Case Studies and assignments.

MZOO 202: PRINCIPLES OF ECOLOGY

Course Objectives:

The objective of this course is to make awareness among the young students about the surrounding environment. The impact of climate change on humans and biodiversity. Know the biotic and abiotic components of ecosystem. Understand diversity among various groups of animal kingdom. Understand the complexity of animal community & ecological adaptation in animals. To understand scope, importance and management of biodiversity. Understanding the concept of population and community ecology, wetland forest and their conservation.

Unit-I

1. Ecosystem and their component (Biotic and Abiotic)
2. Various types of ecological pyramids
3. Food web and food chains
4. Lotic and lentic systems

Unit-II.

1. Ecological succession (Xerosere, Hydrosere and Lithosere)
2. Niche Hypothesis (Realised and fundamental Niche)
3. Ecosystem Energetics (NPP, GPP, TPP)
4. Resilience of ecosystem, Community stability and disturbance

Unit- III

1. Species interaction (Natural selection)
2. Interspecific interaction (Commensalism, mutualism, competition and predation)
3. Bio-magnification and Eutrophicationprocesses
4. Biogeochemical cycle

Unit- IV

1. Concept and principles of Diversity
2. Biodiversity and wildlife conservation methods
3. Sustainable Development and Natural Resource management
4. National legislation for protection of biological resources

Unit-V

1. Demography (Mortality, fecundity and age structure)
2. Population growth (Exponential and logistics)
3. Life history strategies – r and k selection.
4. Metapopulation dynamics

Course Outcomes:

Students will be exposed to the fundamental aspects of ecology. They will get idea about the impact of anthropogenic activities on the environment. Students will get an idea about the natural resources and their conservation.

Books recommended

l. Odum, E. P., 1983. Basic Ecology, Saunders College Publishing.
2. Stiling, P. 2002. Ecology: Theories and Applications. Prentice Hall of India Pvt. Ltd
3. Begon, M.: Harper, J. L. & Townshend. C. R.1996. Ecology. Blackwell Science Ltd.
4. Kormondy, E. J. 1996. Concepts of Ecology. 4th Edition. Prentice-Hall.
5. Ecology and Environmental Biology by Sharma, P.D., Rastogi Pub.

UNIT NO.	Course learning outcome	Teaching and learning	Assessment Task

		Activity	
I	Enrichment about the basic concepts of ecology	Lecture & Student presentations Case study.	Evaluation of students on the basis of class test I and other Written preparation exercises
II	Detailed knowledge of succession	Discussions,use of audio, visuals, video,Students as Teachers.	Evaluation of students on the basis of Oral presentations, Seminars, Assignments.
III	Knowledge of natural selection	Narrated or recorded lectures, Videoclips, Case studies and other problem-solving activities.	Evaluation of students on the basis of power point presentation given by students.
IV	Knowledge of diversity	Lecture, presentation, Expert talks.	Evaluation of students on the basis of class seminar.
V	Effective knowledge of demography.	Lecture &presentation, research paper related with topics.	Evaluation of students on the basis of class test II, Case Studies and assignments.

MZOO 203: ANIMAL PHYSIOLOGY

Course Objectives:
The course will enhance the knowledge of students regarding the importance of physiology and its different branches. The scope of physiology includes elucidation of the function of all cells in all organs and all animals related to nervous, respiratory, circulatory and other physiological systems. This course especially focuses on the modifications/adaptations found in different physiological systems of various organisms across the animal kingdom. Understanding the basic processes of osmosis, diffusion and osmoregulation etc.

UNIT-I
Physiology of Digestion
1. Organisation of digestive system.
2. Secretion of various parts of Gastro intestine.
3. Digestion of carbohydrate, lipid & proteins.
4. Absorption of carbohydrate, lipid & proteins.

UNIT-II
Physiology of Respiration:
1. Respiration
2. Oxygen gaseous exchange.
3. Carbon dioxide gaseous exchange
4. Respiratory Pigment

UNIT-III
Physiology of excretion.
1. Structure and function of kidney, Glomerular filtration.
2. Urea cycle, Renin angiotensin system.
3. Counter current mechanism and Concentration and dilution of urine.
4. Osmoregulation, Glomerular ultrafiltration.

UNIT-IV
Receptor Organ & nerve physiology.
1. Photoreceptors, Bioluminescence.
2. Auditory Receptor & Chemoreceptor.
3. Synaptic Transmission
4. Propagation of nerve impulse.

UNIT-V
Heart and Muscle Physiology
1. Ultrastructure and types of muscles.
2. Physiology of muscle contraction.
3. Structure of human heart.
4. Cardiac cycle.

Course Outcomes:
After going through this course on 'Animal Physiology', the students have a good understanding of how vertebrate animals work and how these animal's biology is influenced by the different environments of their niches. The students will be able to explore an original query in animal physiology. The students will appreciate evolutionary changes and environmental adaptations in different taxa of vertebrates.

Books Recommended

1. Ganong: Review of Medical Physiology (21st Ed.), Lange Medical Publ., 2003
2. Guyton & Hall: Textbook of Medical Physiology (10th Ed.), WB Saunders, 2001.
3. Keel et al: Samson Wright's Applied Physiology (13th Ed.), Oxford Press, 1989
4. Murray et al: Harper's Illustrated Biochemistry (26th Ed.), Appleton & Lange, 2003
5. West: Best and Taylor's Physiological Basis of Medical Practice (11th Ed.), Williams and Wilkins,1981.

UNIT NO.	Course learning outcome	Teaching and learning Activity	Assessment Task
I	Enrichment about the basic concepts of digestion	Lecture & Student presentations Case study.	Evaluation of students on the basis of class test I and other Written preparation exercises
II	Detailed knowledge of respiration	Discussions,use of audio, visuals, video,Students as Teachers.	Evaluation of students on the basis of Oral presentations, Seminars, Assignments.
III	Knowledge of excretion	Narrated or recorded lectures, Videoclips, Case studies and other problem-solving activities	Evaluation of students on the basis of power point presentation given by students.
IV	Knowledge of nerve physiology	Lecture, presentation, Expert talks.	Evaluation of students on the basis of class seminar.
V	Effective knowledge of connective tissue physiology	Lecture &presentation, research paper related with topics.	Evaluation of students on the basis of class test II, Case Studies and assignments.

MZOO 204: COMPARATIVE ANATOMY OF VERTEBRATE

Course Objectives:

Comparative anatomy of vertebrate is the study of animal structure and function. This course helps understand how animals work at all levels, ranging from individual cells to the whole integrated organism. The scope of this subject includes elucidation of the function of all cells in all organs and all animals related to nervous, respiratory, circulatory and other physiological systems. This course especially focuses on the modifications/adaptations found in different classes of chordate.

UNIT-I

1. Origin of Chordates
2. Classification of Vertebrates (Fish, Amphibians, Reptiles, Birds and Mammals)
3. General structure and functions of Integument
4. Vertebrate integument and its derivatives
5. Dermal derivatives of skin (Horn, Hoofs and feathers)

UNIT II

Comparative account of skeletal system:

1. Suspensoria or Jaw suspension
2. Skeletal system: Vertebral Column
3. Skeletal system: Girdles
4. Skeletal system: Limb bones

UNIT-III

Comparative account of circulatory system:

1. Evolution of Heart.
2. Evolution of aortic arches
3. Detailed account of arterial system.
4. Detailed account of venous system.

UNIT-IV

Comparative account of nervous system

1. Brain
2. Central Nervous system
3. Peripheral Nervous system
4. Brief account of neurons and nerve impulse transmission.

UNIT-V

Comparative account of urogenital system:

1. Evolution of nephrons
2. Reproductive system male.
3. Female Reproductive system.
4. Excretory organ vertebrate (with detailed description of mammalian kidney)

Course Learning Outcomes:

After going through this course, the students will have a good understanding of the various mechanisms involved in different activities of animals. How these animals' biology is influenced by the different environments of their niches. The students will be able to explore an original query in animal anatomy. The students will appreciate evolutionary changes and environmental adaptations in different taxa of vertebrates.

Books Recommended

1. Comparative Endocrinology by Gorbman, Dickhoff, Vigna, Clark & Ralph (John Wiley & Sons)
2. Vertebrate Endocrinology by Norris (Lea and Febigar)
3. Comparative Vertebrate Endocrinology by Bentley (Cambridge University Press)
4. Basic & Clinical Endocrinology by Greenspan and Strewler.
5. Wake, M.H. (Ed.) (1979). Hyman's Comparative Vertebrate Anatomy. Edn.3, University of Chicago Press, Chicago
6. Norris: Vertebrate Endocrinology, (2nd ed.), Lea &Febiger, 1997.

UNIT NO.	Course learning outcome	Teaching and learning Activity	Assessment Task
I	Enrichment about the basic concepts about origin of chordates	Lecture & Student presentations Case study.	Evaluation of students on the basis of class test I and other Written preparation exercises
II	Detailed knowledge of skeletal system	Discussions,use of audio, visuals, video,Students as Teachers.	Evaluation of students on the basis of Oral presentations, Seminars, Assignments.
III	Knowledge of circulatory system	Narrated or recorded lectures, Videoclips, Case studies and other problem-solving activities.	Evaluation of students on the basis of power point presentation given by students.
IV	Knowledge of nervous system	Lecture, presentation, Expert talks.	Evaluation of students on the basis of class seminar.
V	Effective knowledge of urogenital system	Lecture &presentation, research paper related with topics.	Evaluation of students on the basis of class test II, Case Studies and assignments.

MZOO205A ENTERPRENEURSHIP

Course Overview The goals of this programme are to inspire students and help them imbibe an entrepreneurial mind-set. The students will learn what entrepreneurship is and how it has impacted the world and their country. They will be introduced to key traits and the DNA of an entrepreneur, and be given an opportunity to assess their own strengths and identify gaps that need to be addressed to become a successful entrepreneur. The programme comprises several short courses, each focusing on a specific entrepreneurial knowledge or skill requirement such as creative thinking, communication, risk taking, and resilience and helping them become career ready, whether it is entrepreneurship or any other career.

Unit I **Contact Hours: 12**

Entrepreneurship: Concept of Entrepreneur, Entrepreneurship and Manager, Difference between Entrepreneur and Entrepreneur, Entrepreneurship, Attributes and Characteristics of successful entrepreneurs. Functions of an Entrepreneurs Function of an Entrepreneur, Classification of Entrepreneurs, Role of Entrepreneur in Indian Economy, Developing Entrepreneurial culture, Factors influencing Entrepreneurship Growth – Economic, Non-Economic Factors, For profit or Not for profit entrepreneurs, Constraints for the Growth of Entrepreneurial Culture, Entrepreneurship as a career, Entrepreneurship as a style of management, Emerging Models of Corporate Entrepreneurship, India's start up revolution-Trends, Imperatives, benefits: the players involved in the ecosystem, Business Incubators-Rural Entrepreneurship, social entrepreneurship, women entrepreneurs, Cases of Tata, Birlas, Kirloskar and new generation entrepreneurs in India.Case study on related topics.

Unit II **Contact Hours: 12**

Theories of entrepreneurship: Innovation Theory by Schumpeter & Imitating, Theory of High Achievement by McClelland, X-Efficiency Theory by Leibenstein, Theory of Profit by Knight, Theory of Social change by Everett Hagen.Case study on related topics.

Unit III **Contact Hours: 12**

Entrepreneurship development: Entrepreneurial Competencies, Developing competencies, concept of entrepreneurship development, Entrepreneur Training and developing, Role of Entrepreneur development Programs (EDP), Role of DIC, EDII, NIESBUD, NEDB, EDP – Objectives – contents – methods – execution, Mudra Yojna: Shishu, Kishore and Tarun Scheme. Role of Mentors. Innovation and Entrepreneurship, Design Thinking Process, Role of consultancy organizations in promoting Entrepreneurs, Problems and difficulties of Entrepreneurs – Marketing Finance, Human Resource, Production; Research – external problems, Mobility of Entrepreneurs,Entrepreneurial change, occupational mobility – factors in mobility.Case study on related topics.

Unit IV **Contact Hours: 12**

Role of Central government and State Government in promoting Entrepreneurship:Introduction to various incentives, subsidies and grants, Export Oriented Units, Fiscal and Tax concessions available, Women Entrepreneurs – Role, Problems and Prospects, Reasons for low women Entrepreneurs, Assistance Programme for Small Scale Units – Institutional Framework – Role of SSI Sector in the Economy – SSI Units – Failure, Causes and Preventive Measures – Turnaround Strategies. Future of Entrepreneurship Development and Government, Start Up India, Make in India.Case study on related topics.

Unit V **Contact Hours: 12**

Enterprise Promotion: Creating Entrepreneurial Venture, Entrepreneurship Development Cycle, Business Planning Process The business plan as an entrepreneurial tool, Elements of Business Plan, Objectives, Market Analysis, Development of product/ idea –Resources, Capabilities, and strategies, identifying attributes of strategic resources, Opportunity Analysis, innovator or imitator, SWOT analysis, Internal and External Environment Analysis, Industry Analysis, Embryonic Companies and Spin off's, Porter's five forces model, Identifying the right Business Model Canvas, Seven Domains of John Mullins, Opportunities in Emerging/Transition/Decline industries, Opportunities at the bottom of the pyramid, Opportunities in social sector, Opportunities arising out of digitization, Marketing, Finance, Organization & Management, Ownership – Franchising, networking and alliances, Buying an existing business, Critical risk contingencies of the proposal, Scheduling and milestones.Case study on related topics.

Text Books:

1. Vasant Desai (2011), Dynamics of Entrepreneurship Development, Himalaya Publishing House.
2. David H. Holt, (1991) Entrepreneurship: New Venture Creation, Prentice Hall.
3. K. Nagarajan, (2017) Project Management, New Age International Pvt Ltd.

Reference book:

1. The Culture of Entrepreneurship, Brigitte Berger.
2. Entrepreneurship: Strategies and Resources, Marc J, Dollinger.

MZOO205B INTELLECTUAL PROPERTY RIGHTS

Objectives

1. To introduce fundamental aspects of Intellectual property Rights to students who are going to play a major role in development and management of innovative projects in industries and Research.
2. To disseminate knowledge on patents, patent regime in India and abroad and registration aspects
3. To disseminate knowledge on copyrights and its related rights and registration aspects
4. To disseminate knowledge on trademarks and registration aspects
5. To disseminate knowledge on Design, Geographical Indication (GI), Plant Variety and Layout Design Protection and their registration aspects
6. To aware about current trends in IPR and Govt. steps in fostering IPR and case studies.

Unit-1	**Overview and Introduction of Intellectual Property**
8-Hrs.	Introduction and the need for intellectual property right (IPR) - Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design – Genetic Resources and Traditional Knowledge – Trade Secret - IPR in India : Genesis and development – IPR in abroad - Major International Instruments concerning Intellectual Property Rights: Paris Convention, 1883, the Berne Convention, 1886, the Universal Copyright Convention, 1952, the WIPO Convention, 1967,the Patent Co-operation Treaty, 1970, the TRIPS Agreement, 1994, Phonograms or Geneva Convention, History of IPR.
Unit-2	**Patents and Drafting**
10-Hrs.	Patents - Elements of Patentability: Novelty , Non Obviousness (Inventive Steps), Industrial Application - Non - Patentable Subject Matter - Registration Procedure, Rights and Duties of Patentee, Assignment and licence , Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties - Patent office and Appellate Board, Patent Filing and Drafting Case studies, Patent Agents role in India.
Unit-3	**Copyrights in IPR**
8-Hrs	Nature of Copyright - Subject matter of copyright: original literary, dramatic, musical, artistic works; cinematograph films and sound recordings - Registration Procedure, Term of protection, Ownership of copyright, Assignment and licence of copyright - Infringement, Remedies & Penalties – Related Rights - Distinction between related rights and copyrights, Filing and Drafting the Copyrights.
Unit-4	**Trademarks and Trading licences**
8-Hrs	Concept of Trademarks - Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) - Non Registrable Trademarks - Registration of Trademarks - Rights of holder and assignment and licensing of marks - Infringement, Remedies & Penalties - Trademarks registry and appellate board, Trading license importance of exports and imports in trading.
Unit-5	**IP transactions; Enforcement of IP, Commercialization**

15Hrs	Implications of Intellectual Property Rights in promoting innovations and their commercialization; technology transfer, Due diligence in patent transactions. Working of patents in India Compulsory license and its implications; Enforcement of Patents against infringer. **Industrial Designs Registrations:** Classification, Protection and Enforcement of Industrial Designs in Indian. Registration and protection of design in India and abroad. **Geographical Indications**: Concept of Geographical Indications and GI registration in India; Global scenario of GI. Protection of Traditional Knowledge and development of balanced benefit sharing models; management of GI to enhance the economic returns from GIs. Enforcement of GI. GI registrations process in India Case studies.
10 –HRS	**Case Studies and Discussions related to IPR**

Learning Outcomes

1. The students once they complete their academic projects, shall get an adequate knowledge on patent and copyright for their innovative research works during their research career, information in patent documents provide useful insight on novelty of their idea from state-of-the art search.

2. This course provides further way for developing their idea or innovations.

3. To Pave the way for the students to catch up Intellectual Property (IP) as a career option a. R&D IP Counsel b. Government Jobs – Patent Examiner c. Private Jobs d. Patent agent and Trademark agent e. Entrepreneur

Assessment Tools: Written examinations, Case study discussions, Viva examinations.

REFERENCE BOOKS

Text book

1. Rimmer, M. (2008). *Intellectual property and biotechnology: biological inventions*. Edward Elgar Publishing.
2. Singh, H. B., Jha, A., &Keswani, C. (Eds.). (2016). *Intellectual property issues in biotechnology*. CABI.
3. Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.
4. Neeraj, P., &Khusdeep, D. (2014). Intellectual Property Rights. India, IN: PHI learning Private Limited.

E-resources:

1. Subramanian, N., &Sundararaman, M. (2018). Intellectual Property Rights – An Overview. Retrieved from http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf
2. 2. World Intellectual Property Organisation. (2004). WIPO Intellectual property Handbook. Retrieved from https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf

Reference Journal: 1. Journal of Intellectual Property Rights (JIPR): NISCAIR http://nopr.niscair.res.in/handle/123456789/45 (Case Studies)

Useful Websites:

1. Cell for IPR Promotion and Management (http://cipam.gov.in/)
2. World Intellectual Property Organisation (https://www.wipo.int/about-ip/en/)
3. Office of the Controller General of Patents, Designs & Trademarks (http://www.ipindia.nic.in/)

MZOO206P:
LAB COURSE-III:

1. Preparation of frequency tables and graphs.
2. Calculation of standard deviation, variance and standard error of mean.
3. Calculation of probability and significance between means using t-test, Chi-square test, ANOVA.
4. Calculation of correlation, regression and probability distribution.
5. Computer software use for computational tasks& data presentation.
6. Estimation of population size by using quadrate method.
7. Determination of abiotic factors in terrestrial ecosystem.
8. To study the insect diversity of a terrestrial ecosystem.

Practical Outcome:
Students will become comfortable using the statistical tools available on any computer such as excel as well the programs for big and complex data. They will be able to handle high proteomic and genetic data. Students will also get an idea about the natural resources and their conservation.

MZOO 207P:LABCOURSE-IV (Practical- Paper Comparative Anatomy Of Vertebrate& Animal Physiology)

1. Study of museum specimen and histological slides of chordates.
2. Osteology of vertebral column, girdles and limb bones of fish, aves& mammals.
3. Demonstration of cranial nerves system of *Scoliodon.*
4. Comparative study of brain in pieces and tetrapods.
5. R.B. Cs& W.B.Cs. count in human blood
6. Hb percentage in human blood
7. Preparation of blood smear for the study of different types of WBC.
8. To study the role of salivary amylase in digestion of carbohydrate.
9. Study of endocrine diseases.
10. To study the disease related to digestive system.

Practical Outcome:

The students will be able to explore an original query in animal anatomy. The students will appreciate evolutionary changes and environmental adaptations in different taxa of vertebrates. They will also understand the basic functioning of animal body.

M. Sc. ZOOLOGY SEMESTER - III

MZOO 301: GENETICS

Course Objectives:
The course aims to bring a direct linkage between chemical structure of nucleic acids and their known functions. It is often elusive in the minds of students that why and how the specialized roles for the two nucleic acids (DNA & RNA) would have evolved, and the course aims to discuss the possible mechanisms for the functions of these two informational macromolecules. The problems of accuracy during information-transfer (replication, transcription and translation) and the mechanism to solve the transmission of misinformation will also be discussed.

UNIT-I
1. Hereditary and variation.
2. Source of hereditary &variation.
3. Scope and significance of genetics
4. Genotype and Phenotype concept.

UNIT-II
1. Mendel principal
2. Genetic code
3Crossing over
4 Identification of genetic material

UNIT-III
1 Chromosomes
2 The chromosome theory of inheritance
3 Structural changes in chromosomes
4 Numerical changes in chromosomes

UNIT-IV
1 Sex determination (Mammalian& Drosophila)
2 Sex differentiation
3 Sex linked inheritance (Haemophilia, colour blindness)
4 Linkage Theory

UNIT-V
1 Mutation and their type
2 Causes of mutation
3 Common genetic diseases in man
4 Genetic engineering

Course Learning Outcomes:
It is expected that a student after completing this course would have fairly good understanding of evolution of genetic material and the design of functional modules in the whole genome settings. The student would be able to structurally and functionally annotate a gene from the

genomic database. Also, they should be able to design experiments for understanding the advanced functional genomics.

Books Recommended:

1. Modern Genetics by F.J. Ayala and J.A. Kiger
2. A primer of population Genetics by D.L. Hartl
3. Genetics by Stickberger
4. Human Genetics by Vogel and Motulsky
5. Genetics in Medicine by Nussbaum
6. An Introduction to Medical Genetics by Roberts and Pembrey
7. New Clinical Genetics by Read &Donnai

UNIT NO.	Course learning outcome	Teaching and learning Activity	Assessment Task
I	Enrichment about the basic concepts of genetics	Lecture & Student presentations Case study.	Evaluation of students on the basis of class test I and other Written preparation exercises
II	Detailed knowledge of mendelian principle	Discussions,use of audio, visuals, video,Students as Teachers.	Evaluation of students on the basis of Oral presentations, Seminars, Assignments.
III	Knowledge of chromosome	Narrated or recorded lectures, Videoclips, Case studies and other problem-solving activities	Evaluation of students on the basis of power point presentation given by students.
IV	Knowledge of sex determination	Lecture, presentation, Expert talks.	Evaluation of students on the basis of class seminar.
V	knowledge of mutation	Lecture &presentation, research paper related with topics.	Evaluation of students on the basis of class test II, Case Studies and assignments.

MZOO 302
IMMUNOLOGY

Course Objectives:
Students are taught the basics of immunology so as to develop understanding of the subject, such as how the immune system does works. What are the molecular and cellular components and pathways that protect an organism from infectious agents or cancer? The course also emphasizes the research and development opportunities for therapeutic intervention arising from recent advances in immunology. The immunological aspects of disease will also be discussed using case-based studies. Upon completion of the course students have a sound understanding of the essential elements of the immune system, preparing them to engage further in this rapidly evolving field.

UNIT-I

1. Cells of immune system
    - 1.1 B-Lymphocytes, T-lymphocytes, Null Cells
    - 1.2 Mononuclear cells
    - 1.3 Granulocytic cells (Neutrophils, Eosinophils and Basophils)
    - 1.4 Mast cells
    - 1.5 Dendritic cells
2. Organs of immune system
    - 2.1 Primary lymphoid organs (Thymus, bone marrow)
    - 2.2 Secondary lymphoid organs (Lymph nodes, spleen, mucosal associated lymphoid tissue, cutaneous associated lymphoid tissue)

UNIT-II

1. Immunoglobulin structure and function
2. Antigen- epitopes, incomplete and complete antigen.
3. Major histocompatibility complex (MHC-class –I and II)
4. Antigen processing and presentation.
5. Cytokines and chemokines.

UNIT-III

1. T-cell Receptor and T-cell activation
2. B-cell Receptor and B-cell activation.
3. Antigen - Antibody Interaction, Cross reactivity
4. Innate and acquired immunity (Humoral and cell mediated immunity)
5. Complement system (classical, alternative and MBL pathway)

UNIT-IV

1. Hypersensitivity reactions – Types I, II, IIIand IV
2. Autoimmune disorders.
3. Primary and secondary immunodeficiency diseases (AIDS)
4. Vaccines.
5. Transplantation.

UNIT-V

1. Tumour immunology.
2. Immune response against viral infection
3. Immune response against bacterial infection.
4. Immune response against worms and protozoan
5. Production of monoclonal antibody (hybridomatechniques), ELISA

Course Learning Outcomes:

The students will be able to identify the cellular and molecular basis of immune responsiveness and understand how the innate and adaptive immune responses coordinate to fight invading pathogens. Understand the immunomodulatory strategies essential for generating or suppressing immune responses as required in hypersensitivity reactions, transplantation, autoimmune diseases and cancer. Learn to review the literature to determine the strengths and weaknesses of the data published in immunology and its novelty. Design new methods to improve existing vaccines and other immunotherapeutic strategies.

Books Recommended:

1. Kuby, Immunology, Mosby, 2003
2. Roit et al, Immunology, Mosby, 2000
3. Nelson et al: .Lehninger Principles of Biochemistry (3rd Ed.), MacMillan Worth, 2000
4. Berg et al: Biochemistry (5th Ed.), Freeman, 2002
5. Mathews et al.: Biochemistry (3rd Ed.), Pearson, 2004

UNIT NO.	Course learning outcome	Teaching and learning Activity	Assessment Task
I	Enrichment about the basic concepts of immunology	Lecture & Student presentations Case study.	Evaluation of students on the basis of class test I and other Written preparation exercises
II	Detailed knowledge of immune cell and organs	Discussions,use of audio, visuals, video,Students as Teachers.	Evaluation of students on the basis of Oral presentations, Seminars, Assignments.
III	Knowledge of immune interaction	Narrated or recorded lectures, Videoclips, Case studies and other problem-solving activities.	Evaluation of students on the basis of power point presentation given by students.
IV	Knowledge of immune diseases	Lecture, presentation, Expert talks.	Evaluation of students on the basis of class seminar.
V	Effective knowledge of tumor biology	Lecture &presentation, research paper related with topics.	Evaluation of students on the basis of class test II, Case Studies and assignments.

MZOO303: DEVELOPMENTAL BIOLOGY

Course Objectives:
Understand the terms: Gametogenesis, Fertilization and early development. Understand the morphogenesis and organogenesis in animals. Understand the aging, apoptosis and senescence.

UNIT-I
1. Oogenesis& Differentiation and growth of oocytes
2. Organization of egg cytoplasm and egg cortex.
3. Vitellogenesis.
4. Spermatogenesis and ultrastructure of sperm

UNIT-II
1. Fertilization
2. Biological role of fertilization
3. Biochemistry of fertilization
4. Cleavage and mechanisms of cleavages

UNIT-III
1. Fate maps
2. Presumptive areas in early embryos of
    a) 1 Amphioxus
    b) 2 Fishes
    c) 3 Amphibian
    d) 4 Birds
3. Differentiation

UNIT-IV
1. Cell and tissue interactions in development
2. Primary embryonic induction and Competence
3. Concept of organizer
4. Metamorphosis
5. Teratology

Course Outcomes:
Students learn best by doing and by having the opportunity to put what they have learned into practice. Therefore, using various model organism as a learning tool in Developmental Biology, students will learn how a cell behaves in response to an autonomous determinant or an external signal depends on the combination of transcriptional and posttranscriptional regulators, signaling pathway components, cytoskeletal elements, and other proteins and RNAs that it has synthesized earlier: i.e., on its developmental history. Students will also understand that cells only express a proportion of their genome, and that differential gene expression underlies cell differentiation and any alteration in the entire process of development leads to devastating diseases.

Books Recommended:
1. Developmental Biology, 9th edition (2010), S.F. Gilbert. Publisher – Sinauer,Associates Inc.

2. Principles of Development, 3rd edition (2007), Lewis Wolpert, Publisher Oxford, University Press.
3. An Introduction to Embryology, 5th edition (2004), B. I. Balinsky. Publisher – Thomas Asia Pvt. Ltd.
4. Developmental Biology, (2001), R. M. Twyman, Publisher - Bios Scientific, Publishers LTD.
5. Analysis of Biological Development , 2000, Klaus Kalthoff, McGrawHill Science; 2nd Ed edition

UNIT NO.	**Course learning outcome**	**Teaching and learning Activity**	**Assessment Task**
I	Enrichment about the basic concepts of developmental biology	Lecture & Student presentations Case study.	Evaluation of students on the basis of class test I and other Written preparation exercises
II	Detailed knowledge of fertilization	Discussions,use of audio, visuals, video,Students as Teachers.	Evaluation of students on the basis of Oral presentations, Seminars, Assignments.
III	Knowledge of fate mapping	Narrated or recorded lectures, Videoclips, Case studies and other problem-solving activities.	Evaluation of students on the basis of power point presentation given by students.
IV	Knowledge of mechanism of development	Lecture, presentation, Expert talks.	Evaluation of students on the basis of class seminar.

MZOO 304A: TECHNIQUES IN BIOLOGY

Course Objectives:

Understand the basic principle of instruments working and its applications for the benefit of human kind.

Understand the Principle, parts, and its application of microscopic techniques. Understand the working principle of spectrophotometer, colorimeter, and fluorimeter. Understand the working principle of Centrifuge, incubator, pH meter. Understand the cell culture techniques and separation techniques in biology and the function of Biosensors.

Unit-I

1. Photobiology: Nature, properties, spectrum of light, & interaction of light on organism.
2. Principle (magnification and resolving power) and working of compound microscope
3. Electron microscope:SEM and TEM
4. Phase Contrast and interference Microscope

Unit-II

1. pH metre: pH definition, Principles of pH meter Types of electrodes.
2. Centrifugation: Types and principles of centrifugation, Ultracentrifugation and its application.
3. Electrophoresis (Principles, types and application) electrophoresis media
4. Chromatography

Unit-III

1. Spectrophotometry and colorimetry
2. MRI
3. ELISA
4. Micrometry and microtomy

Unit-IV

1. Biosensors
2. Autoradiography
3. X-ray
4. Flow cytometry

Unit- V

1. Ultrasound
2. NMR
3. ECG
4. Endoscopy

Course Outcomes:

It is expected that a student after completing this course would have fairly good understanding of instrumentation techniques and the fundamentals of instrumentation. In near future that is the most required eligibility to perform laboratory techniques in higher studies.

Books Recommended:

1. Principles and Techniques of Biochemistry and Molecular Biology, 6th edition (2008), Keith Wilson and John Walker, Publisher–Cambridge University Press.
2. Principles and Techniques of Biochemistry and Molecular Biology, 6th edition (2008), Keith Wilson and John Walker, Publisher–Cambridge University Press.
3. Biochemical Methods, 2018, S.Sadashivam, New Age International Pvt Ltd Publishers; Third edition.

4. Ambrose E.J. &Easty D.M. – Cell Biology. ELBS/ Nelson 1973
5. Skoog D.A., Holler F.J. & Crouch S.R. – Principle of Instrumental Analysis. 6th edn. Thomson 2007
6. Willard H.H., Merritt Jr. L.L., Dean J.A. & Settle Jr. F.A. – Instrumental Methods of Analysis. 6th edn.
7. An Introduction to Practical Biochemistry,2017, David Plummer, McGraw Hill Education; 3th edition.

UNIT NO.	**Course learning outcome**	**Teaching and learning Activity**	**Assessment Task**
I	Enrichment about the basic concepts of photobiology	Lecture & Student presentations Case study.	Evaluation of students on the basis of class test I and other Written preparation exercises
II	Detailed knowledge of chemical detection	Discussions,use of audio, visuals, video,Students as Teachers.	Evaluation of students on the basis of Oral presentations, Seminars, Assignments.
III	Knowledge of spectroscopy	Narrated or recorded lectures, Videoclips, Case studies and other problem-solving activities.	Evaluation of students on the basis of power point presentation given by students.
IV	Knowledge of magnetic imaging	Lecture, presentation, Expert talks.	Evaluation of students on the basis of class seminar.
V	Effective knowledge of ultra sound imaging	Lecture &presentation, research paper related with topics.	Evaluation of students on the basis of class test II, Case Studies and assignments.

MZOO 304B: HORMONE RECEPTORS, AND SIGNALING MECHANISMS

Unit 1:

1. Control of hormone secretion-
    a. Synthesis,
    b. processing,
    c. sorting of preprohormone Precursor,
2. Sequential stages of the regulated secretory pathway,
3. Dense-cored granule Exocytosis,
4. Regulation of exocytosis by calcium and protein kinase C

Unit 2:

1. Receptors –
a. Nuclear receptors,
b. Structure,
c. Families
d. (glucocorticoid, thyroid and estrogen),
e. Metabolism,
2. Activation and recycling

Unit 3:

1. Membrane receptors,
2. Enzyme-linked receptors,
3. Cytokine receptors,
4. G-Protein coupled receptors,
5. Ligand gated ion channels

Unit 4:

1. Hormone signaling-
2. Receptor tyrosine kinase pathway,
3. Cytokine receptors pathway,
4. Cyclic AMP pathway,
5. Phospholipid/calcium- protein kinase C pathway,
6. Nitric oxide signaling pathway,
7. MAP kinase pathway,
8. Hormonal control of gene expression

Unit 5:

1. Molecular basis of hormone synergism and antagonism,
2. Glycogen metabolism Smooth muscle

3. contraction, Termination of hormone action
4. Pathophysiology of hormone receptors,
5. Hormone analogues as drug and xeno-estrogens

Books recommended:

1. Bolander: Molecular Endocrinology (3rd ed 2006, Elsevier)

2. DeGroot and Jameson: Endocrinology, Vol 1 (5th ed 2006 Saunders)

3. Larson: Williams Textbook of Endocrinology, (10th ed 2002, Saunders)

4. Alberts et al: Molecular Biology of the Cell (4th ed 2002, Garland)

5. Squires: Applied Animal Endocrinology (2003, CABI publications)

UNIT NO.	**Course learning outcome**	**Teaching and learning Activity**	**Assessment Task**
I	Enrichment about the basic concepts of hormone secretion	Lecture & Student presentations Case study.	Evaluation of students on the basis of class test I and other Written preparation exercises
II	Detailed knowledge of hormone classification	Discussions,use of audio, visuals, video,Students as Teachers.	Evaluation of students on the basis of Oral presentations, Seminars, Assignments.
III	Knowledge of hormone receptors	Narrated or recorded lectures, Videoclips, Case studies and other problem-solving activities.	Evaluation of students on the basis of power point presentation given by students.
IV	Knowledge of interaction mechanism	Lecture, presentation, Expert talks.	Evaluation of students on the basis of class seminar.
V	Effective knowledge of molecular cross talk	Lecture &presentation, research paper related with topics.	Evaluation of students on the basis of class test II, Case Studies and assignments.

MZOO305A: Wild Life and Conservation Biology

Course Objectives:

To know the principles of evolution, and wildlife and conservation biology and how they are used to manage wildlife and solve environmental problems.

Unit 1

1. Wildlife in India & threatened wildlife.
2. Reasons for wildlife depletion in India.
3. Wildlife conservation approaches and limitations.
4. National and State mammals and birds of India.
5. Wild life Habitat- Characteristic, Fauna and Adaptation with special reference to Tropical forest.
6. Protected Area concept: National Parks, Sanctuaries and Biosphere Reserves, cores and Buffers, Nodes and corridors. Community Reserve and conservation Reserves

Unit 2

1. Management of Wildlife- Red Data Book and Conservation status (endangered, vulnerable, rare, threatened and near threatened species).
2. Wild life Trade & legislation- Assessment, documentation, Prevention of trade.
3. Policies and laws in Wild life management (national) and ethics.
4. Habitat utilization pattern, threats to survival of Slender Loris, Musk deer, Great Indian Bustard, Olive Ridley turtle.

Unit 3

1. Biodiversity extinction and conservation approaches- Perspectives and Expressions.
2. Identification and prioritization of ecologically sensitive area (ESA). Coarse filter and fine filter approaches.
3. Regional and National approaches for biodiversity conservation.
4. Theory and analysis of Conservation of populations

Unit 4

1. National and International efforts for conservation- Information on CITES, IUCN, CBD
2. Convention on wetlands of International Importance (Ramsar convention).
3. Important projects for the conservation of endangered species in India.
4. Conservation of Natural Resources- Resources: Types and Degradations

Unit 5

1. Principles of Remote Sensing and Geographical Information System
2. Basic components of RS & GIS
3. Various software used in RS & GIS
4. Application of RS & GIS in biodiversity conservation

Course Outcomes: At the completion of their Wildlife and Conservation Biology course, students will be able to understand the necessity of wildlife conservation in a better way. Indulge themselves more into the sustainable development and will understand the reason of conflict between the wild and mankind.

Books Recommended:

1. Groom, M. J., Meffe, G. R. and C. R. Carroll. 2006. Principles of Conservation Biology. Sinauer Associates, Inc., USA.
2. Krishnamurthy, K. V. 2003. Textbook of Biodiversity. Science Publication.

3. Primack, R. 2006. Essentials of Conservation Biology.Sinauer Associates, Inc., USA.
4. Hambler, C. 2004. Conservation. Cambridge University Press.
5. Van Dyke,F.2008.Conservation Biology Foundations, Concepts, Applications 2nd Edition, Springer.

UNIT NO.	Course learning outcome	Teaching and learning Activity	Assessment Task
I	Enrichment about the basic concepts of wild life in India	Lecture & Student presentations Case study.	Evaluation of students on the basis of class test I and other Written preparation exercises
II	Detailed knowledge of biodiversity	Discussions,use of audio, visuals, video,Students as Teachers.	Evaluation of students on the basis of Oral presentations, Seminars, Assignments.
III	Knowledge of species conservation	Narrated or recorded lectures, Videoclips, Case studies and other problem-solving activities.	Evaluation of students on the basis of power point presentation given by students.
IV	Knowledge of wild life regulations and jurisdictions	Lecture, presentation, Expert talks.	Evaluation of students on the basis of class seminar.
V	Effective knowledge of modern technologies used	Lecture &presentation, research paper related with topics.	Evaluation of students on the basis of class test II, Case Studies and assignments.

MZOO305B: ANIMAL BEHAVIOR

Course Objectives:

Behavior is one of the most important and interesting aspects of animal biology. Behaviors permit flexibility that allows animals to respond rapidly to environmental changes. This course exposes students to the broad field of animal behavior. Students will come to understand the historical foundations of the field, as well as current theories and evidence for a broad range of behavioral topics. Students also participate in practical exercises to learn some fundamental techniques used to study behavior, and will practice reading and analyzing current scientific literature. Behavioral ecology and the evolution of behaviors as adaptations will be recurring themes interwoven through all topics discussed. The purpose of the Animal Behavior Laboratory is for students to have hands-on experiences designing and implementing experiments that concern a variety of behavior.

Unit 1

1. Behavior: Definition - Innate behavior, learning, reasoning, motivation, conflict and sexual behavior.
2. Migration and homing with special reference to birds.
3. Communication in animals: Visual, olfactory, auditory and tactile.
4. Camouflage and Mimicry – types of mimicry

Unit 2

1. Ecological Aspects of Behavior: Habitat selection, food selection and optimal foraging theory, anti-predator defense mechanisms, aggression, territoriality and dispersal.
2. Social Behavior: Aggregations – Schooling in fishes, flocking in birds
3. Group selection, kin selection, altruism, inclusive fitness.
4. Social organization in insects and primates.

Unit 3

1. Reproductive Behavior: Evolution of sex and sexual selection
2. Reproductive strategies, mating systems, courtship, sperm competition, and parental care.
3. Hormones and behavior,
4. Pheromones and behavior.

Unit 4

1. Biological rhythms: Circadian, circannual, tidal/lunar
2. Synchronization of biological rhythms, phase shift.
3. Photoperiodism with reference to birds
4. Mammals - human circadian rhythms.

Unit 5

1. Introduction to human behavior
2. Human nonverbal communication
3. Linking behaviors to the brain, genes
4. Hormones and environment

Course Outcomes: At the completion of their Animal Behavior course, students will be able to exhibit critical and integrative thinking skills about different animal activities. Demonstrate ability to communicate scientific information in both oral and written formats. Demonstrate

knowledge of key concepts in animal behavior. Exhibit quantitative research skills (or demonstrate ability to perform all parts of the scientific method). Demonstrate ability to think flexibly and apply knowledge to new problem.

Books recommended:

1. Alcock, J. 2009. Animal Behavior: An Evolutionary Approach. Sinauer Associates, Inc., USA.
2. Boitani, L. & Fuller T.K. 2001.Research Techniques in Animal Ecology: Controversies andConsequences.Columbia University Press, 464pp.
3. Dawkins, M.S. 2007. Observing Animal Behaviour: Design And Analysis of Quantitative Data.Oxford University Press, USA.
4. Gotelli, N. 2001.A Primer of Ecology.Sinauer Associates, Inc., USA.
5. Krebs, C. J. 1999. Ecological Methodology. Addison-Wesley, New York.
6. Manning, A. & Dawkins, M.S. 2012.An Introduction to Animal Behaviour.Cambridge UniversityPress, 458pp.
7. Mathur, M. 2005. Animal Behaviour.Rastogi Publications, Meerut, India.

UNIT NO.	**Course learning outcome**	**Teaching and learning Activity**	**Assessment Task**
I	Enrichment about the basic concepts of Animal Behavior	Lecture & Student presentations Case study.	Evaluation of students on the basis of class test I and other Written preparation exercises
II	Detailed knowledge of ecological aspects	Discussions,use of audio, visuals, video,Students as Teachers.	Evaluation of students on the basis of Oral presentations, Seminars, Assignments.
III	Knowledge of reproductive behavior	Narrated or recorded lectures, Videoclips, Case studies and other problem-solving activities.	Evaluation of students on the basis of power point presentation given by students.
IV	Knowledge of biological rhythm	Lecture, presentation, Expert talks.	Evaluation of students on the basis of class seminar.
V	Effective knowledge of human behavior	Lecture &presentation, research paper related with topics.	Evaluation of students on the basis of class test II, Case Studies and assignments.

MZOO 306P
LAB COURSE-V:

1. pH meter
2. Determination of pH of different soil and water samples.
3. Spectrophotometer: Preparation of absorption spectrum.
4. Chromatography: Paper and thin layer chromatography.
5. Electrophoresis: Paper and gel electrophoresis.
6. Microscope: Parts study and principles of various microscopes.
7. Problems on genetics (complete and incomplete linkage; dominance, sex-linked inheritance)
8. Demonstration of Hardy-Weinberg law
9. Experiments based on population genetics, pedigree analysis.
10. Determination of phenotypic and genotypic ratio by mendelian principles.

Practical Outcomes:

Students will be able to design experiments for understanding the advanced functional genomics.

They will be understanding the basics of instrumentation techniques and the fundamentals of instrumentation.

MZOO 307P
LAB COURSE-VI:

Parts study, principles and use of following instruments for different techniques:

1. Study of slides of development of frog.
2. Study of development of Hen's egg, by cover glass window method, staining and mounting of blastodisc.
3. Study of caudal regeneration in Teleost (Meal time effect).
4. Study of embryological slides: spermatogenesis, oogenesis, histology of gonads.
5. To study the development of drosophila.
6. To study the agglutination reaction in various blood samples
7. To determine the concentration of antigen and antibody by ELISA techniques.
8. To study the precipitation reaction of an antigen and antibody.
9. To determine the concentration of an antigen in a biological fluid by using radial immunodiffusion technique.
10. To study the type-I hypersensitivity reaction.

Practical Outcome;

Students will be using various model organism as a learning tool in developmental biology. Understand the immunomodulatory strategies essential for generating or suppressing immune responses as required in hypersensitivity reactions, transplantation, autoimmune diseases and cancer.

M. SC. ZOOLOGY SEMESTER – IV

MZOO 401P Dissertation and Viva-voice

Research problem and research design: Selecting research problem; necessity of defining a problem; techniques involved in defining the problem; meaning of research design; need for research design; important concepts related to research design; different research designs; basic principles of experimental design; important experimental designs. Interpretation and report writing: Meaning of interpretation; technique of interpretation; precautions in interpretation; significance of report writing; layout of research report; types of reports; Presentation of research work- _oral, poster and writing research paper; Precautions for writing research report.

Review of related literature: Understanding the role of review; how to begin a search for related literature- _Library reference, recording and indexing, classification of references, internet sites for biological references; downloading the information through internet; requests for reprints through e- mail and post; classification and filing of reprints. Writing research proposal: Characteristics of a proposal; content and organization of a proposal; weakness in proposal seeking funding.

Defining research question, Approaches and Methodology, Documentation and presentation of data, Analysis and Interpretation of Data, writing of research proposal, report and Research paper: Meaning and types – Structure –Documentation: Footnotes and Bibliography-Editing the final draft –Evaluating the final draft –Checklist for the good proposal /research/report.