

## ZOOLOGY HONOURS SYLLABUS

Semester	Paper Code No	Paper Title	Credits (Theory +Practical)	Marks
I	ZOO-UG-E101	Animal Diversity, Biosystematics and Evolution	4 (3+1)	100
II	ZOO-UG-E201	Cell and Molecular Biology, Genetics, Immunology and Developmental Biology	4 (3+1)	100
III	ZOO-UG-E301	Biochemistry, Animal Physiology, Ecology and Environmental Biology, and Economic Zoology	4 (3+1)	100
IV	ZOO-UG-C401	Functional Biology of Non-Chordates and Chordates	4 (3+1)	100
	ZOO-UG-C402	Cell Biology, Molecular Biology, Immunology and Animal Distribution	4 (3+1)	100
V	ZOO-UG-C501	Genetics, Evolution and Developmental Biology	4 (3+1)	100
	ZOO-UG-C502	Animal Physiology, Biochemistry and Vertebrate Endocrinology	4 (3+1)	100
VI	ZOO-UG-C601	Ecology, Toxicology, Biostatistics and Animal Behaviour	4 (3+1)	100
	ZOO-UG-C602	Applied Zoology and Animal Biotechnology	4 (3+1)	100

### SEMESTER I

#### ZOO-UG-E101: Animal Diversity, Biosystematics and Evolution

##### Unit I: Diversity of Non-chordates

Salient features and classification of Non-chordates up to sub-classes

Introduction to Minor Phyla.

Protozoa: *Paramecium*- Morphology and Reproduction.

Porifera: *Scypha*- Morphology, Skeletal and Canal systems.

Cnidaria: *Obelia*-Morphology and Reproduction.

Helminthes: *Fasciola*- Morphology, Reproduction, Life Cycle and pathogenicity.

*Ascaris*: Morphology, Reproduction, Life Cycle and pathogenicity.

Annelida: *Pheretima*- Morphology and Excretory system.

Arthropoda: *Periplaneta*- Morphology, Mouth parts and Respiratory system.

Mollusca: *Pila*- Respiratory and Nervous systems.

Echinodermata: *Asterias*-Morphology, Water Vascular System and Locomotion.

## Unit II: Diversity of Chordates

Salient features and classification of Chordates (Amphibia and Reptilia up to orders) Pisces and Aves up to subclasses; Mammalia upto infra classes).

Hemichordata: *Balanoglossus*- Morphology, Digestive and Nervous system.

Urochordata: *Ascidia*- Morphology

Cephalochordata: *Amphioxus*-Morphology and feeding habit.

Pisces: *Scoliodon*- Branchial system.

Amphibia: *Duttaphrynus*- Circulatory and respiratory systems.

Reptilia: *Calotes*- Urino-genital system.

Aves: *Columba*-Morphology, digestive and respiratory systems.

Mammalia: *Cavia*- Nervous and Reproductive systems.

Comparative anatomy of heart and circulatory systems from Amphibia to Mammalia.

## Unit III: Taxonomy and Evolution

Binomial Nomenclature, Taxonomic Hierarchy. Concept of Species, Mode of speciation.

Introduction to Geological Time Scale.

Origin of life. Fossils and their significance.

Zoogeographical realms: Introduction, Oriental realm, Neo tropical and Australian realm.

Theories of evolution: Darwinism,

Neo-Darwinism, Lamarckism and Neo-Lamarckism.

## Unit IV: Practical

1. Dissection:

A. *Periplaneta* : Nervous and Mouth Parts.

B. *Labeo* : Afferent and Efferent brachial system

C. *Rattus*: Arterial system and IX & X Cranial nerves.

Location of endocrine glands- Thyroid, Pancreas, Adrenal and Gonads

2. Identification with reasons:

A. Non-Chordates: *Amoeba*, *Euglena*, *Scypha*, *Obelia*, *Aurelia*, *Fasciola*, *Taenia solium*, *Ascaris*, *Nereis*, *Chaetopterus*, *Lepas*, *Balanus*, *Limulus*, *Penaeus*, *Peripatus*, *Nautilus*, *Chiton*, *Octopus*, *Echinus* and *Asterias*.

B. Larval forms: *Nauplius*, *Glochidium*, *Trochophore* and *Bipinnaria*.

C. Chordates: *Balanoglossus*, *Ascidia*, *Branchiostoma*, *Petromyzon*, *Myxine*, *Scoliodon*, *Labeo*, *Trygon*, *Heteropneusts*, *Ichthyophis*, *Tylototriton*, *Hyla*, *Draco*, *Varanus*, *Vipera russelli*, *Naja naja* and *Passer domesticus*.

D: Axial Skeleton of Toad/Pigeon: Skull and Vertebra

## Reading List

1. Ghosh, K. C. and Manna, B. (2004). Fundamentals of Zoology. New Central Book Agency. Kolkata.

2. Hall, B.K. and Hallgrimsson, B. (2008), Strickberger's Evolution, 4<sup>th</sup> Edition. Jones and Bartlett Publishers.

3. Jordan, E. L. and Verma, P. S. (1993). Chordate Zoology. S. Chand Company Ltd.

4. Jordan, E. L. and Verma, P. S. (1992). Invertebrate Zoology. S. Chand Company Ltd.

5. Kotpal, R. L. (2012). Modern Textbook of Zoology: Invertebrates. R. K. Rastogi Publications.

6. Kotpal, R. L. (2012). Modern Textbook of Zoology: Vertebrates. R. K. Rastogi Publications.
7. Mayer, E. (1980). Principles of Systematic Zoology. Addison-Wesley Publishing Company, Inc.
8. Mayr, E. and Ashlock (1991), Principles of Systematic Zoology, 2<sup>nd</sup> Edition. McGraw Hill and Company.
9. Minnelli, A. (1993). Biological Systematics. Chapman & Hall.

## **ZOO-UG-E201: Cell and Molecular Biology, Genetics, Immunology, Developmental Biology and Endocrinology**

### **Unit I: Cyto-genetics**

Prokaryotic and eukaryotic cells

Ultrastructure and functions of plasma membrane, Golgi complex, Mitochondria, Endoplasmic reticulum, Ribosome, Lysosomes (G-ERL system), Cell cycle.

Eukaryotic Chromosomal structure and types: Lamp-brush, Polytene chromosome. Chromosomal organization: Nucleosome model.

DNA structure, mechanism of DNA replication, transcription and translation in prokaryotes. RNA types, RNA structure: Clover leaf model.

### **Unit II: Genetics**

Mendelian Genetics: Experiments and principles of inheritance; Concept of genotype, phenotype, dominance, recessiveness, co-dominance and incomplete dominance; Back cross and test cross. Chromosomal theory of inheritance; Multiple alleles (ABO blood group in man); Gene interactions: Complementary, Epistasis, supplementary, inhibitory and duplicate types; Pleiotropic genes and lethal genes (Tay Sachs disease and Sickel cell anemia).

Chromosomal linkage and Linkage map, Crossing over and Recombination. Mutations: Chromosomal mutation and Point mutation; Down's syndrome, Klinefelter's syndrome. Sex determination in *Drosophila* and man. Dosage compensation and Lyon's hypothesis.

### **Unit III: Immunology, Developmental Biology and Endocrinology**

Immunity: Innate and adaptive. Cellular components: T, B, NK cells and macrophages. Antigen and antibody structure and types. Introduction to MHC, Complements and Cytokines.

Brief idea about Spermatogenesis and oogenesis. Types of eggs; Fertilization; Patterns of cleavage. Process of blastulation and fate maps in frog. Gastrulation in frog with the formation of three germinal layers. Introduction to extra embryonic membrane and Organogenesis of heart.

Structure, hormones and functions of major endocrine glands: Pituitary, thyroid and endocrine pancreas. Classification of hormones. Introduction to mechanism of hormone action.

### **Unit IV: Practical**

1. Problems on colour blindness, Haemophilia and Albinism.
2. Squash preparation of onion root tips (mitosis)
3. Bleeding Time (BT) and Clotting Time (CT).
4. Identification of Chick embryo stages: 24 hours, 48 hours, 72 hours, 96 hours.
5. Identification of mammalian histological tissues: Stomach, ileum, kidney, pancreas, liver, thyroid, spleen, testis, ovary.
6. Staining and whole mounts (temporary): Cyclops, Daphnia and Fish Scales.

## Reading List

1. Albert, B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J. D. (2007). *Molecular Biology of the Cell*, 5<sup>th</sup> Edition. Garland Publishing, London.
2. Bruce, A., Dennis, B., Karen, H., Alexander, J., Julian, L., Martin, R., Keith, R. and Peter W. (2009). *Essential Cell Biology*, 3<sup>rd</sup> Edition. Garland Publishing, London.
3. De Robertis, E. D. P. and De Robertis, L. M. F. (1987). *Cell and Molecular Biology*, 8<sup>th</sup> Edition. Lea and Febiger International Edition.
4. Gardener, E. J., Simmons, M. J. and Snustad, D. P. (2005). *Principles of Genetics*, 8<sup>th</sup> Edition. John Wiley and Sons.
5. Hardin, J., Bertoni, G. P. and Kleinsmith, L. J. (2012). *Becker's World of the Cell*. 8<sup>th</sup> Edition. Pearson, Benjamin Cummings.
6. Karp, G. (2010). *Cell Biology*, 6<sup>th</sup> Edition, John Wiley & Sons, Inc.
7. Klug, Cummings, Spencer and Palladino (2012). *Concepts of Genetics*, 10<sup>th</sup> Edition. Benjamin Cummings.
8. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A. and Scott. M. P. (2012). *Molecular Cell Biology*, 7<sup>th</sup> Edition. W.H. Freeman.
9. Pierce, B. (2012.). *Genetics: A Conceptual Approach*, 4<sup>th</sup> Edition. W.H. Freeman.
10. Strickberger, M. W. (2006). *Genetics*, 3<sup>rd</sup> Edition. Macmillan Publishing Company.

## ZOO-UG-E301: Biochemistry, Animal Physiology, Ecology and Environmental Biology, and Economic Zoology

### Unit I: Biochemistry and Animal Physiology

Classification of carbohydrates, proteins and lipids

Metabolism of lipids and amino acids.

Mitochondria, Glycolysis, TCA cycle, Oxidative Phosphorylation.

Classification and mechanism of enzyme action: brief idea.

Diffusion: Active and passive.

Respiration: Organs of respiration in vertebrates, properties and functions of respiratory pigments, transport of oxygen and carbon di-oxide.

-Mechanism of Blood clotting.

Physiology of nerve impulse and synaptic transmission.

Structure of mammalian kidney and nephron.

### Unit II: Ecology and Environmental Biology

Introduction to Ecology. Concept of ecosystem and ecological niche. Ecological features, limiting factors, zonation and classification of organisms of fresh water and marine ecosystems. Introduction to Biome: Ecological features of Tundra, Desert, Savannah and Tropical Rain forest Biomes.

Food chains, food web, ecological pyramids and energy flow. Population: Density, Relative abundance, Frequency, Growth forms and Carrying capacity. Biotic Community: Species richness, Abundance, Diversity, Dominance, Evenness, Similarity. Ecological succession: Definition, Process, types, theories of succession. Intra and interspecific interactions.

Introduction to animal ethics.

### Unit III: Economic Zoology

Apiculture: Honey bee-different species, social organization, life history, structure of bee hives, methods of bee keeping, products of apiculture and their economic importance.

Sericulture: Silk worm- different species, life history of *Bombyx mori* and its economic importance,

methods of sericulture.

Pisciculture: Basic concept on Mono- and Composite fish culture and induced breeding of fishes.

Fish diseases: symptoms and control.

Entomology: Elements of Integrated pest management (Physical, chemical, hormonal and biological).

Basic concept on crop pests of Sikkim (rice, maize & ginger)

#### **Unit IV: Practical**

1. Qualitative test of Carbohydrate by Fehling's and Benedict's Reagents and Protein by Biuret test.
2. Analysis of dissolved oxygen, free Carbon dioxide and alkalinity of water.
3. Total and differential counts of blood.
4. Identification and comment on the economic importance of the following:  
*Millepora* sp., *Pinctada* sp, *Schistocerca* sp., *Penaeus* sp., *Pheretima* sp., *Sepia* sp., *Schizothorax* sp., *Paa* sp., *Ithaginis cruentus* and *Bos grunniens*.
5. Field trip to study Apiculture/ Sericulture/ Pisciculture/Crop fields of Cardamom/ Rice/Maize.

#### **Reading List**

1. Berg, J., Tymoczko, J., and Stryer, L. (2012). Biochemistry, 7<sup>th</sup> Edition, W. H. Freeman.
2. Campbell, M. K. and Farrell, S. O. (2010). Introduction to Biochemistry. Cengage Learning India.
3. Hall, J. E., (2011). Guyton and Hall Textbook of Medical Physiology, 12<sup>th</sup> Edition (Indian print). Saunders, Elsevier Inc.
4. Hill, R. W., Wyse, G. A. and Anderson, M. (2012). Animal Physiology, 3rd Edition, Sinauer Associates Inc.
5. Murray, R. K. et al., (2011). Harper's Illustrated Biochemistry, 29<sup>th</sup> Edition. McGraw Hill, Lange Publication.
6. Nelson, D. L. and Cox, M. (2012). Lehninger Principles of Biochemistry, 6<sup>th</sup> Edition, W.H. Freeman.
7. Prosser, C. L. (1991). Comparative Animal Physiology. W. B. Saunders & Company.
8. Randall, D. and Burggren, W. (2001). Eckert Animal Physiology, 5<sup>th</sup> Edition. W.H. Freeman.
9. Schmidt-Nielsen, K. (2002). Animal Physiology: Adaptation and Environment. Cambridge University Press. 7
10. Sherwood, L., Klandorf, H., and Yanchey, (2010).Textbook of Animal Physiology. Cengage Learning.

### **ZOO-UG-C401: Functional Biology of non-chordates and chordates**

#### **Unit I: Functional Biology of Animals - I**

Protozoa: Locomotion, nutrition and reproduction. Life cycle and pathogenicity of *Giardia*, and *Trypanosoma*.

Cnidaria: Polymorphism in Siphonophora, Corals, Types of coral reefs.

Morphological and physiological adaptations of parasitic worms, *Taenia*, *Wuchereria*.

Annelida: Metamerism and excretory system.

Onychophora: General organization and affinities.

Arthropoda: Social insects (termites) - life cycle, Vision in arthropods, Metamorphosis in insects.

#### **Unit II: Functional Biology of Animals - II**

Mollusca: Torsion and detorsion in Gastropoda.

Echinodermata: Water vascular system, Larval forms of Echinodermata.  
Affinities of *Balanoglossus* and *Amphioxus*.  
Ascidia: Retrogressive metamorphosis.  
General organization of *Petromyzon*, Ammocoetes larva.  
Pisces: Accessory respiratory organs.  
Dipnoi: General characters and their affinities.  
Amphibia: Parental care and Metamorphosis.

### **Unit III: Functional Biology of Animals - III**

Reptilia: Poisonous and non-poisonous snakes, Poison apparatus and biting mechanism.  
Aves: Flight adaptation in birds and modes of flight, Migration of birds, Distinction between Ratitae and Carinatae.  
Mammalia: Affinities of Monotremata and Marsupials,  
Dentition in mammals, Comparative anatomy of brain and kidney in vertebrates.

### **Unit IV: Term Paper Preparation and Presentation**

#### **Suggested Readings**

1. Jordan, E. L. and Verma, P. S. (1993). Chordate Zoology. S. Chand Company Ltd.
2. Jordan, E. L. and Verma, P. S. (1992). Invertebrate Zoology. S. Chand Company Ltd.
3. Kotpal, R. L. (2012). Modern Textbook of Zoology: Invertebrates. R. K. Rastogi Publications.
4. Kotpal, R. L. (2012). Modern Textbook of Zoology: Vertebrates. R. K. Rastogi Publications.
5. Sinha, A.K., Adhikari, S. and Ganguly, B. B. (2012). Biology of Animals, Vol. I & II. New Central Book Agency. Kolkata.
6. Sinha, A.K., Adhikari, S. and Ganguly, B. B. (2012). Fundamentals of Biology, New Central Book Agency, Kolkata.

## **ZOO-UG-C402: Cell Biology, Molecular Biology, Immunology and Animal Distribution**

### **Unit I: Biophysics and Molecular Cytology**

Microscopic techniques: Phase contrast and Fluorescence microscope.  
Centrifugation and separation of cell organelles.  
Membrane transport of small molecules and ionic basis of membrane excitability. Vesicular traffic in the secretory (such as Golgi complex) and the endocytic pathways (such as phagocytosis and pinocytosis).  
Cell signaling: second messenger (definition, types, role of second messenger in cell signaling).  
Nuclear envelope: Nuclear matrix and nucleolus. Concept of Cytoskeleton.

### **Unit II: Cancer Biology, Gene Regulation, Apoptosis and Immuno-biology**

Cancer types, abnormal cell behaviour and its function. Carcinogens and carcinogenesis.  
Gene regulation: Lac Operon and Tryptophan.  
Apoptosis: Features of apoptic cells, necrosis and role of apoptosis in development.  
T- cell receptors, cytokines; adjuvant and complements. Antigen and Antibody reaction. Basic principles of vaccination. MHC genes and gene products.  
Immunological techniques: Basic principles of gel diffusion, Immunoelectrophoresis and Enzyme Linked Immunosorbent Assay (ELISA).

### **Unit III: Zoogeography and Biodiversity Conservation**

Distribution of animals, Barriers and their impact on animal life. Continental drift mechanism and its impact on faunal distribution.

Conservation and management of endangered wildlife in India. Concept of sanctuaries and National parks. Indian Wildlife Protection Act and its schedules.

Introduction to IUCN and threat categories. Introduction to Biodiversity and human welfare, Biopiracy, Biodiversity Hotspots with special reference to India. Introduction to Mega-diversity.

### **Unit IV: Practical**

1. Demonstration of Fluorescence Microscope.
2. Cytochemical staining to determine nucleic acids DNA by Fielgen stain / RNA by Pyronin Y.
3. PAS reaction for detection of Carbohydrate.
4. Blood grouping and typing in Human.
5. Study of cancer cells through permanent slides.
6. Osteology: Skull; *Bufo*, *Chelonia*, *Cavia*, *Columba* and *Canis*.  
Axial and Appendicular skeletons of *Cavia sp.*

### **Suggested Readings**

1. Albert, B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J. D. (2007). Molecular Biology of the Cell, 5th Edition. Garland Publishing, London.
2. Brown, T. A. (2006). Genomes 3. Garland Science.
3. Cooper, G. M. and Hausman, R. E. (2009). The Cell: A Molecular Approach, 5th Edition. Sinauer Associates Inc. Publishers.
4. Delves, P. J., Martin, S. J., Burton, D. R. and Roitt, I. M. (2011). Roitt's Essential Immunology, 12<sup>th</sup> Edition. Wiley-Blackwell.
5. Hardin, J., Bertoni, G. P. and Kleinsmith, L. J. (2012). Becker's World of the Cell, 8th Edition. Benjamin Cummings.
6. Karp, G. (2010). Cell Biology, 6th Edition. John Wiley & Sons, Inc.
7. Khan, F. H. (2010). Immunology. Pearson Education India.
8. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A. and Scott, M. P. (2012). Molecular Cell Biology, 7th Edition. W.H. Freeman.
9. Owen, J., Punt, J. and Stranford, S. (2012). Kuby Immunology, 7th Edition. W. H. Freeman & Company.
10. Pathak, S. and Palan, U. (2012). Immunology, 11th Edition. Science Publishers.
11. Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M. and Losick, R. (2008). Molecular Biology of the Gene, 6th Edition. Pearson, Benjamin Cummings.

## **ZOO-UG-C501: Genetics, Evolution and Developmental Biology**

### **Unit I: Human Genetics and Modern Gene Concept**

Sex-linked inheritance and sex-linked traits, Extranuclear genomes and extranuclear inheritance: Kappa particles in *Paramecium*, and shell coiling in *Lymnaea*, Basic idea of genomic imprinting. Karyotype, chromosomal and single gene disorders in humans (Alkaptonuria and Sickle cell anemia). Human Genome Project.

Fine structure of gene: Cistron, recon and muton, split genes and overlapping genes. Mobile genetic elements: Insertion elements and transposons. Gene therapy: Introduction, types (in vitro, somatic and germline therapy), Gene therapy for ADA (Adenosine deaminase), Ethics of gene therapy. DNA repair.

## **Unit II: Population Genetics and Evolution**

Population Genetics, Gene pool, Gene frequency, Genetic drift, Gene flow, Polymorphism, Natural Selection. Hardy-Weinberg principle and forces altering Hardy-Weinberg principle.  
Phylogeny of horse and Elephant. Adaptive radiation in mammals.  
Colouration and mimicry.

## **Unit III: Developmental Biology**

Fertilization in vivo and in vitro; Embryo transfer technology.  
Morphogenesis: Epiboly, Invagination, Ingression, Involution and Delamination.  
Fate maps and construction of fate maps in Sea Urchin and Frog.  
Concept of Organizer and embryonic induction.  
Embryonic stem cells: Determination and differentiation. Gastrulation: Post embryonic development in chick.  
Extraembryonic membranes in chick.  
Organogenesis of brain and eye in vertebrates. Placenta in mammals.

## **Unit IV: Practical**

1. Construction of familial pedigree. Probability exercises chi square test.
2. Squash preparation of Grasshopper testis (Meiosis).
3. Mounting of Chick embryo stages: 24, 48, 72, and 96 hours.
4. Construction of Phylogenetic tree (Any two): Horse, Elephant, Camel and Man.

## **Suggested Readings**

1. Gardener, E. J., Simmons, M. J. and Snustad, D. P.(2005). Principles of Genetics, 8thEdition. John Wiley and Sons.
2. Strickberger, M. W. (2006). Genetics, 3rdEdition. Macmillan Publishing Company.
3. Balinsky, B.I. (1981). An introduction to Embryology, 7th Edition. Cengage Learning India
3. Gilbert, S. F. (2010). Developmental Biology, 9thEdition. Sinauer Associates, Inc. Publishers.
4. Wolpert, L. and Tickle, C. (2011). Principles of Development, 4th Edition, Oxford University Press.
5. Klug, W. S., Cummings, M. R., Spencer, C. A. and Palladino, M. A. (2012). Concepts of Genetics, 10thEdition. Benjamin Cummings
6. Pierce, B. (2012). Genetics: A Conceptual Approach, 4thEdition.W.H. Freeman
7. Strickberger, M. W. (2006). Genetics, 3rdEdition. Macmillan Publishing Company.
8. Watson, J. D., Baker, T. A., Bell, S. P., Gann, A.,Levine, M. and Losick, R. (2008). Molecular Biology of the Gene, 6thEdition. Pearson, Benjamin Cummings.

## **ZOO-UG-C502: Animal Physiology, Biochemistry and Vertebrate endocrinology**

### **Unit I: Human Physiology**

Heart: Conduction and regulation of heart beat; cardiac cycle and ECG; peripheral circulation, blood pressure and its regulation.

Respiration: Mechanism of gas exchange in gills and lungs and control of breathing. Acid-base balance and homeostasis: Ultrastructure and function of kidney, Physiology of urine formation, osmoregulators and osmoconformers.

Muscle: Types of muscles, ultrastructure of skeletal muscle, Chemical and Physiological basis of

skeletal muscle contraction.

## **Unit II: Homeostasis and Enzyme Kinetics**

Chemical foundations of physiology

Concept of normal, molar and molal solutions, acid, base, pH and buffers.

Enzymes: Nomenclatures. Properties, active site and specificity, theories and mechanism of enzyme action. Michelis Menten Equation. Enzyme inhibition

## **Unit III: Reproductive Biology and Endocrinology**

Reproductive cycle in mammals; Hormonal regulation of gametogenesis in mammals.

Integrative physiology: Basic concepts of neural and endocrine regulation of physiological processes.

Endocrine glands and hormones: Structural features and histology of endocrine glands (Testis, Ovary and Adrenal glands) and disorders.

Molecular mechanism of hormone action.

Theoretical concept of fixation and staining in relation to Microtechnique.

## **Unit IV: Practical**

1. Estimation of Haemoglobin in Human Blood.

2. Separation of amino acids by Paper Chromatography.

3. Principles of Colorimetry and colorimetric quantification of protein.

4. Salivary amylase action.

5. Microtechnique, tissue preparation and staining of ovary, testis, thyroid, pancreas, adrenal and liver.

## **Suggested Readings**

1. Berg, J., Tymoczko, J. and Stryer, L. (2012). Biochemistry, 7th Edition, W. H. Freeman.

2. Campbell, M. K. and Farrell, S. O. (2010). Introduction to Biochemistry. Cengage Learning India.

3. Chaudhury, S. K. (1996). Practice of Fertility Control: A Comprehensive Textbook. B. I. Churchill Livingston Pvt. Ltd, India.

4. Hadley, M. E. and Levine, M. (2007). Endocrinology, 6<sup>th</sup> Edition. Pearson, Benjamin Cummings.

5. Hafez, E. S. E. and Evans, T. N. (1973). Human Reproduction: Contraception and Conception. Harper and Row, New York.

6. Hall, J. E. (2011). Guyton and Hall Textbook of Medical Physiology, 12<sup>th</sup> Edition. Saunders, Elsevier Inc. (Indian print).

7. Hill, R. W., Wyse, G. A. and Anderson, M. (2012). Animal Physiology, 3<sup>rd</sup> Edition, Sinauer Associates Inc.

8. Hoar, W S. (1983). General and Comparative Physiology. Prentice Hall of India. Pvt. Ltd.

9. Knobil, E. and Neill, J. D. (2006). The Physiology of Reproduction, Vol. 2. Elsevier Publication.

10. Kronenberg, H. M., Larsen, P. R., Melmed, S. and Polonsky, K. S. (2012). William's Textbook of Endocrinology. Saunders, Elsevier Inc.

## **ZOO-UG-C601: Ecology, Toxicology, Biostatistics and Animal Behaviour**

### **Unit I: Ecology and Toxicology**

Bio-geochemical cycles: N<sub>2</sub> and CO<sub>2</sub>, Competition in nature: Inter and intraspecific, Gause's

Exclusion principle, Ecosystem Energetics. Concept of Human ecology.  
Toxicology: Definition of toxicity, classification of toxicants. Xenobiotic and Xenotoxicology concept. Toxic agents and mode of action: Pesticides, metals and radiation.  
LC<sub>50</sub>, LD<sub>50</sub>, acute and chronic toxicity. Environmental Impact Assessment (EIA) and Environmental Management Programme (EMP).

### **Unit II: Biostatistics**

Statistical methods in environmental biology and toxicology: Central tendency (mean, median and mode), dispersion (Standard Deviation, Standard Error and Variance), Basic concept of correlation and regression analysis. Concept of Hypothesis Testing and Statistical inference. t-test and Chi-square test.

### **Unit III: Animal behaviour**

Introduction to animal behavior. Ultimate and Proximate causes of Behavior. Genetical, physiological and neurological basis of behavior.

Basic concept of ethology: Sign stimulus. Innate releasing mechanism, Fixed action pattern and Action specific energy. Circadian rhythm.

Navigation in migratory birds. Communication: Bee's dance language, Communication by pheromones.

Elements of Socio-biology: Eusociality, Co-operation, Altruism and Kin selection. Parental Investment (examples from fish only): Role of males and females in parental investment.

### **Unit IV: Practical**

1. Estimation of soil and water samples with the help of electrometric pH meter.
2. Estimation of population of grassland insect using quadrat method and its statistical analysis.
3. Study of plankton in fresh water bodies.
4. Study of Aggressive behavior in fishes/ Learning behavior in mice.
5. Field trip for Biodiversity study.

### **Suggested Readings**

6. 1. Kendeigh, F C. (1984). Ecology with Special Reference to Animal and Man. Prentice Hall Inc.
7. 2. Odum, E. P. (1971). Fundamentals of Ecology, 3rd Edition. W. B. Saunders Company.
8. 3. Odum, E. P. and Barrett, G. W. (2006). Fundamentals of Ecology, 5<sup>th</sup> Edition, Cengage Learning India.
9. 4. Ricklefs, R. E. (2010). Economy of Nature, 6th Edition. W.H. Freeman.
10. 5. Sharma, P. D. (1990). Ecology and Environment, 7th Edition. Rastogi Publications.
11. 6. Shyam, D. and Rosencranz, A. (2001). Environmental Law and Policy in India. Oxford University Press.
12. 7. Stiling, P. D. (2012). Ecology Companion Site: Global Insights and Investigations. McGraw Hill Education.

## **ZOO-UG-C602: Applied Zoology and Animal Biotechnology**

### **Unit I: Medical Zoology**

Pathogenic microbes: Viruses (Herpes, H<sub>1</sub>N<sub>1</sub>), Bacteria (*Treponema*, *Mycobacterium*, *Streptococcus*).

A brief account of life, mode of infection and pathogenicity of the following pathogens: *Entamoeba histolytica*, *Leishmania donovani*, and *Trichurus trichura*.

Distribution, biology and control of vectors of parasitic diseases (Malaria, Filariasis, Dengue and Chikungunya).

### **Unit II: Applied Economic Zoology**

Insect pests of important food and cash crops: [eg. Tea (*Heliopeltis* sp.), cardamom (Leaf caterpillar, *Artona chorista* Jordon), orange (Citrus leaf minor, *Phyllocnistis citrella*) and paddy (Rice Gundhi bug, *Leptocorisa oratorius*)]. Seasonal occurrence, life history, symptoms, nature of damage and crop pest management of above crops.

Poultry: common breeds, rearing methods and disease control.

Prawn culture: Fresh water and brackish water. Pearl culture.

Dairy Industry: Introduction, breeds of dairy animals (cow, buffalo). Techniques of Dairy management.

### **Unit III: Biotechnology and Bioinformatics**

Basic concepts in genetic engineering. Restriction enzymes, Polymreases, DNA ligases etc. Cloning vectors: plasmids, cosmids, lambdaphage,. Recombinant DNA technology, Transgenic animals.

Elementary idea of PCR and its application.

Gene libraries: construction of cDNA and genomic libraries. Ethical issues and biosafety regulations.

Bioinformatics: Basic concepts, databases and information retrieval using bioinformatics tools.

### **Unit IV Practical**

1. Temporary slide preparation and staining of rectal ciliates in frogs/toads.
2. Study of gut content of cockroach.
3. Staining of bacteria (Gram staining method).
4. Use of camera lucida, stage and ocular micro-meter for cell measurement (using blood film).
5. Identification of some common crop pests (two each of the following crops): Cardamom, Paddy and Orange.
6. Test for determining the quality of milk by using Lactometer.

### **Suggested Readings**

1. Banerjee, G.C. (2000). A Text Book of Animal Husbandry. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Bogitish, B.J., Carter, C. E. & Oeltman, T, N, (2012) Human Parasitology. Academic Press.
3. Bush, A.O., Fernandez, J.C., Esch, G.W., & Seed, J.R. (2001) Parasitism: The diversity and ecology of Animal parasite. Cambridge University Press.
4. Chaterjee, K.D. (2009) Parasitology: Protozoology & Helminthology. CBS Publishers & Distributors Private Limited.
5. Cheng, T.C. (1986) General Parasitology. Academic Press.
6. Flint, S.J. *et al.*: Principles of Virology; 2<sup>nd</sup> Edition, ASM Press.
7. Foley, R.C., Bath, D.L., Dickinson, F.N. and Tucker, H.A. (1973). Dairy Cattle: Principles, Practices, Problems, Profits. Lea & Febiger, Philadelphia.
8. Glick & Pasternak (2002) Molecular Biotechnology. Third Edition, ASM Press.
9. Gupta, S.K. & P.C. Gupta. General and Applied Ichthyology (Fish & Fisheries). S. Chand & Co. Ltd., New Delhi.
10. Hartl & Jones, Genetics: Principles & Analysis of Genes & Genomes. Jones & Bartlett.