

M.Sc. Zoology

Programme Code: 348

Programme Summary

Duration: 2 years

Eligibility

B Sc with CBZ with minimum 45% marks in aggregate.

Programme Outcome:

- To be trained in taxonomy and study of Animal Diversity (Nonchordata and Chordata) and museum specimens and slides.
- To acquire knowledge of intracellular compartmentalization of cell, plasma membrane, cell signalling, cell cycle, cell division and cell death pathways. Understand the concepts of Molecular biology, Elementary biotechnology and microbiology.
- To understand the concepts of genetics and evolution.
- To learn in detail about Principles and applications of instruments (Microscopy, Centrifugation, Ultracentrifugation, Colorimeter, Spectrophotometer, Chromatography and Electrophoresis)
- To learn in detail about the developmental process, organogenesis and pathogenic parasites of human beings.
- To gain knowledge of animal physiology, metabolism and toxicology.
- To understand fundamentals of biochemistry including carbohydrates, lipids, proteins nucleotides, enzymes, acid-base chemistry and bioenergetics.
- To learn detail related to immune response
- Introduction to principle and theories of Ecology, conservation biology and wildlife study
- To be trained in collection, preservation and identification of local fish fauna and insects.
- To gain knowledge and practical application of fish physiology and techniques used in Fishery science.
- To understand the hormones, physiological actions and dysfunction of endocrine gland in vertebrates.
- To understands the fundamentals of animal behaviour.
- To gain knowledge and practical application of insect physiology, Veterinary, Medical, Forensic, Economic insects and techniques used in Entomology.
- To develop aptitude for formulating research problem and experimental planning, data collection, statistical planning and project report compilation.

Course Outcome:

S. No.	Course code	Course name	Credits	Course outcome
1st Semester				
1	SOLS/Zool/C 001	Animal Diversity I – (Lower Non-Chordata)	3	<p>Understand the various aspects of Major and Minor Phyla in relation to general Characters, organization and classification.</p> <p>To introduce the basic concept of morphology, nutrition, locomotion and reproduction of Protozoa.</p> <p>To learn about the morphology, canal system and reproduction of phylum Porifera.</p> <p>Gain knowledge of general feature, Polymorphism and reproduction of phylum Coelenterata.</p> <p>To learn about the morphology and anatomy of Helminthes.</p>
2	SOLS/Zool/C 002	Cell Biology & Molecular Biology	3	<p>To acquire knowledge of Intracellular Compartmentalization of Cell. Their structure, organization, functions and types</p> <p>To learn about the architecture of Plasma Membrane and Solute Transport (Fluid mosaic model) Solute transport across membranes diffusion (Simple and facilitated), Active transport (Primary and secondary), Pumps and transporters, Ion channels (Ligand gated and voltage gated channels), Trans-epithelial transport, Mechanism of regulation of intracellular transport.</p> <p>To provide knowledge of Cell Signalling Cell Cycle and Cell Division, Cell Death, Pathways.</p> <p>To provide knowledge of Intracellular compartments/organelles (ER, Golgi, membrane) protein sorting, secretory and endocytic pathways</p> <p>To learn about Cytoskeleton, its components & functions & derived organelles (cilium, flagellum).</p> <p>To provide knowledge of mitochondria, its structure function & genetic organisation</p> <p>To study about ribosome biosynthesis & formation in nucleolus</p> <p>To understand about cell cycle and its genetic regulation taking yeast as model system</p> <p>To learn about Cellular transformation and malignancy. Retroviruses, Apoptosis and causes of cancer. Nuclear cytoplasmic interaction</p> <p>To provide knowledge of cell and tissue culture in plants and animals, primary culture, cell line, cell clones, callus culture, soma clonal variation.</p> <p>To understand the central dogma of molecular biology</p>

				<p>To acquire knowledge of structure and conformation, supercoiling, packing of DNA into chromosomes, polymorphism of DNA & RNA. three dimensional structure of t-RNA</p> <p>To provide knowledge of DNA replication. Genetic code, transcription and translation in prokaryotes and eukaryotes. RNA processing. Mutations & DNA repair systems.</p>
3	SOLS/Zool/C 003	Genetics, Evolution & Taxonomy	3	<p>To understand the concepts of genetics and evolution.</p> <p>To understand about the gene as carrier of genetic informations and how genes moves from one generation to another generation through the mendals law.</p> <p>To study the fine structure of gene, chromatin and chromosome. Study the pedigree analysis to know probability of disease occurance in family.</p> <p>To get knowledge about genetic disorders, mutations, linkage and operon model and learn how to prepare the genetic map.</p> <p>Basic knowledge of organic evolution and evolutionary theories.</p> <p>To impart knowledge of origin of life and role of natural selection and mutation in evolution.</p> <p>To understand the species formation by allopatric, sympatric and parapatric speciation. Basic information of zoogeographical divisions of world and geological distribution of animals.</p> <p>To understand the evolution of man and horse by use of fossils.</p>
4	SOLS/Zool/C 004	Developmental Biology & Parasitology		<p>To provide the knowledge about predevelopment, development and post development stages of animals.</p> <p>To acquire knowledge about fertilization events, polyspermy and post fertilization development.</p> <p>To understand the concept of cellular differentiation and induction in development of an organism.</p> <p>To learn about the development of Drosophila and role of genes as molecular basis of development</p> <p>To understand the organogenesis, regeneration and metamorphosis in amphibian and insects.</p> <p>To provide knowledge on lymphocyte differentiation, trandifferentiation and metaplasia.</p> <p>To introduce the basic concept of tetratogenesis and genome alteration.</p> <p>To understand the concept of evolution of parasitism.</p> <p>To study the protozoan parasites and their pathogenicity.</p> <p>To study the helminths parasites and their pathogenicity.</p> <p>To study the arthropod vectors and their role in spreading diseases.</p>

				To understand about the parasitism in crustaceans.
5	SOLS/Zool/C 005	Laboratory course 1	3	To impart practical knowledge based on theory papers SOLS/Zool/C 001 and SOLS/Zool/C 002
6	SOLS/Zool/C 006	Laboratory course 2	3	To impart practical knowledge based on theory papers SOLS/Zool/C 003 and SOLS/Zool/C 004
2nd Semester				
7	SOLS/Zool/C 007	Animal Diversity-II (Higher Non-Chordata)	3	Understand the various aspects of Minor Phyla -Phoronida and Rotifera. Understand the organization of Onychophora and Arachnida. Understand the mouthparts and appendages of of insects. To learn about the comparative morphology of all classes of Mollusca. External morphology and anatomy of Grasshopper. To gain knowledge and general features of the reproductive and respiratory system, Larval forms, Torsion and pearl formation in Mollusca. To learn about the larval form, Affinities and Water vascular system in Echinodermata.
8.	SOLS/Zool/C 008	Animal Physiology and Toxicology		To learn about the physiology of respiration and the regulation of it. To acquire the knowledge about the digestive system of mammals, physiology of digestion ,absorption and control of gastrointestinal motility To uderstand the anatomy of kidney, physiology of excretion , regulation by hormones, RAAS and process of osmoregulation To learn about the physiology of cardiovascular system and regulation To gain knowledge about the ECG, myocardial infarction and Blood pressure To study the blood groups, blood coagulation and types of circulatory system in animals. To acquire knowledge about the lymphatic system. To understand the high altitude adaptation for survival To learn about the functional differentiation of brain, types of neurons, physiology of nerve impulse conduction, synaptic transmission, neurotransmitters and reflexes. To understand the neuromuscular physiology and molecular basis of signal transduction. To learn about the eye, the visual process and visual adaptation among animals To study about the ear and auditory processes To gain knowledge about the mechanism of thermoregulation, aestivation and hibernation To learn about the toxicity, exposure to toxicants, duration & frequency of exposure, dose-response relationship, mechanism of action of toxicants and bioaccumulation of

				xenobiotics and process of elimination of xenobiotics
9	SOLS/Zool/C 009	Instrumentation, Computer Application and Biostatistics	3	<p>To learn in detail about Principles and applications of Microscopy (light microscope, electron microscope), Centrifugation and its types, Ultracentrifugation, colorimeter and use of spectrophotometer, to learn how separate different sugars and amino acids by chromatography, Electrophoresis.</p> <p>To learn importance of Statistics in Biological Research</p> <p>To learn, understand and apply tools of mean, median, mode, range, variance, standard deviation and structured problem solving.</p> <p>To learn and apply concepts of co-efficient of variation, skewness & kurtosis. Simple correlation and linear regression (scatter diagram, regression coefficients, regression lines for problem solving and forecasting.</p> <p>To learn sampling techniques.</p> <p>To learn probabilistic distributions like Binominal, Poisson and Normal.</p> <p>To learn and apply student t test, chi square test and f test.</p> <p>Hands on training on statistical softwares</p> <p>To under stand the types of mini, micro, mainframe and super computers. Components of a computer system (CPU, I/O units). Data storage device, Memory concepts.</p> <p>To gain knowledge about the software and types of software.</p> <p>Understanding the computer applications in biology and information communications</p>
10	SOLS/Zool/C 010	Elementary Biotechnology & Microbiology	3	<p>Development of an ability to design and conduct genetic engineering experiments, as well as to analyze and interpret data and construction of DNA and cDNA libraries.</p> <p>Development of research aptitude and technical skills to work in the field of Genetic Engineering.</p> <p>Define biotechnology, provide examples of biotechnology products.</p> <p>Outline the strategies and fundamental steps in a genetic engineering procedure.</p> <p>Describe the mechanism of action and the use of restriction enzymes and Vectors in biotechnology research</p> <p>To gain knowledge of sequence detection, amplification and modification techniques of DNA.</p> <p>Southern, Northern and Western blotting; Probe labelling and hybridization;</p> <p>DNA sequencing (Chemical, enzymatic and automated methods); Sequence assembly for whole genome analysis.</p> <p>Discuss techniques used to probe DNA for specific genes of interest</p> <p>Explain the steps of a bacterial transformation and various selection processes for identifying transformants.</p> <p>Understanding the classification, staining techniques, pathological significance of</p>

				<p>Bacteria</p> <p>To gain knowledge about Physiology, genetics & reproduction of viruses of plants and animals, Bactriophage, lysogenic & lytic cycle.</p> <p>To learn about the Microbial culture techniques & media enrichment techniques.</p> <p>To acquire knowledge about microbes in decomposition and recycling processes.</p> <p>Understanding the role of microbes as pathological agents in plants, animals and man.</p>
11	SOLS/Zool/C 011	Lab Course I Based C007 & C008	3	To impart practical knowledge and hands on training based on courses SOLS/Zool/C 007 and SOLS/Zool/C 008
12	SOLS/Zool/C 012	Lab Course II Based C009 & C010	3	To impart practical knowledge and hands on training based on courses SOLS/Zool/C 009 and SOLS/Zool/C 010
3rd Semester				
13	SOLS/Zool/C 013	Animal Diversity (Chordata)	3	<p>To learn about the General Characters development of Urochordata and Cephalochordata and affinities of Hemichordata, Urochordata & Cephalochordata.</p> <p>To learn about origin evolution of cyclostomata, fishes amphibians, reptiles, birds and mammals.</p> <p>To understand about the parental care in amphibians.</p> <p>To understand about the origin and mechanism of flight in birds. Palate in birds.</p> <p>Migration in birds.</p> <p>To gain knowledge about the dentition in mammals, aquatic and flying adaptations in mammals and adaptive radiation in mammals.</p>

	SOLS/Zool/C 014	Ecology & Wildlife	3	<p>To understand the scope, importance and application of ecology.</p> <p>To understand the limiting factors. Combined concept of limiting factor, factor interaction and homeostasis.</p> <p>To learn about the biogeochemical cycle (nitrogen, phosphorus, carbon & water cycle).</p> <p>Understanding the concept of ecosystem. Concept of habitats & ecological niche.</p> <p>Understanding the concept of population, population growth forms; Carrying capacity; population regulation (Density dependent and independent). Cycles and fluctuations.</p> <p>Understanding the Concept & characteristics of community, succession of communities and key stone species.</p> <p>To gain knowledge about the concepts & importance of Biodiversity.</p> <p>To acquire knowledge about Environmental Impact Assessment., Cumulative Impact Assessment of hydropower development; Environmental flows, DRIFT and BBM.</p> <p>Understanding the identification techniques used in wildlife (Passive and Dynamic marking).</p> <p>Understanding the population estimation techniques of wildlife.</p> <p>To gain knowledge about Biogeography of India.</p> <p>To learn about Wildlife Conservation and Management.</p> <p>Understanding the Endangered species and Endangered fauna of Himalaya.</p>
15	SOLS/Zool/C 015	Lab Course Based on C013 & C014	3	To impart practical knowledge based on courses SOLS/Zool/C 013 and SOLS/Zool/C 014
16	SOLS/Zool/E 01a	Fish Biology I	3	<p>To study the zoogeographical distribution, origin, evolution, and phylogeny of fishes.</p> <p>To study the classification of fossil and living fish proposed by earlier scientists.</p> <p>Methods of collection, preservation and identification of fish by morphometry and meristic characteristics.</p> <p>To learn about the different groups of fish by understanding the morphology and biology.</p> <p>To learn about the comparative morphology of elasmobranch and teleost fish.</p> <p>To study the skeleton system, scales, fins of fish.</p> <p>To learn about the physiology of fish.</p> <p>To provide knowledge about the histology, histochemistry and biochemistry of fish.</p> <p>Composition of blood, haemopoietic tissues, synthesis of hemoglobin in fish.</p> <p>Physiology of Thermo-regulation in fishes.</p> <p>To learn about the spawning patterns and stimulating factors and mechanism of follicular atresia.</p>

				To learn about the mechanism of water- salt balance in freshwater, marine and estuarine fishes.
17	SOLS/Zool/E 01b	Entomology I	3	To introduce the Morphology with their appendages of insects. To provide the knowledge of classification of insect with special reference to that of general characters, habits, habitats, importance of the all 29 insect Orders (Taxonomical aspects).
18	SOLS/Zool/E 02a	Fish Biology II	3	To learn about the special organs in fishes as accessory respiratory organs, swim bladder, weberian ossicles, electric organs, bioluminescent organs and sound producing organs. To study the fish behaviour, parental care and migration in fishes and the factors affecting it. To learn about the effect of pheromones on sexual behaviour of fishes. Basic knowledge of embryology in fishes as pattern of cleavage and formation of blastula, gastrula and post embryonic development. To get knowledge about the endocrine glands, their hormones and their physiological effects in fishes as pituitary gland, thyroid gland, pancreas, corpuscles of stannius and urophysis.
19	SOLS/Zool/E 02b	Entomology II	3	Know and use names and terms specific to insect physiology. Obtain and integrate information pertaining to specific physiological systems. Explain cellular and molecular basis of specific physiological processes. An understanding of principles of insect physiology obtained from lectures, notes and extracurricular reading of a textbook and review literature. Learning examples of how basic research in insect physiology contributes to biomedical advances and pest control applications.
20	SOLS/Zool/E 03	Lab Course Based on E001a/b/c/d & E002 a/b/c/d	3	To impart practical knowledge based on theory papers SOLS/Zool/E 01a/b and SOLS/Zool/E 02a/b
4th Semester				
21	SOLS/Zool/C 016	Endocrinology & Animal Behaviour	3	To obtain knowledge about hormones, neurohormones, hormone like substances (neuronal peptides, autocoids, pheromones, neurosecretion). To learn about the structure, hormones and physiological actions of the Thyroid, Parathyroid, Pancreas, Gastro-intestinal tract, Adrenal cortex and Medulla, Thymus & Pineal in vertebrates. To acquire knowledge about hormonal dysfunction. To provide knowledge about mechanism of action of protein hormones and

				<p>catecholamines, membrane bound receptors, G-protein and control of adenylyl cyclase, Cyclic nucleotide cascade.</p> <p>Mechanism of action of Steroid and Thyroid hormones, Cytosolic receptors, effect on transcriptional and translational processes.</p> <p>To learn about hormone biosynthesis: Protein peptide hormones, gonadotrophins, thyrotrophin, corticotrophin, Steroids and catecholamines.</p> <p>To provide knowledge about the organisation & physiological actions of the testis and ovary. Androgen binding protein (ABP), Inhibin. Neuroendocrine control of testicular functions (Gn RH regulation, FSH- effects on germinal epithelium, LH-effects on Leydig cells, negative feed back regulation) Folliculogenesis, Ovulation, Luteinization, Ovarian cycles; Seasonal reproductive cycles; sexual dysfunctions in man.</p> <p>To learn about the science of behaviour, Proximate and ultimate causes of behaviour, sign stimuli and Fixed Action Pattern, Spatial learning. Associative learning, classical conditioning, operant conditioning, language learning. Imprinting. Kin recognition. Instinct versus learning behaviour.</p> <p>To obtain knowledge about the timing of behaviour, The Biological Clock. Circadian rhythms and their synchronisation and seasonal rhythms. Photoperiodism.</p> <p>To learn about the communication in animals, echolocation in bats, electrolocation in fish, Chemicals (pheromones) as signals in insects, fish and mammals.</p> <p>To provide knowledge about the neural and hormonal control of behaviour.</p> <p>To understand about the evolutionary and ecological aspects of animal behaviour, Ecology of foraging behaviour and Cooperation and conflict in animals.</p>
22	SOLS/Zool/C 017	Biochemistry & Immunology	3	<p>To get information about classification of enzymes, enzyme substrate complex formation and Michaelis-Menten equation.</p> <p>To understand metabolic pathways and their regulation as in carbohydrate metabolism pathway and regulation of glycolysis, gluconeogenesis, glycogen metabolism, citric acid cycle, electron transport chain and pentose phosphate pathway.</p> <p>To learn about protein metabolism by understanding amino acid synthesis and breakdown and urea cycle. To understand fat and nucleic acid metabolism and their regulation, synthesis and degradation of fatty acids and nucleic acids.</p> <p>To introduce the basic concepts of immune system and immunity structure and function of antigen and antibodies.</p> <p>To provide knowledge about Humoral and Cell Mediated Immune Response and Regulation: B- cell and T – cell receptor complex, Positive and negative regulation; Immune Response: T -Cell independent and T- Cell dependent defence mechanisms. Cell mediated cytotoxicity: T cytotoxic cells, Natural Killer (NK) Cells, Antibody</p>

				<p>dependent cell cytotoxicity (ADCC), Macrophage-mediated cytotoxicity. To learn about Complement system, Cytokines and Major Histo-compatibility Complex.</p> <p>To update knowledge in aspect of Immunopathology and Transplantations including : Rh- blood groupings, Hypersensitivity reactions (Antibody mediated type I, anaphylaxis, type II- antibody dependent cell cytotoxicity, type III-immune complex mediated reactions and type IV-delayed hypersensitivity reactions), Autoimmune diseases, Immunodeficiency; Transplantation: Graft vs. host reaction and rejection; Immunization and Vaccines.</p> <p>To provide knowledge of antigen antibody responses and Immunodiagnostic techniques: Immuno-electrophoresis, RIA, ELISA, Chemiluminescence immunoassay, Western blotting, Immunofluorescence.</p>
23	SOLS/Zool/C 018	Lab Course Based on C016 & C017	3	To impart practical knowledge and hands on training based on theory papers SOLS/Zool/C 016 and SOLS/Zool/C 017.
24	SOLS/Zool/E 04a	Fisheries Science	3	<p>To learn about the different component of culture and capture fishery.</p> <p>To understand about the concept of different culture systems: Extensive and intensive fish culture, Fish culture in ponds and reservoirs. Culture in rice fields, bheries, Cage culture, Pen culture, Monoculture and polyculture.</p> <p>To learn about the preparation and maintenance of fish farm, development of natural food and supplementary feeding, Procurement of stocking material from natural sources and Transport of fish seed.</p> <p>To learn about the Induced breeding and use of new generation drugs.</p> <p>To learn about the culture practices Common carp, Exotic Trouts, Prawn, Mahaseer and <i>Schizothorax</i>.</p> <p>To learn about Sewage – fed Fisheries and Integrated fish farming, common fish diseases and their control and culture of larvicidal fishes.</p> <p>To learn about the harvesting and post harvesting techniques, fish preservation and processing techniques.</p> <p>To gain knowledge about the Fish spoilage, causes of rigor mortis, precautions to control rancidity, microbial spoilage.</p> <p>To learn about the problems and perspectives in capture fisheries, marine fishery, Exclusive Economic Zone.</p> <p>Major, Marine and freshwater ornamental fishes, their food & breeding needs. Health management of ornamental fishes. Specific diseases and their cure. Setting and maintenance of aquaria.</p>
25	SOLS/Zool/E	Applied Entomology	3	To have a good understanding of the holistic approach of Integrated Pest management

	04b			<p>and its various components and their implementation in pest management.</p> <p>Knowledge of some beneficial insects like silkworm, honey bees and lac insects and learning methods by which these can be best exploited for the human welfare.</p> <p>Be able to identify the potential impact of different insect species on agriculture, human health, and society in general; to be knowledgeable about preventive measures and potential control strategies.</p> <p>Obtain and integrate information about insecticides and the possible hazards of using insecticides to the mankind and environment in general.</p>
26	SOLS/Zool/E 05a	Methodology in Fishery Science	3	<p>To understand the physico chemical parameters of water as temperature, pH, turbidity. Transparency, DO, BOD, free CO₂, hardness, alkalinity, sulphate, phosphate and nitrate.</p> <p>To learn how to collect the sample of water for their physico chemical estimation and what are the sampling techniques for fish, plankton collection.</p> <p>To learn the quantitative and qualitative estimation of planktons, benthos and periphytons.</p> <p>To get information about the fish preservation, fish identification by using keys and monographs and by molecular taxonomy.</p> <p>To get some knowledge about length-weight relationship, condition factors, dietary components and food preference of fishes.</p> <p>To study gonadosomatic index, fecundity of fish, age of fish and their biology.</p> <p>Understanding the use of statistics and softwares in fishery science.</p> <p>Understanding the Calculation and importance of Coefficient of Similarity (S), Shannon wiener Diversity Index (H), Species richness and Margalef diversity index. Relative Species Number index (RSN x), Descriptive statistics, Regression analysis and Coefficient of correlation, Chi square test (X) test, Analysis of variance (F. test), “t” test. Multivariate analysis, cluster analysis, Factor analysis and Discriminate analysis and FISAT for population dynamics.</p> <p>Understanding the pathological analysis of fish.</p> <p>To learn the techniques of toxicity analysis of pollutants.</p>
27	SOLS/Zool/E 05b	Methodology in Entomology	3	<p>To introduce the basic concepts of Research methodology in entomology.</p> <p>To provide the knowledge of role of entomology in agriculture, Medical entomology, Veterinary entomology, Forensic. Entomology and its importance.</p> <p>To be trained the students in Entomological techniques-Type of sampling survey, Different collection methods, collection of wild flies and domestic insects, Collecting Insect in the wild area, Transporting live adults or larvae. Preservation of insects, classification of insects up to the level of families with hands-on experience in</p>

				<p>identifying the families of insects and Catalogues.</p> <p>To learn about National Biodiversity Authority (NBA),</p> <p>To learn about Trophic relationships, ecological data, and insect diversity: Indices, richness, rarity.</p> <p>To learn the principles of Population estimates. Coexistence and Competition.</p> <p>Distribution patterns, insect biodiversity, physic-chemical parameters of water (turbidity/transparency, velocity, pH, temperature, estimation of CO₂, O₂ hardness)</p> <p>Understanding the Chi-Square test, Student t-test, Transformation of data: square root transformation, logarithmic transformation and angular, transformation, Analysis of variation, Mean separation: LSD and Duncan's Multiple Range test, Probit analysis and Non-parametric analysis.</p> <p>To gain knowledge about the project report preparation.</p>
28	SOLS/Zool/E06	Lab Course Based E004 a/b/c/d & E005 a/b/c/d	3	To impart practical knowledge and hands on training based on theory papers SOLS/Zool/E04a/b and SOLS/Zool/C 05a/b
29	SOLS/Zool/E07	Dissertation	6	To develop skills for carrying out a small research project and statistically interpret the outcomes and write the thesis.