



## **Masters of Science (Zoology)**

### **Program Outcome**

- PO-1) This programme on M. Sc. Zoology is a two years course spanning four semesters and covers almost all areas of the vast field of Zoology. It considers both the classical aspects and the modern fields and technologies, giving students a wholesome knowledge base and equipping them to take the profession of their choice in future, be it in the field of academics and research or in the research and development industries.
- PO-2) The programme comprises of several units or modules viz, functional biology, molecular biology of the cell, genetics, environmental science, biochemistry, bioinstrumentation, biostatistics, evolutionary biology & population genetics, immunology, developmental biology, endocrinology, ethology and practical papers covering all of these.
- PO-3) The fourth semester of the course is devoted to letting the students specialize in one particular field and accordingly has several special papers namely Cell and Molecular Biology, Fish and Inland Fisheries, Environmental Biology, Entomology, Parasitology, Cytogenetics and Comparative Endocrinology. Students can opt any one of the course and are allotted special paper based on the number of seats and facilities (of the respective special paper) available.
- PO-4) While the course is mostly basic aimed at giving students insights into the very intricate science of living beings, it also includes certain applicative aspects which the students with all the basic knowledge can hone in the future. The applicative aspects include knowledge about the modern genetic tools, biochemical and bio statistical tools, assisted reproductive technology, stem cell biology, recombinant DNA technology (cell and molecular biology elective) and fresh water aquaculture, fish pathology, fish biotechnology, fisheries resources and post harvest technology(fish and inland fisheries elective). The course has been designed keeping in view the requirement of equipping the young generation with basic knowledge as only when they understand the intricate web of things that makes things right (read the living system), will they be able to device ways of mitigation when some functioning of the body goes wrong.
- PO-5) At the end of the course, students will be equipped to take up basic research aimed at adding to the vast repertoire of knowledge already there so that they can be brought to use later and also applied research aimed at curing a hell lot of maladies in terms of health plaguing the world as also for revenue generation. The course is also perfectly designed for students who want to take up academic.



## Course Outcome

Sl. No.	Course Code	Course Name	Learning Outcomes
<b>SEMESTER-I</b>			
1.	CC 1	<b>Functional Biology of Invertebrates and Chordates</b>	<p>At the end of this course students will get a basic idea about the functional biology (workings) of various systems and organisms (vertebrates and invertebrates) as a whole. This would include:</p> <p>CO1. The concept of organization of coelom and its significance.</p> <p>CO2. Patterns of feeding and digestion in invertebrates.</p> <p>CO3. Invertebrate larvae and their evolutionary significance.</p> <p>CO4. Mechanism of respiration in invertebrates and vertebrates and respiratory adaptations in higher altitude and diving mammals.</p> <p>CO5. Patterns of osmoregulation and nitrogenous excretion in different phylogenetic.</p> <p>CO6. Mechanism and energetics of muscle contraction (skeletal).</p> <p>CO7. Physiology of electrical and synaptical transmission in neurons, neurotransmitters and their functions and the acoustic laterals system and electroreception in aquatic vertebrates.</p>
2.	CC 2	<b>Molecular Cell Biology</b>	<p>At the end of this course, students will be equipped with a thorough knowledge of the cellular territory. They would:</p> <p>CO1. Understand the structure and function of bio membrane (viz transportation of molecules in and out of cells, signal transduction etc.) in details.</p> <p>CO2. Comprehend the structure and dynamics of the interlinking protein filaments of the cytoplasm, microtubules and microfilaments especially kinesin and dynein.</p> <p>CO3. Get a picture of how the genetic material or DNA replicates in prokaryotes and eukaryotes and also in the phages.</p>



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Sl. No.	Course Code	Course Name	Learning Outcomes
			<p>CO4. Understand the process of transcription of DNA code into RNA both in pro and eukaryotes.</p> <p>CO5. Get a detailed idea about the mechanism of 'Translation' the code contained within RNA into proteins in prokaryotes and eukaryotes (viz initiation, elongation and termination) so that they are able to distinguish between the subtle differences and thereby the relative complexities of the two processes.</p> <p>CO6. Able to appreciate the travel of different kinds of proteins within the cell according to their functions. They would also be acquainted with various modifications that proteins undergo both during and after the process of translation viz glycosylation, phosphorylation, ubiquitination, nitrosylation etc. of specific moieties according to their final destination.</p> <p>CO7. Learn about the vesicular trafficking system through the endoplasmic reticulum, through the golgi bodies and lysosomes.</p>
3.	CC 3	Genetics	<p>The course on genetics will take students through the nuances of genetics covering the classical and the modern aspects in details. Here students would:</p> <p>CO1. Get introduced to the organization of DNA in prokaryotic and eukaryotic chromosomes.</p> <p>CO2. Learn about the different types of heterochromatic and their organization.</p> <p>CO3. Learn the detail of the giant chromosomes viz lampbrush and polytene chromosomes and their significance.</p> <p>CO4. Gain sound knowledge about the genetics of bacteria and viruses. The focus will be on the modes of genetic exchange in bacteria through the processes of transformation, conjugation, sex-duction and transduction they would be able to grasp the horrifying problem of emergence of multi drug resistant (MDR) strains of microorganisms.</p> <p>CO5. Learn about the construction of linkage maps in bacteria by looking at the frequency of recombinants in an interrupted mating experiment.</p>



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			<p>CO6. Get extensive knowledge about the intricate mechanism of recombination both in prokaryotes and eukaryotes.</p> <p>CO7. Be able to appreciate the myriads of preparation a cell has to undertake during cell division. They will understand what molecules are required during alternating growth phases (G1 and G2 Phases) with a synthesis (S phase) and mitotic/meiotic phases (M phase).</p> <p>CO8. Delve deep into the science of cell cycle check points where they would get to know about the various molecular checks that a cell has to undertake while moving from one point to the other which makes the cell cycle a robustly regulated process.</p> <p>CO9. Be acquainted with the varied sex determination strategies adopted by different organism viz C. elegans, Drosophila and humans whereby they would be able to appreciate the evolution of sex and would be able to develop hypothesis on the evolutionary significance of sex determination strategies.</p> <p>CO10. Get a theoretical training on the various genetical methods and techniques in the fields of medicine, anthropology, research, forensics etc. Example: DNA sequencing, Polymerase Chain Reaction (PCR) and its various applications and limitations, DNA fingerprinting using different markers and the methods used to analyse genome expression, like the various blotting techniques, rt PCR and microarray.</p>
4.	CC 4	Practical	<p>The students would get hands on training on:</p> <p>CO1. How to make squash preparation of onion root tips and identify the different stages of mitosis.</p> <p>CO2. Calculation of mitotic index.</p> <p>CO3. Polytene squash preparation from third instars larvae of Drosophila.</p> <p>CO4. Calculation of the number of RBCs in a known volume of diluted blood and simulating the number of RBCs in one cmm of undiluted blood using haemocytometer.</p>



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			<p>CO5. Preparation of histological slides (staining and dehydration) and also whole mount preparation of vertebrate larvae.</p> <p>CO6. Calculation of risks of any genetic disorder through pedigree analysis and construction of linkage maps of the Drosophila chromosomes using data from two and three point test crosses.</p> <p>CO7. Maintenance of class records during experiment.</p> <p>CO8. Making charts/Models.</p>
5.	AECC 1	<b>Environmental Sustainability and Swachha Bharat Abhiyaan Activities</b>	<p>CO1. Students will get the knowledge about the environment and its components in which one survives.</p> <p>CO2. Students will learn how to take care of the surroundings in general. The field work during the completion of the course will make student responsible for their ecosystem.</p> <p>CO3. During the course, students will get to know about so many elements of general studies that can really help them in competitive examinations as well as in day to day activities.</p>
<b>SEMESTER-II</b>			
6.	CC 5	<b>Environmental Science</b>	<p>In this course students will get a thorough understanding of the abiotic (non living such as light, temperature etc.) and biotic factors (living things) of the ecosystem. They will:</p> <p>CO1. Learn about energy flow through the producers (plants) to the primary, secondary and tertiary consumers through Lindman's rule of the trophic dynamics and the energy flow models.</p> <p>CO2. Go through the various biogeochemical cycles to understand the cycling of carbon, sulphur and phosphorous through the biotic (biosphere) and abiotic (atmosphere, hydrosphere and lithosphere) compartments of the earth.</p> <p>CO3. Learn about the water or hydrological cycle and gain a thorough understanding of the continuous circulation of water in Earth-atmosphere system.</p>



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			<p>CO4. Get the concept of factors compensation by ecotypes (genetically distinct variety within a species) to adapt to the limiting effects of the environmental variables.</p> <p>CO5. Be equipped with a thorough knowledge about the size, structure and movements of populations over space and time through the concepts of life tables, generation time, reproductive rate, population growth, intrinsic and extrinsic mechanisms of population regulation etc.</p> <p>CO6. Get the concept of niche or spatial patterns of ecological communities, resource partitioning (division of limited resource by species) and character displacement (and evolutionary change by a species to avoid competition with another species inhabiting the same environment.</p> <p>CO7. Be able to deliberate upon the global environmental issues such as climate change, water security, wildlife conservation etc.</p> <p>CO8. Learn about calculation of carbon footprints (total greenhouse gas emission caused by an individual event, organisation etc.), the causes of extinction of certain species, the various wildlife conservation efforts such as national parks, sanctuaries, biosphere reserves, wildlife protection acts etc.</p> <p>CO9. Comprehend what pollution is and the causes, effects and control of water and air pollution. They will also know about thermal and radioactive pollution and the emerging pharmaceutical and POP pollutants. They will gain a know how about bio magnification and eutrophication and other bio-indicators as index of pollution.</p>
7.	CC 6	<b>Bioinstrumentation and Biostatistics</b>	<p>The course would let students have sound knowledge of various bioinstruments and biostatistical tools. Student will:</p> <p>CO1. Learn about the principle, working and uses of various analytical instruments commonly use in a biochemistry laboratory like a pH mete, colorimeter, spectrophotometer and ultra-cenrifuge.</p>



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			<p>CO2. Be acquainted with the principle and working of different types of microscopes from the basic light microscopy, dark field and phase contrast microscopy to fluorescent, confocal and electron microscopy.</p> <p>CO3. Get the knowledge of the various separation techniques viz chromatography, electrophoresis, flow cytometry and density gradient centrifugation (for cell separation) and their uses.</p> <p>CO4. Learn about the various immunological techniques like RIA and ELISA for quantitative measurement of specific substances in blood or saliva.</p> <p>CO5. Get an idea of the basic tenets of biostatistics like sampling, data collection and the various scaling techniques.</p> <p>CO6. Learn about the different kinds of means and methods to calculate mean, standard deviation and standard error in different kinds of data sets: nominal, ordinal, discrete and continuous.</p> <p>CO7. Be introduced to ANOVA to compare means of more than two groups of data.</p> <p>CO8. Be able to drive equations describing the strength and direction of relation between variables through their knowledge of correlation and regression.</p> <p>CO9. Get the basic concept and rules of probability for hypothesis testing.</p>
8.	CC 7	Biochemistry	<p>In this course concerning biochemistry, students will get a thorough understanding of the various metabolic/biochemical reactions and how interlinked they are working in coordination. They will:</p> <p>CO1. Get the concept of enthalpy, entropy and free energy in relation to the laws of thermodynamics.</p> <p>CO2. Be able to discern how the metabolic processes (the chemical reactions occurring within a cell) cause release as well as trapping of energy.</p>



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SI. No.	Course Code	Course Name	Learning Outcomes
			<p>CO3. Get detailed knowledge about cellular respiration which culminates in electron transport chain and oxidative phosphorylation.</p> <p>CO4. Be taken to the world of sugars. Where they will learn about the different types of sugars or carbohydrates viz monosaccharides &amp; disaccharides (having low molecular weight), oligosaccharides and polysaccharides (both hetero and homo) with examples.</p> <p>CO5. Learn about the chief metabolic pathways that glucose undergoes like the process of glycolysis, the hexose monophosphate pathway, the process of gluconeogenesis (formation of glucose from non-sugar precursors and glycogenolysis (breakdown of glycogen- a polymer of glucose) to yield free glucose.</p> <p>CO6. Master most knowledge about proteins and fatty acids. They will learn about the primary, secondary, tertiary and quaternary structures of proteins and the stabilizing forces (apart from the peptide bonds) in protein structure.</p> <p>CO7. Be acquainted with the Ramachandran plot which can be used to predict the stereochemistry and geometry of proteins.</p> <p>CO8. Learn about the biosynthesis of urea in liver cells which is formed from ammonia produced as a result of catabolism of proteins in cells.</p> <p>CO9. Get extensive knowledge of the fatty acids: their synthesis, importance and metabolism through beta oxidation.</p> <p>CO10. Get a thorough understanding of enzymes: their classification, nomenclature, mechanism of action and kinetics of the enzyme catalyzed reactions. They will also learn about the regulation of enzyme action through feedback inhibition and allosteric inhibition.</p> <p>CO11. Get the concept of free radicals and ways to mitigate the damage caused by them.</p> <p>CO12. Know the basics of histochemical techniques along with preparatory steps before staining.</p>





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SI. No.	Course Code	Course Name	Learning Outcomes
			CO13. Learn about the types of fixatives and the general principle of tissue fixation. They will be given detailed idea about the process of staining specific biomolecules such as carbohydrates, proteins, lipids and nucleic acid in histochemical slides.
9.	CC 8	<b>Biosystematics and Evolution</b>	<p>This course will give students a thorough idea of biosystematics and evolution. They will:</p> <p>CO1. Get the basic concept of nomenclature, taxonomy and classification of animals and the basic of grouping.</p> <p>CO2. Be familiarized with the International Code of Zoological nomenclature (ICZN) its operative principles, and important rules, Zoological nomenclature and scientific names of various taxa.</p> <p>CO3. Be made aware of the modern branches of taxonomy viz Chemo – taxonomy, cyto-taxonomy and molecular taxonomy. They will also get the concept of 'species' which falls at the end of the systematic hierarchy.</p> <p>CO4. Be trained to appreciate and understand the basis of the eclectic variation and the vast diversity of living organisms that one sees around.</p> <p>CO5. Be taken to the variation that exists at the molecular level: polymorphism found at the level of proteins, chromosome structure and ultimately at the level of nucleotide sequence. They will also be given the concept of how the force of evolution, i.e. natural selection acts upon the diversity in varied ways.</p> <p>CO6. Understand the trending theory of evolutionary biology i.e. Molecular evolution concerned with evolutionary changes at the level of DNA sequence.</p> <p>CO7. Understand the neutral theory of molecular evolution and appreciate how most evolutionary changes occur at molecular level and they are mostly due to random genetic drift of the mutant alleles which are selectively neutral.</p> <p>CO8. How new genes evolve and the concept of gene families based on shared nucleotide sequences.</p>



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			<p>CO9. Get a thorough know how about the patterns and mechanisms of reproductive isolation which causes the coming up of new species. They will also get to know about the role of geographic barriers and spatial separation in speciation.</p> <p>CO10. Get the concept of population genetics whereby they would learn about gene pools, allelic frequencies, genotypic frequencies, calculation of genotypic frequencies from allelic frequencies and vice versa. They will be given the concept of Hardy-Weinberg equilibrium.</p>
10.	CC 9	Practical	<p>CO1. In this practical paper students will be trained to perform some very important and useful biochemical tests such as:</p> <ul style="list-style-type: none"><li>• Determination of salivary amylase activity.</li><li>• Colorimetric estimation of glucose, urea and uric acid in urine samples.</li><li>• Separation of amino acids by paper chromatography and biochemical detection of glucose by Benedict's test.</li></ul> <p>CO2. Students will learn to identify figures of:</p> <ul style="list-style-type: none"><li>• Archaeopteryx</li><li>• Darwin's finches</li><li>• Beaks of birds showing adaptive radiation</li><li>• Homologous (organs having same structure but different functions) and analogous organs (organs having different structures but performing the same function) and know about their evolutionary significance.</li><li>• They will also learn to arrange the cephalothoracic appendages of prawn exhibition serial homology.</li></ul> <p>CO3. Students will be demonstrated different kinds of staining techniques such as:</p> <ul style="list-style-type: none"><li>• Periodic acid Schiff (PAS) staining technique for detection of glycogen in histochemical sections,</li><li>• Sudan black B staining technique for detection of lipids,</li><li>• Methylgreen pyronin staining technique for detection of nucleic acids DNA and RNA respectively and</li><li>• Mercury bromophenol staining technique for detection of proteins</li><li>• Students will also learn how to make temporary mounts and identify planktons from given sample.</li></ul>



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			<p>CO4. Students will get hands on training on some experiments useful for environmental studies such as:</p> <ul style="list-style-type: none"><li>• Measurement of pH of water sample,</li><li>• Estimation of dissolved O<sub>2</sub> in water sample</li><li>• Estimation of total hardness</li><li>• Estimation of free CO<sub>2</sub></li><li>• Estimation of carbonate &amp; bicarbonate alkalinity etc.</li></ul> <p>CO5. In addition they will also know to assess the composition and taxonomic diversity in any given habitat:</p> <ul style="list-style-type: none"><li>• Students will learn to find out standard deviation and standard error from a given sample.</li><li>• They will also learn to work out correlation or regression between two data sets and compare means of two samples by performing student t-tests.</li></ul> <p>CO6. They will learn how to record results of experiments and prepare class record accordingly.</p>
11.	SEC 1	Skill Enhancement Course: Yogic Science	<p>CO1. Students will learn the theoretical foundations of Yoga philosophy.</p> <p>CO2. Students will equip themselves with a fair number of yogic practices including meditative techniques.</p> <p>CO3. Yogic knowledge and practices will help the students to revitalise themselves and work with more attention.</p>
<b>SEMESTER-III</b>			
12.	CC 10	Vertebrate Immunology	<p>After completing the course, students will be able to:</p> <p>CO1. Grasp the concept of antigenicity and immunogenicity and the subtle difference between them.</p> <p>CO2. Get a thorough idea about the structure of the B and T cells.</p> <p>CO3. Comprehend the importance of antigen presentation by the B cells, dendritic cells and NK cells.</p> <p>CO4. Understand major histocompatibility complex (MHCs), their gross and fine structures and their different classes and sub-classes.</p>



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SI. No.	Course Code	Course Name	Learning Outcomes
			<p>CO5. Get in-depth knowledge about antigen-antibody interaction, the specificity of binding and the agglutination and precipitation process.</p> <p>CO6. Understand the complement system which is a cascade of reactions that basically aims at clearing microbes and damaged cells from the system and the cytokines, which affects the growth of blood and other immune cells and help in mounting immune and inflammatory response.</p> <p>CO7. Understand the process of generation of antibody and T cell receptor diversity through a specific type of recombination process that occurs in the B and T cells called the VDJ recombination.</p> <p>CO8. Understand the cause and consequences of hypersensitivity reactions (overactivation/undesirable reactions with examples).</p> <p>CO9. Learn about autoimmunity whereby body's own system is attacked by its immune cells and its causes. Next, they would be made aware of the immune responses to bacterial, viral and parasitic (protozoa and helminth parasites) infections.</p> <p>CO10. Learn about immunodeficiencies or immunocompromisation whereby the immune system's ability to fight infections is compromised.</p>
13.	CC 11	<b>Gamete and Developmental Biology</b>	<p>The course will let students have sound knowledge of gamete and developmental biology.</p> <p>CO1. The nuances of gamete biology and learn about spermatogenesis, growth and differentiation of ovarian follicles in a cyclical manner and oogenesis.</p> <p>CO2. Phenomenon of ovulation which happens cyclically after a female attains puberty.</p> <p>CO3. Transport of ovum through the fallopian tube.</p> <p>CO4. The molecular events occurring when sperm meets an ovum.</p> <p>CO5. In vitro oocyte maturation.</p> <p>CO6. Super ovulation, In vitro-fertilization.</p>



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			<p>CO7. Intra cytolaplasmic sperm injection, gamete intralafallopian transfer etc.</p> <p>CO8. Methods of collection and preservation of gametes, and also</p> <p>CO9. Methods of immunocontraception.</p> <p>CO10. Altering cell potencies throughout development.</p> <p>CO11. Differentiation of genetically identical cells viz commitment, specification and determination.</p> <p>CO12. Morphogenetic gradients created by certain cytoplasmic determinants already present in the egg which kickstarts differentiation and decide cell fates during the initial stages of development.</p> <p>CO13. The dorso- ventral and antero posterior axis formation in Drosophila which has been worked out in details and will give a fair idea about axis formation in general.</p> <p>CO14. Limb development and regeneration in vertebrates which will give an understanding of the mechanism of cell –cell signaling in controlling embryonic development.</p> <p>CO15. The definition and characteristics of stem cells and about the different types of stem cells based on their potencies location etc.</p> <p>CO16. The niti-grities of nuclear reprogramming and Ipsc (induced pleuripotent stem cells) which has been the subject of huge interest in the recent times.</p> <p>CO17. The applications of stem cells and therapeutic cloning for development of embryonic stem cells which can be used in therapeutics or research for understanding a disease or development of better treatment strategies.</p>



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SI. No.	Course Code	Course Name	Learning Outcomes
14.	CC 12	Vertebrate Endocrinology	<p>This course will give students a thorough understanding of vertebrate endocrinology, its various aspects and its aims and scopes. After completing the course, students will:</p> <p>CO1. Understand how hormones secreted by the different endocrine glands, travel through the blood to distinct target sites and work as chemical messengers.</p> <p>CO2. Get a thorough idea about the neuroendocrine system which involves the interaction maintaining homeostasis, regulating reproduction, metabolism, eating and drinking, behavior, energy utilization, osmolarity and blood pressure.</p> <p>CO3. Understand the vital role of the endocrine system in reproduction both in case of seasonal breeders and in continuous breeders.</p> <p>CO4. Learn about the biosynthesis of different types of hormones.</p> <p>CO5. Understand the mechanism of hormone action which is mediated through various receptors.</p> <p>CO6. Appreciate the role and importance of second messengers during signal transduction through the hormones and the different intracellular signaling pathways affecting the ultimate effect of hormones.</p>
15.	CC 13	Animal behavior	<p>This course will give students an understanding of the intricacies of behavior. At the end of the course they would be able to understand:</p> <p>CO1. The approaches and methods of studying behavior viz observation, experimentation, clinical, survey, genetic methods etc.</p> <p>CO2. Patterns of different behaviors like innate which is present from birth and need not be learnt and learned behavior like trial and error learning, reasoning, cognition etc.</p> <p>CO3. Social behavior of insects (Honey bees, ants and termites), schooling in fish, flocking in birds, social organization of primates and parental care in fish.</p>



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			<p>CO4. The concept of altruism, reciprocal altruism, inclusive fitness, group selection and kin selection and learn how behaviors like altruism and kin selection have been selected because they provide fitness advantage to the species although reducing individual fitness.</p> <p>CO5. How sex evolved and why a chunk of energy is devoted to devising reproductive strategies.</p> <p>CO6. The concept of mate recognition system and species courtship rituals. Finally they would also learn about parental behaviours: parental care and parental investment.</p> <p>CO7. The biological rhythms: the circadian (24hrs), circannual (yearly), the lunar-tidal (24.8 hrs) and epicycles. They would also learn about navigation, orientation and also migration in fish and birds.</p> <p>CO8. The mechanism of control of behavior, neural and hormonal. They would also be made aware of the ecological aspects of behavior like habitat selection, optimal foraging theory and aggressive behavior.</p>
16.	CC 14	Practical	<p>Students will be given hand on training on:</p> <p>CO1. Determination of blood group using ABD antisera.</p> <p>CO2. Blood film preparation and identification of different WBCs under the microscope.</p> <p>CO3. Observing the features of the transverse sections of different endocrine glands viz, hypothalamus, thyroid, pancreas, ovary, testis etc.</p> <p>CO4. Identification of the embryological slides such as blastula, gastrula etc. of frog.</p> <p>CO5. Identification of chick embryos at different hours of development like 24, 48, 72, 96 hrs etc.</p> <p>CO6. Throughout the course students will get trained on keeping practical records.</p>
17.	AECC 2	Human values and professional ethics and gender	<p>CO1. Students will get the knowledge about values regarding humanity, gender equality and professionalism.</p>



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		<b>sensitisation</b>	<p>CO2. Students will learn how to work together in an empathetic and unbiased way. The field work during the completion about the dignity of a human being.</p> <p>CO3. During the course, students will acquaint themselves with such notions of morality that they will find it more easy to work together in a group in a co-operative and productive way.</p>
<b>SEMESTER-IV</b>			
18.	EC 1A	<b>Cell and Molecular Biology</b>	<p>Students opting for this elective course in their final semester will get a thorough knowledge about different aspects of cell and molecular biology. After finishing the course they will:</p> <p>CO1. Get a thorough idea about the basic mechanism of and regulation of gene expression in eukaryotes and prokaryotes.</p> <p>CO2. Get detailed information about cancer biology and apoptosis.</p> <p>CO3. Understand the details of the functional architecture of the interphase nucleus and nuclear envelop which will include transcription, pre-mRNA splicing, ribosome assembly and transport of mRNA and ribosome subunits outside into the cytoplasm.</p> <p>CO4. Learn about the special nuclear domains called nucleolus which is responsible for the assembly of ribosome, alteration of t RNA and sensing cellular stress.</p> <p>CO5. Understand the mechanism of biogenesis of ribosomes.</p> <p>CO6. Learn about the mechanism of nuclear cytoplmic exchange.</p> <p>CO7. Revisit signaling mechanisms viz the cell surface receptors like tyrosine kinase receptor, G protein coupled receptors, the second messenger system most prominently cAMP and signal transduction pathways.</p> <p>CO8. Know about the gene predicting tools mostly the computational tools, through sequence analysis such as similarly searches through alignment tools such as BLAST and Clustal W and the Ab-initio gene predicting methods.</p>





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			<p>CO9. Learn about the Human Genome Project and its stages before the human genome sequence was finally published in 2003.</p> <p>CO10. Get acquainted with the organization of the human genome: the coding and non-coding parts, the genes, pseudogenes, the repetitive sequence etc.</p> <p>CO11. Know about the prospects and applications of gene therapy.</p> <p>CO12. Gain sound idea of recombinant DNA technology (RDT).</p> <p>CO13. Understand transposable genetic elements or the jumping genes, their types and mechanism of transposition.</p>
19.	EC 2A	Practical	<p>Here students will revise the experiments they performed in sem II such as:</p> <p>CO1. Different kinds of staining techniques such as:</p> <ul style="list-style-type: none"><li>• Periodic acid Schiff (PAS) staining technique for detection of glycogen Sudan black B for detection of lipids.</li><li>• Methylgreen pyronin staining technique for detection of nucleic acids and</li><li>• Mercury bromophenol staining technique for detection of proteins</li></ul> <p>CO2. Students will get hands on training on:</p> <ul style="list-style-type: none"><li>• Vital staining of mitochondria from buccal epithelial cells using janus green stain.</li><li>• Calculation of the number of sperm from epididymal washes of laboratory mice.</li></ul> <p>CO3. They would be demonstrated the process of separation of DNA fragments through agarose gel electrophoresis.</p>
20.	EC 1B	Fish and inland fisheries	<p>This course is divided into two parts fish biology and applied fisheries wherein they would learn taxonomy and evolution of fish, fish anatomy, fish physiology, fish endocrinology, fresh water aquaculture, fish pathology, fish biotechnology, fisheries resources and post harvest technology. In this course they would learn about:</p>



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Sl. No.	Course Code	Course Name	Learning Outcomes
			<p>CO1. Taxonomy and evolution of fish and fish anatomy.</p> <p>CO2. Classification of fishes and origin and evolution of different groups.</p> <p>CO3. Structure and function of alimentary canal &amp; its modification in relation to feeding habit, acoustico-lateralis system and air bladder &amp; its modification.</p> <p>CO4. Fish physiology and fish endocrinology and under these broad field they will be acquainted with the mechanism of gill respiration, the features and examples of accessory respiratory organs, sound production, mechanism of excretion and osmoregulation, reproduction, the different endocrine organs and their functions.</p> <p>CO5. Fresh water aquaculture where they would get idea about the construction and lay out plan of different types of ponds and their management.</p> <p>CO6. Role of physico-chemical and biological factors in aquaculture, aquatic weeds &amp; their control, pen &amp; cage culture, collection and transport of fish seeds from riverine resources, fish food organisms: types and their culture; supplementary feeding and pollutants and their effect on fisheries.</p> <p>CO7. Fish pathology and fish biotechnology whereby students will learn about nutritional diseases, intrinsic diseases, bacterial, viral and other parasitic diseases in fish and their control.</p> <p>CO8. Cryopreservation of fish gamete.</p> <p>CO9. Induced breeding in fish using Carp pituitary extract (CPE) and new generation drugs, androgenesis, gynogenesis and transgenic fish, cytogenetical techniques in aquaculture and integrated fish farming.</p> <p>CO10. Fisheries resources and post-harvest technology.</p>
21.	EC 2B	Practical	<p>In this course students will be given hands on training on:</p> <p>CO1. Calculation of O<sub>2</sub> consumption by fish in relation to body size.</p>



# UNIVERSITY DEPARTMENT OF ZOOLOGY

LALIT NARAYAN MITHILA UNIVERSITY

KAMESHWARANAGAR, DARBHANGA

SI. No.	Course Code	Course Name	Learning Outcomes
			<p>CO2. Haematological analysis (Hb estimation, RBC counting)</p> <p>CO3. Estimation of pH using pH meter, dissolved oxygen, total alkalinity and total hardness etc of water sample.</p> <p>CO4. Microtomy, dehydration and staining of some tissues of fish.</p> <p>CO5. Making whole mounts of scales, olfactory lamella and respiratory epithelium.</p> <p>CO6. Biological analysis of water using phytoplankton, zooplankton, macrophytes and zoomacro-benthos.</p> <p>CO7. Apart from this, students will be trained to identify:</p> <ul style="list-style-type: none"><li>• Fish using key</li><li>• Representative fish parasites and their life histories.</li><li>• Fry and fingerlings of major cultivated species of fresh water fish.</li><li>• Some museum specimen of fish</li><li>• Certain histochemical slides.</li></ul>
22.	GE	<b>Generic Electives: Human Rights</b>	<p>CO1. Students will get themselves familiar with the various aspects of human rights, their importance and the contribution of various thinkers in the conceptual development of the Human Rights.</p> <p>CO2. Students are expected to emulate whatever they have learned in the course in their daily lives.</p> <p>CO3. This course of human rights is almost inevitable to appear in the question paper of any competitive exams and interviews.</p>