Shivaji University, Kolhapur

Name of Department: Zoology

Name of Programme: M. Sc.

Vision
To spread higher education in the subject of Zoology including recent advances for the welfare of Society.
Mission
To create expertise in the field of Research in various disciplines of Zoology including Animal physiology, Environmental pollution, Aquaculture and fishery technology, Insect pests and disease management, Animal technology, Cell and molecular biology and Animal diversity.
Program Outcomes
1. Apply the knowledge of zoology in day today life. 2. Students are able to understand animals from their sub-cellular to ecosystem level. 3. Gain knowledge of agro based entrepreneurship like Sericulture, aquaculture, apiculture and lac culture for providing lab-to-land benefits to Society. 4. Students are able to frame hypothesis, design experiment, analyse data & generate conclusions. 5. Students are able to work to work in animal cell culture lab, taxonomy, able to operate different instruments in biological sciences like toxicity studies. 6. Students are able to work in different fields of biological sciences like animal cell culture, toxicology, enzymology, bio-instrumentation and taxonomy. 7. Students are able to address societal issues like pollution, health awareness, pest-parasite management and biodiversity conservation. 8. Students are able to gain knowledge on applied science and its application to sustainable development.
Program Specific Outcomes
1. Students are capable to get positions in the various fields of life sciences such as scientists, academic and administrative, industries, corporate, entrepreneurs, animal conservator, entomologists and taxonomists. 2. Perform procedures in laboratory areas of taxonomy, physiology, cell biology, ecology, genetics, applied Zoology, tools and techniques of Zoology, toxicology and pest control. 3. Groom and encourage the students for examinations like NET, SET, GATE and

for their research careers. 4. Developing academically sound researchers and manpower in the field of Cell biology, Physiology, entomology, fisheries-aquaculture and Sericulture.		
Course Outcomes		
Part-I Semester-I		
CC-101	Biosystematics and Biodiversity	1. To understand the important components of biosystematics through which different species are discovered, identified, described, named, classified and catalogued. 2. Provides indispensable information to support many fields of research and beneficial applied programs. 3. To understand the total biodiversity at global, national and local level along with threats, causes of biodiversity loss and biodiversity conservation methods. 4. General taxonomic rules on animal classification. 5. Distribution of fauna in different realms interaction.
CC-102	Ecology and Environmental Pollution	1. The students will understand different types of habitats, species interaction, communities, types of ecological successions and environmental impact assessment procedure. 2. To understand different types of pollution and its impact on the ecosystem and human and their remedial measures. 3. Conceptual knowledge of ecology and environmental pollution. 4. Judicious exploitation of available natural resources.
CC-103	Molecular Cell Biology	1. Apply the knowledge of structure and functions of animal cell and its relation with various metabolic functions of the organisms. 2. To gain deeper understand of structure and function of nucleus, events of DNA packaging from chromatin to chromosomes

		and their structures. 3. Able to understand the basics of cell-cell junctions, membrane transport, protein sorting and vesicular trafficking. 4. To learn structural assembly and functions of cellular degradation and respiration of cell organelle. 5. Able to understand how cells communicate with each other by studying molecular mechanism of cell signaling. 6. Understand cell cycle regulation its relevance to problems associated with abnormal cell division. 7. Able to understand the Cytoskeletal elements and their role in cell structure and function.
CC-104	Applied Entomology	1. Students are able to know detailed morphology of Insect (Grasshopper) body, Internal systems viz., Digestive, Circulatory, Respiratory, Reproductive, Nervous and Excretory system 2. Thorough knowledge would be acquired on Identification, life cycle, nature of damage and Management of Household pests, stored grain pests and Medicinal pests 3. Students would be acquiring exclusive knowledge on Identification, life cycle, nature of damage and Management of Veterinary and Forest Pests. 4. Students would be learning Entrepreneurship activities of Sericulture involving mulberry cultivation, rearing techniques of four types of silkworms, Disease and Pest Management of Silkworms and their host plants. 5. Students would be gaining knowledge on Types of Honey bees, Life cycle, Rearing technique, extraction and significance of honey, construction of Honey comb, Pest and Disease Management in apiculture.

		6. Students would be nurturing knowledge on Identification, Life cycle of Lac insect, Propagation of Lac insect, host plants of Lac insect and extraction techniques of Lac 7. Students would be acquiring knowledge on Identification of Arthropods that are associated with corpses and their role in Forensic medicine 8. Students would be attaining knowledge on Nutritional value of Insects, types of Insects that can be used in Nutrition, Revenue earning options by nurturing nutritional Insects.
AEC-I	Communicative English-I	1. Display competence in oral and written communication 2. Use the current technology related to the communication field
Part-I Semester-II		
CC-201	Physiological Chemistry	1. Understand thermodynamics in Biology and structural biochemistry of various biomolecules and their role in metabolism 2. Understand the Metabolism of carbohydrates, amino acids, nucleic acids and lipids 3. Understand metabolic disorders. 4. The students will understand the structure, role and functions of the important biomolecules. 5. To understand chemistry behind the different biological processes and the synthesis of biologically active molecules.
CC-202	Bioinstrumentation and Biostatistics	1. Enable students to utilize statistical methods in biological data analysis. 2. Enables students to establish relationship between various biological entities with correlation and regression analysis. 3. Helps to understand probability principles and its biological application. 4. Students able to understand statistical tests and its application in comparison of various

		experimental groups. 5. Gain conceptual knowledge and practical skills of various separation techniques and able to apply it for separation of various biological compounds. 6. Enable to understand basics of analytical techniques and its practical application. 7. Enable to understand basics of microscopy and its use for study of cellular and anatomical aspects of organism.
CC-203	Anatomy and Physiology	1. Be able to define the basic concept of morphological parts of body. 2. Describe anatomical content of digestive system of animal body. 3. Focus and relate to the detailed mechanism of vitamins and its regulations. 4. Describe basics the elements involved in the mechanism of breathing. 5. Explain details biomechanics of gases transportation and its productivity. 6. Illustrate detailed regulatory physiology of respirations. 7. Define the blood and its content and also gives idea about the different blood groups. 8. Describe different parts of cardiac system and its functions. 9. Explain about the normal ECG and its regulations.
CC-204	Biology of Parasites	1. Students would be acquiring knowledge on Animal association and Inter-relationship between host and parasite responses. 2. Students would be gaining knowledge on Vectors, Relationship of vertebrate pathogen to vector immunology, Physiology of vector, Population studies and effectiveness of vector. 3. Students would be attaining knowledge on Arthropod vectors of Medical and veterinary importance and their control. 4. Students would be acquiring knowledge on

		Identification, life cycle, Pathogenecity and management of parasites from Protozoa &Cestoda of Platyhelminthes 5. Students would be achieving knowledge on Identification, life cycle, Pathogenecity and management of parasites from Trematoda of Platyhelminthes and Nematoda.
SEC-I		1. To inculcate awareness of information security among students. 2. Acquaintance of basic terminology of security. 3. Develop a basic understanding of internet security, Digital certificates, and Browser security. 4. Develop an understanding of online transaction and email security.
CCPR-205	Practical – I	1. Enable students to identify and classify animals based using identification keys for correct identification of animal. 2. Enable students to use appropriate methods for collection and preservation of animal specimens. 3. Students will be able to identify animals in their natural habitat. 4. Students will be able to analyze quality of water sample by various parameters. 5. Enable students to demonstrate subcellular macromolecules by using histochemical techniques. 6. Students will be able to demonstrate cell organelles with organelle specific histochemical techniques. 7. Students will be able to demonstrate functions of cell organelles with physicochemical techniques. 8. Enable students to identify pest of stored grans, veterinary animals and human importance for their proper management. 9. Enable students to understand biology of economically important animals.

CCPR-206	Practical – II	1. Enable students to estimate biomolecules such as carbohydrate, lipids, proteins and nucleic acids from biological materials. 2. Students are able to separate and purify biological macromolecules by using various techniques. 3. Students will be able to process data with descriptive statistical methods. 4. Students will be able to generate hypothesis and conclusion by using various statistical tests. 5. Students will be able to determine physiologically important components and understand their significance. 6. Students will be able to understand physiological processes with their practical knowledge. 7. Students will be able to collect, preserve and identify various parasites. 8. Enable students to understand life cycle of various parasites.
Part-II Semester-III		
CC-301	Genetics	1. Understand the aneuploidy, causes and consequences of aneuploidy, molecular basis of sex determination in human. 2. Understand variation in alleles and genotypes within the gene pool. 3. Understand horizontal gene transfer in bacteria and their evolution. 4. Understand how bacteria acquire resistance against antibiotics and bacteriophages. 5. Understand the molecular mechanism and types of mutations. 6. Understand the mechanism of DNA repair. 7. Understand the significance and ethical aspects of Genetic counselling. 8. Able to construct pedigree charts and their analysis for genetic counselling.
CBE-302	Enzymology	1. Impart knowledge of enzymes classification, purification and its Structure.

		2. Understand enzymes kinetics and Industrial application. 3. To understand the fundamentals concepts of enzyme classification and nomenclature and role of the cofactors for enzyme activation 4. To gain profound knowledge to know the purification, identification and their structure of enzymes.
CBE-302	Laboratory Animals in Biomedical Research	1. Enable students to care and manage laboratory animals. 2. Students will be able to learn about various aspects of laboratory animal breeding. 3. Students will be able to understand physiological models and their use in drug testing. 4. Students will be able to understand recent advancements in laboratory animals.
CCS-303	Molecular Biology of Gene	1. Understand the genetic mapping techniques and blotting techniques. 2. Understand the importance of satellite DNA, Transposable DNA, Organelle DNA in human genome. 3. To gain profound knowledge of concept of gene, gene structure and transcription, post transcriptional control of gene expression. 4. Understand the significance of recombinant DNA technology and genetic manipulations by Knockout, transgenesis techniques and genome editing tools and applications.
CCS-304	Developmental Biology	1. To understand the fundamentals of basic concepts of development of animals 2. Able to understand the molecular basis of gametogenesis, fertilization and mechanism of blastulation. 3. To gain knowledge of gastrulation and organogenesis of chosen animals 4. To understand the molecular mechanisms of axis formation and neurulation of chosen animals
CCS-303	Animal Physiology	1. Able to define the basics of membrane

		potential in different cells of body. 2. Enable students to describe the mechanism of nervous system in sensory part of body. 3. Students will be able to understanddetails of musclephysiology. 4. Enable students to understand physiology of sense organs in animals. 5. Students will be able to describe anatomy and physiological mechanism of body. 6. Students will be able to explains different aspects of regulations of sense organs. 7. Enable students to define the basic concept of reproduction. 8. Enable students to describe anatomy of male and female reproductive system. 9. Gives understanding of modern techniques in the field of reproduction. 10. Students will be able to explain different steps in the animal development. 11. Students will be able to definefeatures of gametogenesis in animals. 12. Enable students to get knowledge of reproductive phases in different animals.
CCS-304	Applied Physiology	1. Students will understand the mechanism of breathing in animals on land and space. 2. Students will be able to describe mechanism of respiration in space and deep-sea diving. 3. Students will be able toexplain the effect of changes in atmosphereon physiology. 4. Students enable to get basic idea of work physiology. 5. Students will be able to explains mechanism involved in the muscle contraction and relaxation. 6. Students will be able to relate the physiology of exercise and its regulations. 7. Enable students to define the basic concept of ergonomics and its applications. 8. Students will be able to describe different

		working capacities and its regulation. 9. Students will be able to understand detailed metabolism and its regulations. 10. Enable students to understand physiological mechanism as per occupation. 11. Enable students to differentiates the physical and mental capacities as per different work. 12. Students will be able to understand effects of different parameters in the work environment.
CCS-303	Basic Entomology	1. The student will understand the morphological details as well as classification of dominant animal group of the earth i. e. insects. 2. Enable students to identify, classify and discover new species of insects. 3. Students will be prepared to become taxonomist.
CCS-304	Agricultural Entomology	1. Students would gain knowledge on Identification, characteristics, biology, damage and management of important pests on Cereals and Pulses. 2. Students would become familiar with important pests of fruits and fruit trees, their Identification, characteristics, biology, damage and management 3. Students would get acquainted with important pests of sugar cane, fiber crops and oilseed crops, their Identification, characteristics, biology, damage and management 4. Students would acquire knowledge on important Pests of vegetable crops, plantation crops and spices and narcotics, their Identification, characteristics, biology, damage and management
CCS-303	Fisheries Resources – Inland and Marine	1. Concepts of fisheries in inland and marine resources

	fisheries	2. Knowledge on natural recourses of fisheries
CCS-304	Fish Pathology and Reproductive Endocrinology	1. Concepts of fish diseases and its management 2. Knowledge of fish reproduction and hormonal regulation
CCS- 303	General Sericulture and management ofmulberry	1. Gives detailed information about silk production, its geographical distribution and importance of silk. 2. Explains climatic conditions required for mulberry cultivation including characteristics of soil and land preparation. 3. Gives practical and theoretical knowledge of varieties of mulberry, various methods propagation. 4. Focus on establishments and maintenance of mulberry garden for chawki and late age rearing. 5. Students would gain knowledge of mulberry pests and its management. 6. Students understands about various mulberry diseases and their control.
CCS-304	Silkworm Biology & Rearing Technology	1. Gives detailed information of various silkworm breeds, their classification and geographical distribution. 2. Students are able to understand life cycles of mulberry and non-mulberry silkworms. 3. Students would understand anatomical features and functions of various organ systems of mulberry silkworm. 4. Gives practical and theoretical knowledge of mulberry silkworm rearing, management of rearing houses. 5. Enable students to understand diseases and pests of mulberry silkworm and their biological control.
Part-II Semester-IV		
CC-401	Animal Cell Culture	1. Able to understand the basic requirement for animal cell culture laboratory set up, aseptic conditions and carry out Animal cell culture 2. Able to understand the nutritional and

		special requirement of mammalian cell culture and different types of cultures viz Monolayer culture, Suspension culture, Micro carrier culture etc. 3. Able to carry out in vitro viability and cytotoxicity assays, characterization of cultured cells. 4. Able to evaluate chemical carcinogenicity using cultured cells. 5. Able to understand surgical manipulations during in vitro fertilization 6. Able to understand how to prepare hybridoma, grow differentiated cells, feeder layer and Reconstituted basement membrane rafts.
CBE-402	Toxicology	1. Enable students to gain knowledge of toxic compounds, its effects on health and environmental deterioration. 2. Imparts knowledge of types of toxicities, toxicological tests and its application in toxicity assessments. 3. Enable students to understand harmful effects and Toxicokinetics of commonly used toxicants like pesticides and metal ions. 4. Gain knowledge of Bioaccumulation and biotransformation of various persistent toxicants and its issue in toxicity. 5. Gives information about food toxicants and its health effects.
CBE-402	Evolution and Behavior	1. Students will able to understand the basic process of evolution of animal. 2. Enable student to understand origin of biological molecules and their evolution. 3. Enable students to understand molecular mechanism of evolution and its significance. 4. Students will gain knowledge of animal behavior, its mechanism and application.
CCS-403	Immunology	1. To learn the fundamentals of immune system and role and mechanism of defence cells and organs

		2. To understand the different types of hypersensitivity reactions 3. To understand the significance of antigens, antibodies, complements, MHCs, cytokines and chemokines in immune functions. 4. To gain knowledge of mechanism of transplant rejection and how tumour cells escape immune surveillance.
CCS-404	Cell Pathology	1. Understand the molecular mechanism of cellular stress response 2. Understand the basic mechanism of cell death by apoptosis and necrosis 3. Understand the molecular basis of cancer 4. Understand the cellular and molecular changes in cell during ageing. 5. Impart the knowledge of inhibitors of DNA replication, transcription, translation and mitochondrial metabolism 6. Understand the different types of animal viruses and their multiplication in host cells.
CCS-403	Physiology of Health	1. Students will be able to explain the digestive system and its digestive mechanism. 2. Enable to describe pathology of digestive system and its effects on digestive mechanism. 3. Enable students to understand regulation of digestive mechanism. 4. Enable students to understand basics of physiology of respiratory mechanism. 5. Students will be able to describe abnormalities in the respiration and breathing. 6. Enable students to understand regulation in the mechanism of respiration. 7. Enable students to understandexcretory mechanism. 8. Enable students to describe pathology of Nephron and kidney. 9. Enable students to relate with regulatory

		defects of excretion mechanism. 10. Able to explain the abnormalities of muscle and nerve. 11. Enable students to describe pathology different types of muscles. 12. Students will be able to understand regulations and pathology of neuronal cells and associated diseases.
CCS-404	Clinical Physiology	1. Enable students to understand information about abnormal endocrine mechanism. 2. Enable students to describe pathology of different endocrine cells. 3. Students will be able to explain regulations in endocrine physiology. 4. Students will be able to explain basics in the sensory system. 5. Enable students to describe pathology in different sense organs. 6. Students will be able to explain regulations in eye, ear, tongue, etc. 7. Students will be able to understand various components of blood and immunity. 8. Students will be able to describe pathology in blood and circulation. 9. Students are able to get information about the abnormalities in immune system. 10. Students will be able to describes the basic concept of cancer development. 11. Students will be able to describe cancer mechanism in different organs. 12. Enable students to understandpatho-physiology of carcinoma in different clinical conditions.
CCS-403	Insect Anatomy and Physiology	1. The students will understand the anatomical and physiology of all the systems of insects which is essential for conservationists and agriculturists. 2. CO2: To study developmental and reproductive biology of insects.
CCS-404	Pest Management	1. Students would be gaining knowledge on

	Concepts	Biotic and abiotic factors that are responsible for Natural control of Insect Pests. 2. CO2: Eco-friendly suppression of Insect pests through Cultural, Mechanical, Physical and Legal control aspects 3. CO3: The role of Antifeedent, Attractants, Repellents and Chemo sterillants in Pest Management. 4. CO4: Students would get knowledge on agents of Biological Pest Control; organizations involved Biocontrol research and success stories of Biocontrol programs in India 5. CO5: Students would get acquainted with Concepts and agents of Microbial Pest Management, their mode of action and application techniques 6. CO6: Students would gain knowledge on mode of Genetic, Hormonal, Radiation and behavioral Control in Pest Management. 7. CO7: Students would attain the knowledge on various aspects of Chemical Control including Plant origin and synthetic (organic and inorganic) insecticides, chemistry, mode of action and applications. 8. CO8: Students would gain knowledge on aspects of Integrated Pest Management, necessity of IPM, tools of IPM 9. CO9:Students would get acquainted with Recent Advances in Pest management
CCS-403	Aquaculture Practices	1. Aqua culture systems, induced breeding techniques, post harvesting techniques 2. CO2: Innovative concepts in aquaculture practices.
CCS-404	Fishery Technology	1. Understanding of scientific method and concepts in fisheries technology. 2. Application of fishery technology for blue revolution concept.

CCS-403	Breeding of silkworm, mulberry and cytogenetics	1. Understand basic concepts of Mendelian Genetics with respect to mulberry silkmoths. 2. Enable student to understand silkworm as laboratory tool for genetic study. 3. Gives details information of genetic mapping of silkworm genes. 4. Gives knowledge of inheritance of various traits of mulberry silkworm and environmental influence on it. 5. Provides detailed information about silkworm breeding, its status in India and various methods of breeding. 6. Explains about selection methods of superior breeds. 7. Gives detailed information about maintenance of silkworm genetic resources, its characterisation and conservation. 8. Focuses on genetics, its hybridization and development of disease and draught resistant varieties of mulberry plants.
CCS-404	Silkworm seed, silk production technologyand Economics	1. Students would be able to understand silkworm seed production, its storage, incubation and embryonic development. 2. Gives information about assessment of silk and cocoon properties. 3. Provide details of silk processing industries including cocoon storage, reeling and spinning. 4. Gives details of marketing of cocoons and silk; economics of sericulture and silk processing industries.
CCPR-405	Practical III	1. Students will be able to understand and demonstrate various techniques related to genetic studies. 2. Enable student to draw conclusions based on given genetic experimental information. 3. Students will be able to isolate and estimate concentration of enzymes. 4. Students will be able to demonstrate activity of various enzymes and determine rate of

		enzyme activity.
CCPR-405	Practical III	1. Students will be able to understand and demonstrate various techniques related to genetic studies. 2. Enable student to draw conclusions based on given genetic experimental information. 3. Students will be able to breed and maintain various laboratory animals. 4. Enable students to demonstrate toxicity effects on laboratory animals 5. Students will be able to develop models for various experimental studies
CCPR-405	Practical III	1. Students will be able to Separate, estimate, and determine various biomolecules including DNA, RNA, Proteins, Histones, Plasmids etc. 2. Students will be able to demonstrate cell differentiation and determination in various parts of Chick embryo. 3. Enable students to demonstrate various developmental stages and processes in chick embryo. 4. Students will be able to demonstrate effects of chemicals on chick embryonic development
CCPR-405	Practical III	1. Enable students to demonstrate histological structures of reproductive parts. 2. Students will be able to evaluate vitality of reproductive cells. 3. Students will be able to estimate ions and other biochemical compounds of physiological importance. 4. Students will be able to demonstrate various aspects of ergonomics
CCPR-405	Practical III	1. Enable students to collect, preserve small insect specimens and prepare microscopic slide for identification and record. 2. Enable students to prepare slides of various taxonomically important parts of small insects.

		3. Students will be able to collect, preserve and identify various insect pests
CCPR-405	Practical III	1. Students will be able to identify various food fishes and shellfishes. 2. Students will be ablet to assess water quality of fish ponds and maintain healthy fish ponds
CCPR-405	Practical III	1. Enable students to demonstrate various system of silkworms. 2. Enable students to perform various moriculture activities. 3. Students will be able to collect, preserve and identify various pests of mulberry and other non-mulberry food plants. 4. Students will be able to rear mulberry and non-mulberry silkworms
CCPR-406	Practical IV	1. Students will acquire practical skills in animal cell culture and its maintenance. 2. Enable students to exhibit various applications of cell culture techniques in research and analysis. 3. Students will be able to culture embryo. 4. Students will be able to analyze the toxicity of various compounds based on toxicity test studies. 5. Student will be able to determine the presence of various toxic compounds in water and biological samples
CCPR-406	Practical IV	1. Students will acquire practical skills in animal cell culture and its maintenance. 2. Enable students to exhibit various applications of cell culture techniques in research and analysis. 3. Students will be able to culture embryo 4. Enable students to demonstrate process of evolution through effects of evolutionary drivers on natural selection. 5. Enable students to demonstrate process of evolution through evolutionary evidences. 6. Students will be able to demonstrate various

		animal behaviors. 7. Enable students to record and demonstrate animal behaviors from field
CCPR-406	Practical IV	1. Enable students to demonstrate various lymphoid organs immunological importance. 2. Students will be able to demonstrate various techniques in immunological assessment. 3. Enable students to demonstrate immunological response during various stresses. 4. Able to demonstrate various biochemical changes during aging
CCPR-406	Practical IV	1. Students will be able to analyze blood by determination of various hematological parameters. 2. Enable students to detect various biochemical compounds and gases in body fluids. 3. Enable students to assess the functions and effect of various hormones on metabolism and development. 4. Students will be able to estimate, separate and determine various biochemical molecules. 5. Enable students to incorporate ectomy skills to understanding of various hormone functions
CCPR-406	Practical IV	1. Students will be able to dissect and demonstrate histological structures in various systems in insects. 2. Enable students to demonstrate chitinous structures of insects. 3. Enable students to demonstrate and evaluate physiological functions. 4. Enable students to collect and preserve insects appropriately. 5. Enable students to identify insect pest, predators and parasitoids. 6. Students will be able to understand the

		mechanism of various pesticide appliances
CCPR-406	Practical IV	1. Enable students to identify fishes, understand structure and uses of fisheries crafts, gears, nets. 2. Students will be able to estimate biological molecules from fish tissue. 3. Enable students to assess water quality of fish ponds and maintenance of fish ponds
CCPR-406	Practical IV	1. Students are able to identify silkworm breeds and their cocoons for seed production. 2. Enable students to demonstrate various grainage activities. 3. Students will be able to identify mutant, defective cocoons and various diseases of it. 4. Students are able to demonstrate various cellular and subcellular structures of silkworms and mulberry. 5. Student will understand mechanism of various machines used in silk industries. 6. Students will be able to prepare various handicrafts of cocoons