ZOOLOGY

APPENDIX 'A'

AIMS AND OBJECTIVES:

1. To develop and understanding of the problems of Zoological Sciences by means of observations & experimentations & thus finding out solutions of the problems.
2. to equip the students with sufficient basic information on different aspects of Animal life so that they are able to manage basic human problems such as sanitation, health, agriculture, Animal breeding, Fisheries, Poultry and Wild life etc.
3. To give them enough scientific training which would be necessary for them to serve on different positions in Forestry, Fisheries Science, Zoological survey, Pest Control, Primary and secondary education, Wildlife, Health Education, Museums, Zoological Gardens, Environments and other related professions.
4. To provide them with all necessary information required for higher education in various disciplines of Zoology.

Scheme of Studies:

*There will be three papers. For every paper a minimum of 85 lectures must be delivered during the academic session.

Theory:	**Title**	**Marks**
Paper A:	Principles in Animal Life	45
Paper B:	Invertebrates and Chordates Diversity: Classification, Phylogeny and Organization	50
Paper C:	Animal Form and Function: A Comparative Perspective	45
	Total:	**140**

Practicals:

Practical Paper A:	20
Practical Paper B:	20
Practical Paper C:	20
Total:	60
Grand Total:	**200**

APPENDIX 'B'

(SYLLABI & COURSES OF READING)

PAPER A: PRINCIPLES IN ANIMAL LIFE

1. Place of Zoology in Science.

A One-World View: Genetic Unity, The Fundamental Unit of life, Evolutionary Oneness and the Diversity of Life, Environment and World Resources; What is Zoology? The Classification of Animals; The Scientific Method.

2. The Chemical Bases of Animal Life.

Atoms and Elements: Building Blocks of All Matter, Compounds and Molecules: Aggregates and Atoms; Acids, Bases and Buffers; The Molecules of Animals: Fractional Account of Carbohydrates, Lipids, Proteins. Nucleotides and Nucleic Acids, based on their structural aspects.

3. Cells,Tissues,Organs and Organ System of Animals.

Structure and Functions of Cell Membranes; Various Movements across Membranes; Cytoplasm, Organelles, and Cellular Components: Functional account of Ribosomes , Endoplasmic Reticulum, Golgi Apparatus, Lysosomes, Mitochondria, Cytoskeleton, Cilia and Flagella, Centrioles and Microtubules, and Vacuoles based on their structural aspects. The Nucleus: Nuclear Envelope, Chromosomes and Nucleolus.Tissues: Diversity in Epithelial Tissue, Connective Tissue, Muscle Tissue and Nervous Tissue ,to perform various functions. Struatural integrations for functions in Organs and Organ Systems.

4. Energy and Enzymes: Life's Driving and Controlling Forces.

Energy and the Laws of Energy Transformation; Activation Energy; Enzymes: Structure, Function and Factors affecting their Activity; Cofactors and Coenzymes; ATP: How Cells Convert Energy? An Overview.

5. How Animals Harvest Energy Stored in Nutrients.

Glycolysis: The first Phase of Nutrient Metabolism, Fermentation: "Life without Oxygen"; Aerobic Respiration: The Major Source of ATP; Metabolism of Fats and Proteins; Control of Metabolism; The Metabolic Pool.

6. Cell Division.

Mitosis, Cytokinesis, and the Cell Cycle: An Overview; Control of the Cell Cycle; Meiosis; The Basis of Sexual Reproduction; Gamete Formation.

7. Inheritance Patterns.

The Birth of Modern Genetics; Mendelian Inheritance Patterns; Other Inheritance Patterns; Environmental Effects and Gene Expression.

8. Chromosomes and Gene Linkage.

Eukaryotic Chromosomes; Linkage Relationships; Changes in Chromosome Number and Structure.

9. Molecular Genetics: Ultimate Cellular Control.

DNA: The Genetic Material; DNA Replication in Eukaryotes; Genes in Action; Control of Gene Expression in Eulkaryuotes; Mutation; Applications of Genetic Technologies Recombinant DNA.

10. Ecology I : Individuals and Populations.

Animals and Their Abiotic Environment; Populations; Interspecific Interactions.

11. Ecology II: Communities and Ecosystems.

Community Structure and Diversity ; Ecosystems; Ecosystems of the Earth, Ecological Problems, Human Population Growth, Pollution ,Resource Depletion and Biodiversity.

12. Animal Behaviour.

Four Approaches to Animal Behaviour, Proximate and Ultimate Causes; Anthropomorphism, Development of Behaviour, Learning, Control of Behaviour, Communication, Behavioral Ecology, Social Behaviour.

13. Evolution: A Historical Perspective .

Pre-Darwinian Theories of Change,Lamarck, An Early Development of Darvin's Ideas of Evolution, The Theory of Evolution by Natural Selection, Evolutionary Thought after Darwin; Biogeography.

14. Evolution and Gene Frequencies.

The Modern Synthesis: A Closer Look; The Hardy –Weinberg Theorem; Evolutionary Mechanism. Population Size, Genetic Drift, Neutral Selection, Gene flow, Mutation and Balanced Polymorphism, Species and Speciation; Rates of Evolution; Molecular Evolution; Mosaic Evolution.

BOOKS RECOMMENDED:

Principal Reference Book:

1. Miller, A.S. and Harley, J.B., 1999 & 2002 . Zoology , 4th and 5th Edition (International), Singapore:McGraw Hill.

Additional Readings:

2. Hickman, C.P., Robertsd, L.S. and Larson, A., 2001. INTEGRATED PRINCIPLES OF ZOOLOGY, 11th Edition (International) . Singapore: McGraw Hill.
3. Pechenik, J.A., 2000 . BIOLOGY OF INTERVEBRATES, 4th Edition (International). Singapore: McGraw Hill.
4. Kent, G.C. and Miller, S., 2001 . COMPARATIVE ANATOMY OF VERTEBRATES.New York: McGraw Hill.
5. Campbell, N.A., 2002 . BIOLOGY Sixth Edition. Menlo Park, California: Benjamin/ Cummings Publishing Company, Inc.

PAPER B: INVERTEBRATES AND CHORDATES DIVERSITY: CLASSIFICATION, PHYLOGENY AND ORGANIZATION

1. Introduction.

Classification of Organisms; Evolutionary Relationsihips and Tree Diagrams; Patterns of Organization.

2. Animal-Like Protists; The Protozoa.

Evolutionary Perspective; Life Within a Single Plasma Membrane: Symbiotic Life-styles. Protozoan Taxonomy: (upto phyla,subphyla, superclasses, wherever applicable).Pseudopodia and Amoeboid Lecomotion; Cilia and Other Pellicular Structurews; Nutrition Genetic Control and Reproduction; Symbiotic Ciliates;Further Phylogenetic Consideeration.

3. Multicellular and Tissue Levels of Organization.

Evolutionary Perspective;Origins of Multicellularity; Animal Origins.Phylum Porifera: Cell Types,Body Wall, and Skeletons; Water Currents and Body Forms; Maintenance Functions;Reproduction.Phylum Cnidaria(Coelenterata). The body Wall and Nematocysts: Alternation of Generations; Maintenance Functions: Reproductin and Classification up to class.Phylum Gtenophora; Further Phylogenetic Considerations.

4. The Triploblastic_Acoelomate Body Plan.

Evolutionary Perspective; Phylum Platyhelminthes: classification up to class; The Free-Living Flatworms and the Tapeworms, phylum Nemertea; phylum Gastrotricha; Further Phylogenetic Considerations.

5. The Pseudocoelomate Body Plan:Aschelminths.

Evolutionary Perspective; General Characterisitcs; Classification up to phyla with External Features, Feeding and the Digestive System;Other Organ Systems; Reproduction and Development of phylum Rotifera and phylum Nematoda; Phylum Kinorhyncha. Some important Nematode Parasites of Humans; Further Phylogenetic Consideration.

6. Molluscan Success.

Evolutionary Perspective: Relationships to Other Animals;Origin of the Coelom;Molluscan Characteristics;Shell and Associated Structures:Classification up to class. Feeding and Digestion:Gas Exchange:Locomotion; Reproduction and Development;Other Maintenance Functions and Diversity in Gastropods:Bivalves and Cephalopods;Further Phylogenetic Considerations;

7. Annelida:The Metameric Body Form.

Evolutionary Prespective:Relationships to Other Animals:Metamerism and Tagmatization:Classification up to class.External Structure and Locomotion:Feeding and the Digestive System;Gas Exchange and Circulation:Nervous and Sensory Functions.Excretion; Regeneration, Reproduction, and Development in Polychaeta,Oligochaeta and Hirudinea;Further Phylogenetic Considerations.

8. The Arthropods:Blueprint for Success.

Evolutionary Prespective:Classification and Relationships to Other Animals; Metamerism and Tagmatization, The Exoskeleton; Metamorphosis; Classification up to class; Further Phylogenetic Considerations.

9. The Hexapods and Myriapods; Terrestrial Triumphs.

Evolutionary Perspective; Classification up to class. External Structure and Locomotion, Nutrition and the Digestive System, Gas Exchange , Circulation and Temperature Regulation, Nervous and Sensory Functions, Excretion, Chemical Regulation, Reproduction and Development in Hexapoda; Insect Behavior; Insects and Humnans; Further Phylogenetic Considerations.

10. The Echinoderms.

Evolutionary Parspective; Relatiionships to other Animals; Echinoderm Characteristics; Classification up to class, Maintenance Functions, Regeneration, Reproduction and Development in Asteroidea, Ophiuroidea, Echinolidea, Holothuroidea and Crinoidea; Further Phylogenetic Considerations; Somke Lesser-Known Invertebrates; The Lophophorates,Entoprocts,Cycliophores, and Chaetognaths.

11. Hemichordata and Invertebrate Chordates.

Evolutionary Perspective; Phylogenetic Relationships; Classification up to subphylum or class where applicable; Further Phylogenetic Considerations.

12. The Fishes: Vertebrate Success in Water.

Evolutionary Perspective.Phylogenetic Relationships; Survey of Superclass Agnatha and Gnathostomata, Evolutionary Pressures: Adaptations in Locomotion, Nutrition and the digestive System, Circulation,Gas Exchange, Nervous and Sensory Functions, Excretion and Osmoregulation, Reproduction and Development; Further Phylogenetic Considerations.

13. Amphibians:the First Terrestrial Veriebrates.

Evolutionary Prespective. Phylogenetic Relationships; Survey of Order Caudata, Gymnophiona and anura Evolutionary Pressures: Adaptations in External Structure and Locomotion , Nutrition and the Digestive System, Circulation, Gas Exchange , Temperature Regulation Nervous and Sensory Functions , Excretion and Osmoregulation, Reproduction, Development, and Metamorphosis; further Phylogenetic Considerations.

14. Reptiles: The First Amniotes.

Evolutionary Prespective: Cladistic Interpretation of the Amniotic Lineage; Survey of Order Testudines or Chelonia, Rhynehocephalia, Squamata, and Crocodilia, Evolutionary Pressures; Adaptations in External Structure and Locomotion,Nutrition and the digestive System, Circulation.Gas Exchange and Temperature Regulation, Nevous and Sensory Functions, Excretion and Osmoregulation, Reproduction and Development; Further Phylogenetic Considerations.

15. Birds: Feathers, Flight, and endothermy.

Evolutionary Prespective: Phylogenetic Relation ships; Ancient Birds and the Evolution of Flight: Diversity of Modern Birds; Evolutionary Pressures; Adaptations in External Structure and Locomotion, Nutrition and the Digestive system , Circulation, Gas Exchange and Temperature Regulation, Nervous and Sensory Systems, Excretion and Osmoregulation, Reproduction and Development, ;Migration and Navigation.

16. Mammals: Specialized Teeth, Endothermy,Hair, and Vivipartiy.

Evolutionary Prespective:Diversity of Mammals; Evolutionary Pressure: Adaptations in External Structure and Locomotion, Nutrition and the Digestive Systems, Circulation, Gas Exchange and Temperature Regulation, Nervous and Sensory Functionss, Excretion and Osmoregulation,Behavior, Reproduction and Development.

BOOKS RECOMMENDED:

Principal Reference Book:

1. Miller, A.S. and Harley, J.B., 1999 & 2002 . Zoology , 4th and 5th Edition (International), Singapore:McGraw Hill.

Additional Readings:

2. Hickman, C.P., Robertsd, L.S. and Larson, A., 2001. INTEGRATED PRINCIPLES OF ZOOLOGY, 11th Edition (International) . Singapore: McGraw Hill.

3. Pechenik, J.A., 2000 . BIOLOGY OF INTERVEBRATES, 4th Edition (International). Singapore: McGraw Hill.

4. Kent, G.C. and Miller, S., 2001 . COMPARATIVE ANATOMY OF VERTEBRATES.New York: McGraw Hill.

5. Campbell, N.A., 2002 . BIOLOGY Sixth Edition. Menlo Park, California: Benjamin/ Cummings Publishing Company, Inc.

PAPER C: ANIMAL FORM AND FUNCTION: A COMPARATIVE PERSPECTIVE

1. Protection.Support and Movement.

Protection.The Integumentary System of Invertebrates and Vertebrates; Movement and Support. The Skeletal System of Invertebrates and Vertebrates; Movement; Non-muscular movement; An Introduction to Animal Muscles; The Muscular System of Invertebrates and Vertebrates.

2. Communication l: Nerves.

Neuron. Structure and Function: Neuron Communication: Introductory accounts of Resting Membrance Potential, Action Potential (Nerve Impulse) and Transmission of the Action Potential Between Cells; Invertebrate and Vertebrate Nervous Systems; The Spinal Cord, Spinal Nerves, The Brain, Cranial Nerves and The Autonomic Nervous System.

3. Communication II: Senses.

Sensory Reception: Baroreceptors, Chemoreceptors, Georeceptors, Hygroreceptors, Phonoreceptors, Photoreceptors, Proprioceptors, Tactile Receptors and thermo receptors in invertebrates; Lateral-Line System And Electrical Sensing, Lateral-Line system and Mechanoreception, Hearing and Equilibrium in Air, Hearing and Equilibrium in Water, Skin Sensors of Damaging Stimuli, Skin of Heat and Cold, Skin Sensors of Mechanical Stimuli, Sonar, Snmell, Taste and Vision in Vertebrates.

4. Communication III: The Endocrine System and Chemical Messengers.

Chemical Messengers: Hormones Chemistry and their Feedback Systems; Mechanisms of Hormone Action; Some Hormones of Porifera, Cnidarians, Platyhelminths. Nemerteans,Nematodes, molluses, Annelids, Arthropods, and Echinoderms, Invertebrates. An Overview of the Vertebrate Endocrine System; Endocrine Systems of Vertebrates other than Birds or Mammals ; Endocrine Systems of Birds and Mammals.

5. Circulation and Gas Exchange.

Internal Transport and Circulatory System in Invertebrates; Characteristics of Invertebrate Coelomic Fluid, Hemolymph and Blood Cells; Transport System in Vertebrates; Characteristics of Vertebrate Blood, Blood Cells and Vessels; The Heart and Circulatory System of Bony Fishes, Amphibians, and Reptiles, Birds and Mammals; the human Heart; Blood Pressure and the Lymphatic System;Immmunity; Nonspecific Defenses, The Immune Response; Gas Exchange; Respiratory Surfaces; Invertebrate and Vertebrate Respiratory Systems: Cutaneous Exchange, Gills, Lungs and Lung Ventilation; Human Respiratory System ; Gas Transport.

6. Nutrition and Digestion.

Evolution of Nutrition; The Metabolic Fates of Nutrients in Heterotrophs; Digestion; Animal Strategies for Getting and Using Food. Diversity In Digestive Structure of Invertebrates and Vertebrates; The Mammalian Digestive System; Gastrointestinal Motility and its control, Oral Cavity, Pharynx and Esophagus,Stomach,Small Intestine; Main Site of Digestion , Large Intestine; Role of the Pancreas in Digestion; Role of the Liver and Gall Bladder in Digestion.

7. Temperature and body Fluid regulation.

Homeoestasis and Temperature Regulation: The Impact of Temperature on Animal Life;Heat gain and losses;Some solution to Temperature fluctuations; Temperature Regulation in Invertebrates, Fishes, Amphibians, Reptiles, Birds and Mammals. Heat Production in Birds and Mammals; Control of Water and Solutes (Osmoregulation and excretion) Invertebrates and Vertebrate Excretory Systems,How Vertebrates achieve Osmoregulation; Vertebrate Kidney Variations; Mechanism in Metanephric Kidney Functions.

8. Reproduction and Development.

Asexual Reproducation in invertebrates; Advantages and Disadvantages of Asexual Reproducation; Sexual Reproduction in invertebrates; Advantages and Disadvantages of Sexual Reproduction.Sexual Reproduction in Vertebrates; Reproductive Strategies; Examples of Reproduction among Various Vertebrate classes; The human male reproductive system; Spermatogenesis Transport and hormonal control, Reproductive function; The human female reproductive system.Folliculogenesis, Transport and Hormonal control; Reproductive Functions;Hormonal Regulation in gestation; Prenatal Development and birth events;of prenatal development; The Placenta; Birth; Milk Production and laction.

9. Descriptive Embryology.

Fertilization; Embryonic development; Cleavage, and Egg types; The Primary Germ Layers and their Derivatives; Echinoderm Embryology; Vertebrate Embryology; The Chordate Body Plan, amphibian embryology, Development in terrestrial Enviornments, Avian Embryology, the fate of Mesoderm.

BOOKS RECOMMENDED:

Principal Reference Book:

1. Miller, A.S. and Harley, J.B., 1999 & 2002 . Zoology , 4th and 5th Edition (International), Singapore:McGraw Hill.

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3. Pechenik, J.A., 2000 . BIOLOGY OF INTERVEBRATES, 4th Edition (International). Singapore: McGraw Hill.
4. Kent, G.C. and Miller, S., 2001 . COMPARATIVE ANATOMY OF VERTEBRATES.New York: McGraw Hill.

5. Campbell, N.A., 2002 . BIOLOGY Sixth Edition. Menlo Park, California: Benjamin/ Cummings Publishing Company, Inc.

PRACTICAL PAPER A: PRINCIPLES OF ANIMAL SCIENCES

1. Tests for different carbohydrates, proteins and lipids.

Note for 1: (Emphasis on the concept that tests materials have been ultimately obtained from living organisms).

2. Study of the prepared slides of squamous,cuboidal, columnar epithelial tissues, adipose connective, cartilage bone, blood, nervous, skeletal muscle, smooth muscle and cardiac muscle tissues.

Note for 2: (Prepared Microscopic and/ or projection slides and/ or CD ROM computer projections must be used).

3. Plasmolysis and deplasmolysis in blood.
4. Protein digestion by pepsin.
5. Study of mitosis in onion root tip.
6. Study of meiosis in grass hopper testis.

Note for 5-6: (Prepared Microscopic and/ or projection slides and/ or CD ROM computer projections must be used).

7. Problem based on study of Mendelian ratio in animals.
8. Multiple alleles Study in blood groups.
9. Survey and study of a genetic factor in population and its frequency.
10. Study of chromosomal number and structural change in Drosophila.

12. Study of cytochemical demonstration of DNA in protozoa and avian blood cell.
13. Study of stages in the development of an Echinoderm.

14. Study of early stages in the development of a frog, chick and a mammal.

Note for 10-14: (Prepared Microscopic and/ or projection slides and/ or CD ROM computer projections must be used).

15. Study to demonstrate nervous or endocrine basis of behavior (conditioned reflex or aggression or parental behavior) .
16. Study to demonstrate social behaviour(Honey bee, monkey group in a zoo).
17. Ecological notes on animals of a few model habitats.
18. Field observation and report writing on animals in their ecosystem (a terrestrial and an aquatic ecosystem study).

BOOKS RECOMMENDED FOR PRACTICALS

1. Miller, S.A , 2002 GENERAL ZOOLOGY LABORATORY MANUAL. 5th Edition (International) Singapore: McGraw Hill.
2. Hickman, C.P., and Kats, H.L., 2000. LABORATORY STUDIES IN INTEGRATED PRINCIPLES OF ZOOLOGY. Singapore: McGraw Hill.

PRACTICAL PAPER B: INVERTEBRATE AND CHORDATE DIVERSITY: PHYLOGENY AND ORGANIZATION

1. Study of Euglena, Amoeba, Entamoeba, Plasmodium, Trypanosoma, Paramecium as representative of animal like protests (Prepared Slides).
2. Study of sponges and their various body forms.
3. Study of principal representative classes of phylum coelenterata.
4. Study of principal representative classes of phylum Platyhelminthes.
5. Study of representative of phylum Rotifera, Phylum Nematoda.
6. Study of principal representative of classes of phylum Mollusca.
7. Study of principal representative of classes of phylum Annelida.
8. Study of principal representative classes of groups of phylum Arthropoda and Echinoderms.
9. Study of a representative of hemichordate and invertebrate chordate.
10. Study of representative groups of class fishes.
11. Study of representative groups of class amphibian.
12. Study of representative groups of class Reptilia.
13. Study of representative groups of class Aves.

14. Study of representative groups of class Mammalia.
15. Field trips to study animal diversity in an ecosystem.
16. Preparation of permanent stained slides of the following.
    Paramecium , Obelia , Daphnia and Parapodia of Neries.

Note: (Preserved specimen and / or colored projection slide and / or CD ROM projection of computer must be used).

BOOKS RECOMMENDED FOR PRACTICALS

1. Miller, S.A , 2002 GENERAL ZOOLOGY LABORATORY MANUAL. 5th Edition (International) Singapore: McGraw Hill.

2. Hickman, C.P., and Kats, H.L., 2000. LABORATORY STUDIES IN INTEGRATED PRINCIPLES OF ZOOLOGY. Singapore: McGraw Hill.

PRACTICAL PAPER C: ANIMAL FORM AND FUNCTION: A COMPARATIVE PERSPECTIVE

1. Study of insect cuticle, fish scale, amphibian skin, reptilian scales, feathers and mammalian skin.
2. Study and notes on skeleton of Labeo, Rana tigrina, Varanus, Fowl and Rabbit.

Note for 2: Exercises of notes on the adaptations of skeletons of their functions must be done.

3. Earthworm or leech; cockroach, freshwater muscle, channa or catla catla or Labeo or any other local fish, frog, pigeon and rat or mouse or rabbits are representative animals for study in dissections.
4. Study of models or preserved brains of representative animals and notes on adaptations.
5. Study of nervous system of earthworm and a fish.
6. Study of endocrine system in an insect and a mammal.
7. Study of different types of blood cells in blood smear.
8. Study of heart, principal arteries and principal veins in a representative vertebrate.
9. Study of repiratory system in cockroach or locust and a vertebrate representative.
10. Study of excretory system in an invertebrate and a vertebrate representative. (Model)
11. Study of nutritive canal in an invertebrate and a vertebrate representative.
12. Study of male reproductive system in an invertebrate and a vertebrate representative.
13. Study of female reproductive system in an invertebrate and a vertebrate representative.
14. Study of hormonal influence of a reproductive function. (Model)
15. Study of preserved advanced stages of avian and mammalian development for amniotic membranes and placenta.

Note for 4-6 and 8-13: (Notes of comparisons in to adaptation must be written).

BOOKS RECOMMENDED FOR PRACTICALS

1. Miller, S.A , 2002 GENERAL ZOOLOGY LABORATORY MANUAL. 5th Edition (International) Singapore: McGraw Hill.
2. Hickman, C.P., and Kats, H.L., 2000. LABORATORY STUDIES IN INTEGRATED PRINCIPLES OF ZOOLOGY. Singapore: McGraw Hill.