

## Master's Program in Zoology

### Admission Requirements:

Applicants must adhere to the rules of the Deanship of the Graduate Studies:

1. Must have a bachelor's degree in Zoology from King Saud University, or the equivalent estimate of at least "good."
2. To pass the written test and personal interview.
3. Approval of the employer.
4. Should be entirely dedicated for the study in the M.Sc. program.
5. To pass any supplementary courses if department sees the need for that.

General program for a master's degree (M.Sc.) in Zoology  
(12 hours compulsory (Core) + 12 hours specialization + 6 hours of research)

#### Compulsory hours (12 hours)

Course No.	Course Name	Credit hours
ZOO 500	Experimental Design in Zoology	2 (1+1)
ZOO 511	Applied Entomology and Parasitology	2 (1+1)
ZOO 521	Aquatic Animals	2 (1+1)
ZOO 531	Advanced Animal Physiology	2 (1+1)
ZOO 543	Cell and Tissue Biology	2 (1+1)
ZOO 571	Animal Ecology and Pollution	2 (1+1)
		<b>12 hours</b>

**Student choose [12 hours] from one of the following Paths**

**Path 1: Animal Ecology and Pollution**

Course No.	Course Name	Credit hours
ZOO 572	Animal Conservation	2 (2+0)
ZOO 573	Advanced Ecology	3 (2+1)
ZOO 574	Animal Zoogeography	2 (2+0)
ZOO 575	Eco-physiology	3 (2+1)
ZOO 576	Pollution Measurements Methods	3 (2+1)
ZOO 577	Animal Pollution	3 (2+1)
ZOO 578	Geographical Distribution of Pollutants	2 (1+1)
ZOO 579	Selected Topics in Ecology and Pollution	2 (2+0)
		<b>20 hours</b>

**Path 2: Cell Biology, Genetics, and Histology**

Course No.	Course Name	Credit hours
ZOO 541	Advanced Histo-Chemistry	3 (2+1)
ZOO 542	Advanced Cytology	3 (2+1)
ZOO 544	Advanced Histology	3 (2+1)
ZOO 546	Advanced Techniques in Histology	1 (1+0)
ZOO 551	Advanced Genetics	3 (2+1)
ZOO 552	Quantitative and Population Genetics	2 (1+1)
ZOO 553	Molecular Biology and Genetic Engineering	2 (2+0)
ZOO 554	Developmental Genetics	3 (2+1)
ZOO 556	Advanced Cytogenetics	2 (1+1)
ZOO 558	Selected Topics in Cell Biology, Genetics, and Histology	2 (2+0)
		<b>24 hours</b>

**Path 3: Physiology and Developmental Biology**

Course No.	Course Name	Credit hours
ZOO 532	Advanced Cell Physiology	2 (1+1)
ZOO 533	Physiology of Reproduction	3 (2+1)
ZOO 534	Physiology of Hormones	2 (1+1)
ZOO 535	Mechanisms of immune responses	2 (1+1)
ZOO 536	Invertebrate Physiology	2 (1+1)
ZOO 537	Molecular Developmental Biology	3 (2+1)
ZOO 538	Advanced Descriptive and Experimental Embryology	3 (2+1)
ZOO 539	Selected Topics in Physiology and Development	2 (1+1)

ZOO 541	Advanced Histo-Chemistry	3 (2+1)
ZOO 575	Eco-Physiology	3 (2+1)
		<b>23 hours</b>

#### Path 4: Entomology and Parasitology

Course No.	Course Name	Credit hours
ZOO 510	Advanced Parasitology	3 (2+1)
ZOO 512	Physiology of Parasites	3 (2+1)
ZOO 513	Ecology of Insects	3 (2+1)
ZOO 514	Physiology of Insects	3 (2+1)
ZOO 515	Ecology of Parasites	3 (2+1)
ZOO 516	Acarology	3 (2+1)
ZOO 517	Selected Topics in Entomology and Parasitology	2 (2+0)
ZOO 518	Advanced Techniques in Entomology and Parasitology	1 (1+0)
		<b>21 hours</b>

#### Path 5: Aquatic Animals

Course No.	Course Name	Credit hours
ZOO 522	Aquatic Ichthyology	3 (2+1)
ZOO 523	Economic Aquatic Invertebrates	3 (2+1)
ZOO 524	Fish Culture and Management	3 (2+1)
ZOO 525	Economic Invertebrates Culture	3 (2+1)
ZOO 526	Selected Topics in Aquatic Animals	2 (2+0)
ZOO 527	Standard Environmental Specifications Aquatic Animal	1 (1+0)
ZOO 528	Fishery Resources	2 (1+1)
		<b>17 hours</b>

Later (classes) Paths .....		
Course No.	Course Name	Credit hours
ZOO 596	Research project	
ZOO 600	Thesis	6 (0+6)
		<b>6 hours</b>

## **Brief Description of the Master's Degree Courses**

### **1: Compulsory hours (12 hours):**

<b>ZOO 500</b>	<b>Experimental Design in Zoology</b>	<b>2 (1+1)</b>
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**Contents:** Animal surveys and censuses, concepts of sampling experimental animals. Sampling units, random sampling techniques, use of random numbers for sampling experimental animals. Methods of summarizing data and graphical representation of data. Estimation, regression, correlation, contingency tables and the Chi square, analysis of variance, and experimental design. Methods of experimental design. Growth and its estimation.

<b>ZOO 511</b>	<b>Applied Entomology and Parasitology</b>	<b>2 (1+1)</b>
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**Contents:** A brief of arthropods and parasites of medical, veterinary, and economic importance. Host-parasite relationships. Methods of infection with parasites and parasitic arthropods. Diseases of man and domestic economical animals caused by the various groups of parasites (protozoa, platyhelminthes and nematode arthropods as vectors of aetiological agents of diseases of man and domestic animals- mange, myiasis, allergy-). Parasitic zoonoses. Immunity against arthropods and parasitic infections. Economical arthropods.

<b>ZOO 521</b>	<b>Aquatic Animals</b>	<b>2 (1+1)</b>
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**Contents:** Advanced biology of aquatic vertebrates (mammals, reptiles, amphibians, birds, fishes) and invertebrates (mollusks, crustaceans, echinoderms) characteristics, phylogeny, classifications, reproduction, and geographical distributions.

<b>ZOO 531</b>	<b>Advanced Animal Physiology</b>	<b>2 (1+1)</b>
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**Contents:** The importance of metabolic activities control in living organisms. Molecular, biological, neural, hormonal and homeostatic controlling mechanisms in living organisms. Coordination of body functions: interaction of cardiovascular functions, control of respiration, renal regulation of extracellular volume and osmolarity, regulation of  $K^+$ ,  $Ca^{2+}$ , and  $H^+$  concentration, regulation of gastro-intestinal processes, regulation of organic metabolism and energy balance, and regulation of reproductive processes.

<b>ZOO 543</b>	<b>Cell and Tissue Biology</b>	<b>2 (1+1)</b>
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**Contents:** Biological membranes and their functions. The chemical nature of genetic material, the cellular and molecular basis of chromosomes. DNA replication, gene expression and its regulation in prokaryotes, cellular tissue contents of bone marrow, brain and kidneys, macrophages, mast cells and the general functions of these tissues.

**Contents:** Introduction, ecology of individuals: organisms limiting factors, important a biotic factors, dispread Population ecology; structure and diversity; Biomass system population regulation, interspecific competition. Community and Ecosystem ecology: Zoogeography. Aquatic ecological zones in Saudi Arabia, ecological relationship between plankton and nekton in marine, fresh water and estuarine habitats. Effects of ecological factors on aquatic animals and their media. Aquatic community stratification. Productivity, methods and measurements and primary productivity. Pollution and pollutants. Ozone layer pollution, heavy metals, oxides, sage and hydrocarbons pollution. Pesticides and physical pollution.

## **2: Specialized hours (12 hours):**

### **Path One: Animal Ecology and Pollution**

<b>ZOO 572</b>	<b>Animal Conservation</b>	<b>2 (2+0)</b>
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**Contents:** Ecological introduction, species and population characteristics, and ecological equilibrium. Reasons behind species extinction, study of animals in Saudi Arabia (terrestrial and aquatic). The importance of animal conservation, endangered species, protected areas in Saudi Arabia. Management of both terrestrial and aquatic animals.

<b>ZOO 573</b>	<b>Advanced Ecology (1)</b>	<b>3 (2+1)</b>
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**Contents:** Characteristics of aquatic and terrestrial populations (natality rate, mortality rate, density, and age distribution). Population growth, effect of abiotic factors on population growth (terrestrial and aquatic). Species intra- and inter- relationships. Population cycles, community changes, desert animal communities.

<b>ZOO 574</b>	<b>Animal Zoogeography</b>	<b>2 (2+0)</b>
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**Contents:** Patterns of life, continental drift, theory, the zoo-bio-geo-graphic subdivisions of the earth. Center of species dispersal and diffusion, island zoogeography. Population dispersion (random, regular, and aggregational). Population distribution (emigration, immigration, and migration). Aquatic zoogeography of animal species in freshwater and marine ecosystems. Bipolar animal species.

<b>ZOO 575</b>	<b>Eco-physiology</b>	<b>3 (2+1)</b>
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**Contents:** Responses of different systems (respiratory, circulatory, and digestive systems of both vertebrates and invertebrates) to environmental factors. Environmental factors effects on animals. Quantitative analysis of energy exchange, thermo-regulation, water and osmo-regulation of animals.

<b>ZOO 576</b>	<b>Pollution Measurement Methods</b>	<b>3 (2+1)</b>
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**Contents:** Introduction and definition of the different polluting agents to measure pollution. Utilization of some living organisms for measurement and estimation of pollution percentage. Investigation of the factors that may affect the accuracy of aids utilized in measurement of the pollution agents. Methods adopted for measurement of air and soil pollutants and determination of the international accepted pollution limits. Study of some of the methods for measurement of pollutants in Saudi Arabia and the Gulf States and the limits of pollution in the Gulf States.

<b>ZOO 577</b>	<b>Pollution in Animals</b>	<b>3 (2+1)</b>
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**Contents:** Introduction to pollution. Pollution glossary, pollution and the food chains. The effect of pollution on animal physiology and distribution. Selected studies on the effect of pollution on animals in Saudi Arabia and the Gulf States.

<b>ZOO 578</b>	<b>Geographical Distribution of Pollutants</b>	<b>2 (1+1)</b>
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**Contents:** Introduction to pollution. Quantitative and qualitative distribution of pollutants. Statistical methods used in pollution distribution. The relationships between pollutant distribution, species diversity and equitability indices and animals distribution. Pollution control as related to their geographical distribution.

<b>ZOO 579</b>	<b>Selected Topics in Ecology and Pollution</b>	<b>2 (2+0)</b>
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**Contents:** Selection and discussion of recent research papers in ecology and pollution.

## **Path Two: Cell Biology, Genetics, and Histology**

<b>ZOO 541</b>	<b>Advanced Histo-Chemistry</b>	<b>3 (2+1)</b>
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**Contents:** Histochemical battery for detection and differentiation of carbohydrates, carboxylated and sulphated acid muco-substances as well as neutral muco-substances. Enzyme histochemistry to detect and isolate various enzymes by different methods. Methods for detection of different types of simple and conjugated lipids. Histochemical techniques to detect minerals in human and animal tissues. Immuno histochemical techniques.

<b>ZOO 542</b>	<b>Advanced Cytology</b>	<b>3 (2+1)</b>
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**Contents:** Brief study of the concept of the cell. Cell growth and division, cell synchronization, and cell cycle regulation. Cell chromatin structure and function, the structure of the chromosome, and nucleic acids. DNA replication and repair.

<b>ZOO 544</b>	<b>Advanced Histology</b>	<b>3 (2+1)</b>
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**Contents:** Histology of the immune system (lymph nodes, tonsils, spleen, thymus, bursa of fabricius). Histology of the sense organs (ear, eye, taste buds). Histology of the endocrine glands (thyroid, pituitary, adrenal glands). Histology of the central nervous system.

<b>ZOO 546</b>	<b>Advanced Techniques in Histology</b>	<b>1 (1+0)</b>
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**Contents:** Special techniques for preparation of sections of the eye, various parts of the central nervous system, and sections of soft and hard bones. Biological staining techniques in histology. Histological preparation of museum specimens.

<b>ZOO 551</b>	<b>Advanced Genetics</b>	<b>3 (2+1)</b>
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**Contents:** Mutations, recombination in bacteria, transposable of genetic material. Genetic control of the immune response and cell division (oncogenes and proto-oncogenes). Important studies in genetics such as the experiments of Lederberg and Tatum, Hershey and Chase, Melson and Stahl. Chargaff's Rules and Griffin experiments. Watson and Craig contributions in discovery of the DNA structure.

<b>ZOO 552</b>	<b>Quantitative and Population Genetics</b>	<b>2 (1+1)</b>
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**Contents:** Genetic structure of the population. Forces of gene frequency changes, small populations, measurements of variability, resemblance between relatives, heritability, selection, inbreeding and cross breeding. Metric traits. BLUB estimation.

<b>ZOO 553</b>	<b>Molecular Biology and Genetic Engineering</b>	<b>2 (2+0)</b>
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**Contents:** Restriction enzymes, cloning vectors and cloning. Construction of genomic, chromosome and cDNA libraries. Identification of specific clones sequences in cDNA and

genomic libraries. DNA sequence analysis. Application of genetic engineering, hazards and problems of recombinant DNA technology and the possible techniques to minimize bio-hazards.

<b>ZOO 554</b>	<b>Developmental Genetics</b>	<b>3 (2+1)</b>
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**Contents:** Short and long term regulations of gene expression and their mechanisms in eukaryotes. The differentiation of the egg and maternal influences on development. Study of the developmental genetics of *Drosophila sp.*, vertebrates and the general principles of abnormal development.

<b>ZOO 556</b>	<b>Advanced Cytogenetics</b>	<b>2 (1+1)</b>
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**Contents:** Architecture of viral, prokaryotic and eukaryotic chromosomes. Nature and consequences of altered chromosomal structure. Sources and consequences involving chromosome number. Karyotype preparation, banding chromosomal techniques. Human chromosomes and the genetic maps.

<b>ZOO 558</b>	<b>Selected Topics in Cell Biology, Genetics, and Histology</b>	<b>2 (2+0)</b>
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**Contents:** Selection and discussion of recent scientific research papers in cell biology, genetics, and histology.

### **Path Three: Physiology and Developmental Biology**

<b>ZOO 532</b>	<b>Advanced Cell Physiology</b>	<b>2 (1+1)</b>
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**Contents:** A study of cells at the physiological level, including the structure and function of organelles and membranes. Enzymology, energy relationships and metabolic control, response to radiations, excitability and contractibility, and the regulation of cell growth and differentiation.

<b>ZOO 533</b>	<b>Physiology of Reproduction</b>	<b>3 (2+1)</b>
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**Contents:** Comparative anatomy and physiology of the reproductive system of higher vertebrates. Reproductive cycle and reproductive hormones, puberty, gametogenesis, fertilization, implantation, prenatal growth, parturition and initiation of lactation. Endocrine regulation of reproductive phenomena.

<b>ZOO 534</b>	<b>Physiology of Hormones</b>	<b>2 (1+1)</b>
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**Contents:** Cellular and organismal action of hormones in vertebrates. Regulation of hormones secretion, mechanism of action of hormones, hormones and blood sugar level, hormonal regulation of body fluids, regulation of calcium and phosphorus metabolism. Hormonal regulation of metabolic rate, food intake and body composition and growth. Hormonal regulation of reproduction. Hormones and animal behavior, hormones homeostasis.

<b>ZOO 535</b>	<b>Mechanisms of immune responses</b>	<b>2 (1+1)</b>
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**Contents:** Overview of cell and tissues of the immune system (Different types of immune cells – lymphoid tissues – immune cells migration)- Innate immune response (innate immune cells – Complement system – phagocytosis – inflammation)- Adaptive immune response (T cells adaptive immunity – B cells adaptive immunity – antibodies – lymphocyte memory)- Cytokines (Cytokines properties – Cytokines receptors – Cytokines actions – Cytokines in diseases)- The major histocompatibility complex (MHC) class I and class II (MHC class I molecules – MHC class II molecules – antigen processing and presentation by MHC class I and class II)- Tolerance immunology ( mechanisms of tolerance induction – maintenance of tolerance)- Abnormalities of immune system- Immunological assays methods.

<b>ZOO 536</b>	<b>Invertebrate physiology</b>	<b>2 (1+1)</b>
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**Contents:** Comparative study of invertebrate physiology including: nervous system, support and locomotion, endocrine system, respiratory system, circulatory system, digestive system, excretory system and reproductive system.

<b>ZOO 537</b>	<b>Molecular Developmental Biology</b>	<b>3 (2+1)</b>
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**Contents:** The role of cytoplasm and nuclear contents in gametogenesis, physical and chemical changes and metabolism during fertilization and cell division, protein synthesis during cleavage. Examples on the molecular development of oocytes in invertebrates, amphibians and mammals.

Inhibitors and exhibitors of cellular differentiation. Relationship between cellular differentiation and cancer development.

<b>ZOO 538</b>	<b>Advanced Descriptive and Experimental Embryology</b>	<b>3 (2+1)</b>
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**Contents:** Oocyte growth, the role and function of follicle cells, vitellogenesis, pinocytosis and phagocytosis during oocyte growth. Partenogenesis, control of number and size of cells during growth. The tissue growth after embryological stages, the role of embryonic organizers and induction experiments, embryonic tissue culture. Radioactive labeling, artificial insemination and test tubes offspring.

<b>ZOO 539</b>	<b>Selected Topics in Physiology and Development</b>	<b>2 (1+1)</b>
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**Contents:** Selected topics of interest in the field of physiology and development which will depend and focus on the subfield of study of each graduate student.

<b>ZOO 541</b>	<b>Advanced Histo-Chemistry</b>	<b>3 (2+1)</b>
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**Contents:** Histochemical battery for detection and differentiation of carbohydrates, carboxylated and sulphated acid muco-substances as well as neutral muco-substances. Enzyme histochemistry to detect and isolate various enzymes by different methods. Methods for detection of different types of simple and conjugated lipids. Histochemical techniques to detect minerals in human and animal tissues. Immuno histochemical techniques.

<b>ZOO 575</b>	<b>Eco-Physiology</b>	<b>3 (2+1)</b>
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**Contents:** Responses of different systems (respiratory, circulatory, and digestive systems of both vertebrates and invertebrates) to environmental factors. Environmental factors effects on animals. Quantitative analysis of energy exchange, thermo-regulation, water and osmo-regulation of animals.

#### **Path Four: Entomology and Parsitology**

<b>ZOO 510</b>	<b>Advanced Parasitology</b>	<b>3 (2+1)</b>
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**Contents:** The concept of parasitism. Comparison of the origin of parasitism, predation, and other related animal associations. Economic and social importance of parasites to be highlighted through the studies of specific examples of parasitic protozoa, helminthes and arthropods. Methods of treatment of parasitic infections. Control of parasitic infections.

<b>ZOO 512</b>	<b>Physiology of Parasites</b>	<b>3 (2+1)</b>
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**Contents:** A study of the metabolism of carbohydrates, proteins, and lipids in various parasites. A study of enzyme systems of various parasites in relation to host infection. A study of the various physiological methods followed by parasites in the infection and establishment in the hosts. A study of the effects of parasites on their hosts, especially the competition between the parasites and their hosts for food and other vital substances, and the deleterious effects on the host immune system such as stimulation and inhibition. A study of the structure of systems of some parasitic helminthes, especially the digestive and reproductive systems. A study of the general characteristic of teguments and other outer walls of various parasites.

<b>ZOO 513</b>	<b>Ecology of Insects</b>	<b>3 (2+1)</b>
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**Contents:** Introduction to insect communities and their habitats. Zoo-geographical distribution of insects. A study of the various insect communities and their habitats with emphasis on the ecological factors affecting the prevalence and distribution of insects. Reproduction and life cycles of insects and their relationships to the insect bio-tops. The relationship between the insects feeding requirement and their habitat.

<b>ZOO 514</b>	<b>Physiology of Insects</b>	<b>3 (2+1)</b>
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**Contents:** A comparative histological and physiological study on the digestive systems of two insects, a carnivorous insect and a sap-feeding one, together with a detailed study on the digestive enzymes, food needs and secretions of the salivary glands of each insect. A detailed study of chemo-coloration of insects. A detailed histological and physiological study of the central and the anatomic nervous systems of insects and their roles in physiology, especially in growth, reproduction and protein synthesis. A detailed histological study of insect blood cells. A physiological study of the blood volume in insects and the various methods used in measuring it. An experimental physiological study of metamorphosis in insects. A detailed study of the physiology of respiration in insects.

<b>ZOO 515</b>	<b>Ecology of Parasites</b>	<b>3 (2+1)</b>
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**Contents:** Types of parasites and hosts. The host as an environment for the parasite. A study of specific examples of the interactions of the various stages of parasites with their living environments (hosts), as well as the external environment. The zoogeography of parasites. Parasites as ecological control agents of hosts. A study of specific examples of parasites of terrestrial and aquatic animal hosts.

<b>ZOO 516</b>	<b>Acarology</b>	<b>3 (2+1)</b>
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**Contents:** A review of the acari. The taxonomic status of ticks and mites. A morphological study of ticks and mites. The internal structures and physiology of the acari with special emphasis on hard ticks. Ecology of the acari. The classification of the acari (especially ticks) into families and genera with emphasis on species found in Saudi Arabia. The economic and medical importance of acari. Control of acari.

<b>ZOO 517</b>	<b>Selected Topics in entomology and Parasitology</b>	<b>2 (2+0)</b>
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**Contents:** Entomology and parasitology bibliography and reference sources, reference indexing, writing up of research proposals, writing up of research papers.

<b>ZOO 518</b>	<b>Advanced Techniques in Entomology or Parasitology</b>	<b>1 (1+0)</b>
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**Contents:** Students specializing in entomology will focus on the advanced entomological techniques, according to their specialization. Likewise, students specialized in parasitology will focus on the advanced parasitological techniques especially immune-parasitology, according to their specialization.

### Path five: Aquatic Animals

<b>ZOO 522</b>	<b>Advanced Ichthyology</b>	<b>3 (2+1)</b>
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**Contents:** Advanced phylogeny, classification, anatomy, physiological adaptation, reproductive strategies, relationships and diversification of fishes.

<b>ZOO 523</b>	<b>Economic Aquatic Invertebrates</b>	<b>3 (2+1)</b>
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**Contents:** Advanced biology of aquatic invertebrates: their characteristics, anatomy, classification, phylogeny, reproduction, adaptations, and diversity.

<b>ZOO 524</b>	<b>Fish Culture and Management</b>	<b>3 (2+1)</b>
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**Contents:** General principles of fish culture, common procedures of tilapia, catfish, and carps culture. Aquaculture economics.

<b>ZOO 525</b>	<b>Economic Invertebrates Culture</b>	<b>3 (2+1)</b>
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**Contents:** Natural histories, special requirements of culture and management of economically important invertebrates adaptable to artificial impoundments: prawn, lobster, crabs, oyster, and squid.

<b>ZOO 526</b>	<b>Selected Topics on Aquatic Animals</b>	<b>2 (2+0)</b>
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**Contents:** Selected topics on research in aquatic animals.

<b>ZOO 527</b>	<b>Standard Environmental Specifications for Aquatic Animals</b>	<b>1 (1+0)</b>
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**Contents:** To provide the students with the general test procedures to establish water quality criteria and tentative water quality criteria for temperature, dissolved oxygen, carbon dioxide, finely divided solid matter, manohydric phenols, pH, ammonia, chlorine, zinc, copper, and cadmium.

<b>ZOO 528</b>	<b>Fishery Resources</b>	<b>2 (2+0)</b>
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**Contents:** Fisheries as a renewable natural resource. Its contribution to the food security of the nation, and its superiority to the other sources of animal proteins. Modern and recent methods of fisheries development and preservation. Laws of protection of the fisheries. The Saudi Arabian fisheries and its future. Aquaculture development to meet the demand for fish. Mariculture prospects for Saudi Arabia.

## Later (classes)

<b>ZOO 596</b>	<b>Research project</b>
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**Contents:** The course aims to train students to design and conduct scientific research experiments, record data, analyze them statistically, discuss their meanings and scientific interpretations, and submit them in seminars.

<b>ZOO 600</b>	<b>Thesis</b>	<b>6 (6+0)</b>
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**Contents:** The student conduct scientific research in one of the tracks before then writes a dissertation under the supervision of a faculty member supervisor.