

## **M.Sc. Zoology**

Duration: 4 Semesters.

Eligibility: B.Sc. or equivalent degree with Zoology as one of the subjects and having 50% marks (45% for SC/ST) in Graduation.

### **Semester – I**

<b>Course Code</b>	<b>Name of Course</b>	<b>Internal Assessment Marks</b>	<b>End Semester Marks</b>	<b>Total marks</b>	<b>Credits</b>
AUZOO 101	Structure and Function of Animals – I	40	60	100	4
AUZoo 102	Biostatistics and Computer Applications	40	60	100	4
AUZoo 103	Biodiversity and Wildlife	40	60	100	4
AUZoo 104	Environmental Biology and Toxicology	40	60	100	4
AUZoo 105	Practical based on Zoo 101 and Zoo 102	40	60	100	3
AUZoo 106	Practical based on Zoo 103 and Zoo 104	40	60	100	3

### **Semester – II**

<b>Course Code</b>	<b>Name of Course</b>	<b>Internal Assessment Marks</b>	<b>End Semester Marks</b>	<b>Total marks</b>	<b>Credits</b>
AUZoo 201	Animal Physiology and Endocrinology	40	60	100	4
AUZoo 202	Metabolic Regulations of Cell	40	60	100	4
	iochrmistry				
AUZoo 203	Structure and Function of Animals-II	40	60	100	4
AUZoo 204	Medical	40	60	100	4

	Zoology				
AUZoo 205	Practical based on Zoo 201 and Zoo 202	40	60	100	3
AUZoo 206	Practical based on Zoo 203 and Zoo 204	40	60	100	3

### Semester – III

Course Code	Name of Course	Internal Assessment Marks	End Semester Marks	Total marks	Credits
AUZoo 301	Biotechnology	40	60	100	4
AUZoo 302	Immunology	40	60	100	4
AUZoo 303	Molecular Biology and Genetics	40	60	100	4
AUZoo 304	Developmental Biology	40	60	100	4
AUZoo 305	Practical based on Zoo 301 and Zoo 302	40	60	100	3
AUZoo 306	Practical based on Zoo 303 and Zoo 304	40	60	100	3

### Semester – IV

Course Code	Name of Course	Internal Assessment Marks	End Semester Marks	Total marks	Credits
AUZoo 401	Techniques in Biology	40	60	100	4
AUZoo 402	Specialization Paper : Entomology/Molecular Parasitology/Endocrinology, Animal Behavior/Genomics/Fish Biology	40	60	100	4
<b>AUZoo 403</b>	Project Work	--	250	250	10
<b>AUZoo 404</b>	Seminar	--	50	50	--
<b>Total Marks</b>				<b>2300</b>	<b>84</b>

#### Note: End Semester Theory Examination

Attempt FIVE questions in all. Question No.1 is compulsory of 20 marks with short - type answers covering the whole syllabus. For others two questions will be set from each unit, one to be attempted. Maximum marks for each theory paper will be 60 and time 3 hours.

## **SEMESTER – I**

### **AUZoo 101: Structure and Function of Animals – I**

#### **Unit-I**

Cytoskeleton: Basic characteristics and its role in locomotion. Flagella and ciliary movement in protozoa; Skeleton, its role and types: an overview. Hydrostatic skeleton in Cnidaria and Flatworms Exoskeleton in arthropods and molluscs Evolution of Coelom, Bilateral symmetry and Metamerism and their significance in locomotion

#### **Unit –II**

Ingestion of food Mechanism and regulation of digestion Symbiotic nutrition Intracellular transport in Protozoa. Circulation of external medium of transport within the body of sponges and cnidarians Filter feeding in Polychaeta, Mollusca, Echinodermata.

#### **Unit-III**

Open and closed circulatory systems. Chambered, tubular and ampullary hearts, neurogenic and myogenic hearts Blood and Evolution of Heart

#### **Unit – IV**

Organs of Respiration: Gills, Lungs and Trachea. Respiratory pigments and their functions Mechanism of Respiration and transport of gases

#### **Suggested Reading Materials:**

- Barrington, E. J. W. (1967), Invertebrates Structure and Functions. Houghton Mifflin Co. Boston.
- Gardiner, M. S. (1972), The Biology of Invertebrates, McGraw Hill, New York
- Hyman, L. H. The Invertebrates. Vol I– Protozoa through Ctenophora (1940), Vol. II – Platyhelminthes and Rhynchocoela (1951), Vol. III- Acanthocephala, Aschelminthes and Entoprocta (1951), Mc Graw Hill, New York
- Kent, G. C. and Carr, R. K. (2001), Comparative Anatomy of the Vertebrates 9th edition, McGraw Hill Higher Education, New York.
- Prosser, C.L. (1984), Comparative Animal Physiology. Satish Book Enterprise Books seller & Publishers, Agra.
- Smith, H.S. Evolutin of chordate structure, Hold Rinehart and Winston Inc. New York.

## **AUZoo 102: Biostatistics and Computer Applications**

### **Unit-1**

Data analysis and database – Brief description and tabulation of data, Measure of central. Measures of central value Arithmetic mean, mode and median Definition, calculation and its properties Measures of Dispersion Range, Interquartile range, Quartile deviation Mean deviation and standard deviation Correlation: Methods studying correlation. Regression analysis (Regression lines and regression equation).

### **Unit-II**

Concept of sampling and sampling methods Definition and law of sampling, judgment sampling, Random sampling, stratified sampling, systematic sampling, multi-stages sampling and quota sampling. Test of significance for large samples and small samples. Chi-square analysis. Analysis of variance Probability and law of probability, Bioinformatics

### **UNIT-III**

Introduction to computer capability, history and classification of computers Computer architecture, organization, its components, hardware and software concepts, operating systems, peripherals, I/O devices Introduction to programming Languages, Internet

### **Unit – IV**

MS-Windows basics, MS-Word – Meaning of Word–Processing, Creating, Saving, Printing documents, Formatting, Spell-Check, Adding page numbers, Header and Footer, Macros, Creating tables, Converting table to text and vice-versa. MS-Excel – Spreadsheets, Using different types of formulae, Creating graphs and charts, Exporting charts to MS-Word, MS-PowerPoint – Creating presentations, Formatting, Adding effects and timings.

### **Suggested Reading Materials:**

- Sinha, P.K. (1992). Computer Fundamentals.
- Peter Norton's Introduction to Computers, 6th Ed.
- Windows Based Computer Courses, Sumit Kumar, and JBD Publishers.
- Gupta, S.C. (2004). Fundamentals of Statistics. Himalaya Publishing House.

## **AUZoo 103: Biodiversity and Wildlife**

### **Unit-I**

Biological diversity, concept and level, role of biodiversity in ecosystem, function and stability. Biodiversity as a resource and causes of its depletion Ecological sub regions and distribution of wildlife in India. Basic knowledge of National and international organization: ZSI, WII, BNHS. The animal welfare board of India, TRAFFIC, CITIES, WWE, UNEP World heritage and biodiversity convention (Ramsar convention)

### **Unit-II**

Need for conservation of biodiversity. Benefits from biodiversity Threats to biodiversity IUCN Categories of threat, distribution and global pattern, terrestrial biodiversity hot spots. Red Data Book & Conservation status (endangered, vulnerable, rare, threatened and near threatened species) – definitions

### **Unit-III**

Wildlife, History Cause of depletion Wildlife of India- wildlife schedules, ecozones, national parks, sanctuaries, reserves. National & State mammals and birds of India Policies and Laws in Wildlife Management (National) Endangered species management and biodiversity protection Important projects for the conservation of endangered species in Himachal Pradesh and other parts of India

### **Unit-IV**

Environmental awareness and education regarding conservation of wildlife Restoration of wildlife populations by reintroduction and captive breeding *In situ* and *ex situ* conservation. Conservation of invertebrates with special reference to corals and butterflies Wildlife and its status in India – Important ecological sites and their status Zoo Geographical regions

### **Suggested Reading Materials:**

- Aggarwal, (2000). Wildlife of India.
- Brewer: Principal of Ecology.
- Burton, L. D. (2003). Fish and Wildlife: Principles of Zoology and Ecology. Delmar.
- Fulbright, Timothy, E. and Hewitt, D. G. (2008). Wildlife Science: Linking Ecological Theory and Management Applications. CRC Press, Taylor and Francis: BocaRaton, F L.
- Gopal, R. (1992). Fundamental of Wildlife management Justice Home Allahabad. Thompson Learning Pb.
- Dasmann, R. F. (1982). Wildlife Biology, Wiley Eastern, New Delhi.
- Giles, R. H. (1984). Wildlife Management Techniques, Natraj Publishers, Dehradun.
- Hosetti, B. B. (1997). Concepts in Wildlife Management, Chawla Press, Delhi.
- Odum, E. P. (1983). Basic Ecology.

## **AUZoo 104: Environmental Biology and Toxicology**

### **Unit-I**

Environmental pollution: Definition, primary and secondary pollutants. Types of pollution: their causes, sources, effect and control management/method. Green House effect: Definition, global warming, consequences and significance. Ozone layer: Ozone as a friend and a foe; reasons of ozone depletion and its possible effects on plants, animals and man; Measures to check depletion of ozone layer.

### **Unit-II**

Concepts of sustainable development, its utility and significance Environment Impact Assessment: Definition, Introduction, Different phases and significance. Environmental Policy: Economic environmental policy, social environmental policy, legal environmental policy at global and national level. Environmental Audit

### **Unit-III**

Environmental Toxicology: Historical background, Classical toxicology, ecotoxicology and environmental toxicology. Classification of toxicants Toxic agents: Pesticides, metals, solvents Radiation, carcinogens, poisons, Bio-toxins, petrochemicals. Toxicant uptake: Route of toxicant uptake/Absorption of toxicant uptake at tissue and cellular level. Distribution and storage of toxicant Biotransformation and elimination of toxicant Xenobiotics: Definition, types and significance.

### **Unit-IV**

Effect of pollutant on ecosystem Solid waste management: Primary waste products- Solid waste, toxic biological and hospital landfills, incineration, source reduction and recycling. Bioremediation, its role and significance Applications of toxicology, anthropogenic activities and environment Human toxicology and medicinal ethics

### **Suggested Reading Materials:**

- Principles of Environmental Toxicology by I. C. Shaw and J. Chadwick; Taylor & Introduction to Toxicology, 3rd Ed. Taylor & Francis, London by Timbrell, J.
- Applied Ecology and Environmental Management by Edward I. Newman Francis ltd.
- Fundamentals of Ecology by W.B. Odum, E.P. Saunders, Toppan Co. Ltd., Tokyo, Japan
- Handbook of Environmental Health and Safety – principle and practices by H. Koren; Lewis Publishers
- Textbook: A Textbook of Modern Toxicology. Third Edition by E. Hodgson (Ed.). John Wiley & Sons, Inc. (Posted on the D2L content page).

## AUZoo 105: Practical based on AUZoo 101 and AUZoo 102

- To study the Protozoan culture.
- To study the temporary mounting of different invertebrates
- To study the specimens of various phyla.
- Study of permanent slides.
- Salivary glands.
- Radula of Pila and jaws of Leech.
- Using slides/charts/models/videos study of following:-  
Anatomy of gut in relation to food and feeding habits of detritivores, carnivores Herbivores, omnivores and sanguivores.  
Different kinds of Heart and blood vascular system in animals.  
Respiratory structures: Gills (Crustaceans, Bivalves, Cephalopods, and Fish) Book Lungs (Scorpion); Trachea and spiracles (Cockroach).
- To study the Hydrostatic skeleton.
- MS-Windows basics, MS-Word – Meaning of Word–Processing, Creating, Saving, Printing documents, Formatting, Spell-Check, Adding page numbers, Header and Footer, Macros, Creating tables, Converting table to text and vice-versa.
- MS-Excel – Spreadsheets, Using different types of formulae, Creating graphs and charts.
- Exporting charts to MS-Word, MS-PowerPoint – Creating presentations, Formatting, Adding effects and timings.
- Concept of sampling and sampling methods. Definition and law of sampling, Test of significance for large samples and small samples.
- Chi-square analysis.
- Analysis of variance.
- Probability.

## **AUZoo 106: Practical based on AUZoo 103 and AUZoo 104**

- Visit Report on nearby fauna and their adaptation
- To study the species diversity, evenness by using Simpson diversity index.
- Study of Indian Wild life Sanctuaries/ National Parks and their fauna with the help of Maps/ charts.
- To study flora and fauna of wild life sanctuary of District Mandi, Himachal Pradesh
- Study of different types of forests in India with the help of maps/charts.
- National & State mammals and birds of India.
- IUCN Categories of threat.
- Important projects for the conservation of endangered species in India.
- *In situ* and *ex situ* conservation.
- Classification of toxicants and Toxic agents.
- Bioremediation
- Biotransformation and elimination of toxicant.
- Toxicant uptake: Route of toxicant uptake/Absorption of toxicant uptake at tissue and cellular level
- To estimate the different parameters of polluted water sample
- Visit to an industry for waste water and solid waste management

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## **SEMESTER – II**

### **AUZoo 201 Animal Physiology and Endocrinology**

#### **UNIT – I**

Nutrition: Chemistry, metabolic role, sources and deficiency diseases.

Blood and Circulation: Blood corpuscles, Haemopoiesis and formed elements, plasma function, blood volume regulation, blood groups, haemoglobin, haemostasis.

Heart structure, myogenic heart, specialised tissue.

ECG- its principle and significance, heart as a pump, blood pressure.

Respiration: exchange of gases, transport of gases, waste elimination.

Respiratory pigment through different polygenic group

#### **UNIT – II**

Physiology of Muscles: Types of muscles and their components, molecular organization of myosin, role of heavy and light meromyosin.

Molecular organization of actin: interaction of actin and myosin, role of actin (microfilaments) and myosin in eukaryotic cells.

Excretion: kidney, urine formation, urine concentration, waste elimination and micturition.

#### **UNIT – III**

Nervous system: Neurons, chemotaxis and chemotactic signals of the plasma membrane, Na<sup>+</sup> and K<sup>+</sup> permeability and channels and neurotransmitters.

Physiology of impulse transmission through nerves and synapsis

Sense organs: Sensing the Environment- photoreception, chemoreception, mechanoreception, echolocation endogenous and exogenous biological rhythms.

Chromatophores and bioluminescence

Reproductive Physiology: Structure and functions of vertebrate testis and ovary, spermatogenesis, folliculogenesis and ovogenesis and their hormonal control.

#### **UNIT – IV**

Endocrinology: Chemical nature and classes of hormones, steroid hormones, and amino acid derived hormones, mechanism of hormone action. Hormones and diseases

Phylogeny of endocrine system: Evolution of pituitary gland, Physiological actions of pituitary hormones. renin-angiotensin system. Importance of adrenocortical and adrenomedullary interaction

Evolution of thyroid gland: thyroid hormones, parathyroid gland, hormonal regulation of calcium and phosphate homeostasis.

## References:

- Benjamin Lewin, Genes VII, Oxford University Press
- Hoar, W.S. General and comparative animal physiology
- Prosser, C.L. Comparative animal physiology. W.B. Saunders and Co.
- Hall, J. E., Guyton and Hall Text Book of Medical Physiology, 12th edition, Saunders Company (2010)
- Bentley, P.J., Comparative Vertebrate Endocrinology, Cambridge Univ. Press (1998).
- Vander, A.J., Sherman, J.H. and Luciano, D.S., Human Physiology, McGraw Hill Publ. Co. (1990).
- Animal Physiology: Adaptation and Environmental, Nelson K. S. (ed.) Cambridge University Press, Cambridge, UK
- Comparative Vertebrate Endocrinology, Bentley, P. J., Cambridge University Press, UK
- Vertebrate Endocrinology, Norris D. O., Elsevier Academic Press

## **AUZoo 202 Biochemistry**

### **UNIT – I**

Carbohydrates: General structure, classification and chemical properties of carbohydrates.

Homo and heteropolysaccharide: Structure of starch, pectins, dextrans, glycogen, cellulose and chitin. Bacterial polysaccharides, Mucopolysaccharides, Blood group substances, Biological functions of important polysaccharides

Lipids: Simple lipids, general structure and chemical properties of simple lipids.

Compound lipids: Structure of phospholipids like lecithins, lysolecithins, cephalins, phosphatidyl serine, phosphatidyl inositol, plasmalogens, cardiolipids, sphingomyelins, glycolipids, cerebrosides, gangliosides, properties and functions of phospholipids.

Derived lipids: Cholesterol and steroid hormones (chemistry), biological functions of lipids.

### **UNIT – II**

Proteins: Amino acids as monomers of proteins and their properties, types of proteins and their classification, levels of protein structure and forces stabilizing protein structure and shape.

Conformation of proteins: subcellular assemblies of protein, functions and their denaturation.

Conjugated proteins: Lipoproteins, glycoproteins, nucleoproteins, metalloproteins and chromoproteins, biological functions of proteins.

Nucleic acids: Molecular structure and biological functions of DNA and RNA molecules, ZDNA and its biological significance.

Physical properties of nucleic acid - denaturation of DNA, hydrolysis of nucleic acid, nucleic acid and protein interaction

### **UNIT - III**

Enzymes: Enzyme kinetics, mode of action of enzymes and biochemical role of coenzymes and isoenzymes.

Effect of enzyme concentration, substrate concentration and pH on enzyme activity

Mechanism of enzyme action - a brief description, allosteric enzymes, concentration of effector, feedback inhibition - various mechanisms, covalent modifications irreversible and reversible

Oxidation of fatty acids: Oxidation, biosynthesis of saturated and unsaturated fatty acids.

Energy rich bonds, compounds and biological energy transducers

### **UNIT – IV**

Metabolism: ATP - cycle, energy rich phosphate compounds, major pathways of catabolism of carbohydrates.

Glycolysis and tricarboxylic acid cycle

Phosphogluconate pathway and glycogenolysis

Mitochondrial -Electron Transport Chain, inhibitors of electron transport chain.

Mechanism of mitochondrial oxidative phosphorylation, inhibitors and uncouplers of mitochondrial oxidative phosphorylation

## References

- Abeles, R.H., Fray, P.A. and Jencks, W.P. (1992) Biochemistry, Jones and Bartlett Publishers, London.
- Berg, J. M., Tymoczko, J.L. and Stryer (2002) Biochemistry (5th Ed.) W.H. Freeman and Co. NY.
- Cohn, E.E., Stump.P.K., Bruening , G. and Doi, R.H. (1987) Outlines of Biochemistry(5th Ed)Johan Wiley & Sons, NY.
- Practical Biochemistry – Principles and Techniques, Wilson and Walker, Cambridge University Press, Cambridge, UK
- Nelson, D. L. and Cox, M. M., Lehninger Principles of Biochemistry, 5th ed., W.H. Freeman and Company, New York (2008 ).
- Satyanarayana, U. and Chakrapani, U., Biochemistry, 3rd ed., Books and Allied Pvt. Ltd. (2009).

## **AUZoo 203 Structure and Function of Animals-II**

### **Unit-I**

Integumentary System: Embryonic origin, General features of the Integument, Specializations of integument. Evolution of Skin

Digestive system: comparative account of alimentary canal, digestive organs in vertebrates.

### **Unit-II**

Skeletal System: Comparative account of skeleton system in vertebrates.

Evolution of the Appendicular system.

Nervous Systems: Chemical coordination of body functions through neuro-secretion

Evolution of functional anatomy of brain

### **Unit – III**

Circulatory system: comparative account of heart structure in vertebrates.

Excretory system: organs, waste products, comparative physiology of vertebrates.

### **Unit – IV**

Origin of birds, Migration of birds and fishes, extinct reptiles, Evolutionary Histories of Horse, Camel, elephant and man.

## **References**

- Barrington, E. U. W. (1967), Invertebrates Structure and Functions. Houghton Mifflin Co. Boston
- Barth, R. H. and Broshears, R. E (1982), The Invertebrate world. Holt Saunder, Japan
- Gardiner, M. S. (1972), the Biology of Invertebrates, McGraw Hill, New York.
- Kent, G. C. and Carr, R. K. (2001), Comparative Anatomy of the Vertebrates 9th edition, McGraw Hill Higher Education, New York.
- Prosser, C.L. (1984), Comparative Animal Physiology. Satish Book Enterprise Bookseller & Publishers, Agra.
- Goodrich, E. S. (1958), Structure and Development of Vertebrates, Vol. I and II. D. E. Publication, New York.

## **AUZoo 204 Medical Zoology**

### **UNIT-I**

Introduction to Parasitology (pertaining to various terminologies used) Brief introduction to pathogenic microbes: Viruses, Rickettsiae, Spirochaetes and Bacteria.

Brief accounts of life history, mode of infection and pathogenicity of the following pathogens with reference to man prophylaxis and treatment:

Pathogenic protozoans: *Entamoeba*, *Trypanosoma*, *Leishmania*, *Giardia* *Trichomonas*, *Plasmodium*.

Pathogenic helminths: *Fasciolopsis*, *Schistosoma*, *Echinococcus*, *Ancylostoma*, *Trichinella*, *Wuchereria*, *Dracunculus*, *Oxyuris*.

### **UNIT-II**

Brief account of arthropods as direct agents of disease or discomfort; accidental injury to sense organs; blood loss; entomophobia; dermatosis; myiasis; allergy and venoms.

Arthropods as vectors of human diseases; Malaria (*Anopheles stephensi*, *A. culicifacies*); yellow fever and Dengue haemorrhagic (*Aedes aegypti*, *Ae albopictus*); Filariasis (*Culex pipiens*, *C. fatigans*, *Mansonia* sp.); Japanese B. Encephalitis (*C. tritaeniorhynchus*) Plague (*Ctenocephalides cheopie*) and Epidemic typhus (*Pediculus*).

### **UNIT-III**

Distribution biology and control of the above mentioned vectors.

Histopathological changes in organs in relation to diseases such as liver cirrhosis, nephrosis; tumours, cancers

Epidemic diseases, such as typhoid, cholera, small pox; their occurrence and eradication programmes.

### **UNIT-IV**

Brief introduction to human defense mechanisms, Antigens and antibodies

General account of drug therapy and drug resistance

Vaccination: Immunization, different types of vaccines

Current status of vaccines for different diseases

### **References**

- Kettle, D.S: Medical Veterinary Entomology (CAB International).
- Cheng, T.C: General Parasitology, (Academic Press).

## **AUZoo 205 Practical based on Zoo 201 and Zoo 202**

- To demonstrate that the optimum activity of salivary amylase is pH dependent.
- To study the effects of various osmolarities on erythrocytes.
- To study the effect of exercise on cardiovascular and respiratory system.
- To estimate the glucose level by glucometer.
- Analysis of blood Groups: A, B, O and AB.
- Blood: Erythrocyte sedimentation rate (ESR); Haematocrit; bleeding time; coagulation time; prothrombin time.
- R.B.C., W.B.C. counts.
- To study the histology of endocrine glands of mammals through prepared slides.
- Qualitative/Quantitative estimation of Carbohydrates.
- Qualitative/Quantitative estimation of Glucose.
- Qualitative/Quantitative estimation of proteins.
- Qualitative/Quantitative estimation of fats.

## **AUZoo 206 Practical based on Zoo 203 and Zoo 204**

- Study of permanent slides: Skin of fish, frog, lizard, bird and mammal. Setae of earthworm, Spicules of Sponges and *Herdmania*. Internal ear of fish, Tentorium of grasshopper, Muscle fibers, cartilage and bone. Endocrine glands of vertebrates.
- Study the following with the help of charts/models/videos/permanent slides. Appendages of Prawn, Wing venation, coupling and types of wings of insects, Comparative anatomy of nervous system in Earthworm, Cockroach, Pila, Sepia and Fishes. Modification of antenna in arthropods
- **To study the vertebrates skelton system.**
- Examination of blood parasites: *Trypanosoma* and *Plasmodium*.
- Study of permanent slides and specimens of parasitic protozoans, helminths and arthropods mentioned in the theory syllabus.
- *Anopheles*: Study of female adult mosquitoes for sporozites and oocytes through charts/models/video clippings.
- Collection of helminthes parasites from vertebrates; their preservation and staining. Staining bacteria.
- Study of slides showing histopathological changes in liver and kidney in respect of cirrhosis and nephrosis respectively.
- Metamorphosis through charts/audio video means in frog and insect

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## SEMESTER – III

### AUZoo 301 Biotechnology

#### UNIT-I

Biotechnology: Scope, significance, microbes and microbial system and their improvement for biotechnological use.

Principles and techniques of plant, animal cell culture.

Basic concepts in genetic engineering

Enzymology of genetic engineering: Restriction enzymes, DNA *ligase*, Polymerase etc.

Cloning Vehicles: Plasmids, Cosmids, Lambda phage, Charon phage, Shuttle vectors, 2  $\mu$ DNA plasmids, yeast plasmids.

#### UNIT-II

Recombinant DNA technology: Introduction of cloned genes into the host cells: Transformation, transduction, Particle gun, electroporation, and liposome mediated cultivation etc.

Analysis and expression of cloned gene in host cells: Gene cloning and Sequencing. Restriction endonuclease. Identification of Specific clone with a specific probe

Techniques: Southern, Northern, Western Blotting, PAGE, PCR, DNA finger printing, DNA foot printing

In situ hybridization, RFLP, RAPD, Ligase, Ribozymes, DNA probes, antisense RNA, Expression of cloned genes. Practical applications of gene cloning

#### UNIT-III

Gene libraries - Construction and analysis of cDNA, mRNA, isolation, cDNA synthesis

Cloning and amplification of gene libraries, Genomic DNA libraries, Measuring activity of fused genes and identifying the products of cDNA clones

Changing genes: Site - directed mutagenesis. Transferring genes into animal oocytes, eggs, embryos and specific animal tissues

Application and Impact of rDNA technology Ethical issues and bio-safety regulations

#### UNIT-IV

Fermentation technology, design process

Scale up and down stream processing, procedure and antibiotics,

Beverages, enzymes, ethanol and methanol from biomass

Bioremediation, biopesticides and biosensors

Single cell protein

#### Suggested Reading Materials:

- De Robertis and De Robertis. Cell and molecular biology. Lea and Febiger.
- P.K. Gupta. Molecular cell biology. Rastogi publications.
- Watson, Gilman, Witkowsky, Zoller. Recombinant DNA. Scientific American books.
- Gardner, Simmons, Snuskd. Principle of genetics. John Wiley and Sons Inc.
- T.A. Brown. Gene Cloning
- Daniel L. Hartl, Elizabeth W. Jones. Genetics-Principles and Analysis. Jones and Bartlett

## **AUZoo 302 Immunology**

### **Unit-I**

Overview of the immune system: components of the immune system.

Principles of innate and adaptive immunity

Recognition and effector mechanisms of the adaptive immunity- antigen and immunogenicity

Clonal selection theory

Antigen recognition by immune cells: Adaptive immunity- antibody structure, antigen recognition by B lymphocytes, TCR, antigen recognition by T- cells.

### **Unit-II**

Structure and function of MHC complex, Structural variations in immunoglobulin constant regions: antigen processing and presentation to T lymphocytes- antigen presenting cells. Role of CD1 in antigen presentation, Innate Immunity- pattern recognition in the innate immune system Role of TLRs in innate immune response, complement and innate immunity, induced innate response to infection.

### **Unit-III**

Effector mechanisms and regulation of immune responses NK and NKT cell functions, mucosal immunity, immunological memory, regulation of immune response: cytokines and chemokines. Complement system, leukocyte activation and migration, APC regulation of the immune response, T- cell mediated regulation of immune response, Immunological tolerance and allergy.

### **Unit-IV**

Immunity in health and disease: introduction to infectious disease, innate immunity to infection, adaptive immunity to infection.

Evasion of the immune response by pathogens, autoimmunity, immunodeficiency diseases- inherited immunodeficiency diseases, acquired immune deficiency syndrome.

Allergy and hypersensitivity- IgE and allergic reactions, hypersensitivity diseases; autoimmunity- responses to self antigens, transplant rejection- responses to allo-antigens; manipulation of immune responses, Vaccines.

### **Suggested Reading Materials:**

- Kuby Immunology, Richard, Thomas, Barbara, Janis, (5th Ed., 2003), W. H. Freeman and company, New York, USA.
- Benjamini, Immunology, 5th ed., Coico & Sunshine, Wiley-Liss Publication, New York (2003).
- Roitt, I.M., Brostoff, J. and Male, D., Immunology, 8th ed., Mosby Publications, Edinburgh, Mosby (2012)
- Paul, W.E., Fundamental Immunology, 7th ed., Lippincott Raven Publication, Philadelphia, New York (2012).

## **AUZoo 303 Molecular Biology and Genetics**

### **Unit-I**

Chromosome organization: structure of chromosome, heterochromatin and euchromatin. DNA replication, Prokaryotic and eukaryotic DNA replication, Mechanics of DNA replication, Enzymes and Accessory proteins involved in DNA replication.

Transcription: Prokaryotic transcription, Eukaryotic transcription, RNA polymerases, General and specific transcription factors and regulatory elements.

Mechanisms of transcription regulation, Transcription termination, 3'-end processing and polyadenylation, Splicing, Editing, Nuclear export of mRNA

### **Unit-II**

Genetic code

Translation, Prokaryotic and eukaryotic translation, The translational machinery, Mechanisms of initiation, elongation and termination

Regulation of translation, Co- and post-translational modifications of proteins, Antisense and Ribozyme technology, Inhibition of splicing, polyadenylation and translation, Types of ribozymes, hammerhead, hairpin and other ribozymes, Application of antisense and ribozyme technologies.

### **Unit-III**

Cell Division: Molecular basis of cell division; mitotic apparatus; forces of cell division (chromosome movement).

Molecular Mutations: Molecular basis of mutations; wobble's hypothesis;

Overlapping and split genes, Regulation of Gene Operon hypothesis, pro and eukaryotic operons, induction and repression, complex gene clusters.

Genes in Populations: Hardy Weinberg Law and calculation of gene frequencies. Human Genome Project and Gene Therapy

### **Unit-IV**

Recombination and repair, Holiday junction, gene targeting, gene disruption, Cre/lox recombination, RecA and other recombinases

DNA repair mechanisms Molecular mapping of genome.

Pedigree, analysis, Animal trafficking and poaching; germplasm maintenance and taxonomy

### **Suggested Reading Materials:**

- Molecular Biology of the Gene, J.D. Watson, N.H. Hopkins, J.W. Roberts, J.A Steitz and A.M. Weiner. The Benjamin/Cummings Pub. Co., Inc., California.
- Molecular Cell Biology, J. Darnell, H. Lodish and D. Baltimore Scientific American Books, Inc., USA
- Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson. Garland Publishing Inc., New York.
- Gene VI, Benjamin Lewin, Oxford University Press, U.K.
- Molecular Biology and Biotechnology. A comprehensive desk reference, R.A Meyers (Ed.), VCH Publishers, Inc., New York.
- Molecular Cloning: a Laboratory Manual, J. Sambrook, E.F. Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York.

## **AUZoo 304 Developmental Biology**

### **Unit – I**

Scope, science of developmental biology and its application Developmental pattern in metazoan Gametogenesis and Fertilization: Spermatogenesis and oogenesis. Egg and sperm interaction, fertilization, vitellogenesis

Natural and artificial parthenogenesis, *In vitro* fertilization and embryo transplantation.

Biology of sex determination: Chromosomal sex determination - mammals and *Drosophila*, Testis determining genes, ovarian development, Environmental sex determination.

### **Unit – II**

Cleavage: Cleavage and its patterns. Biochemical changes during cleavage. Influence of male and female pronuclei during early development.

Gastrulation and morphogenetic movements

Differentiation, Determination, transdetermination.

### **Unit – III**

Induction and Maturation: Induction, competence and inductive response.

Principles of reciprocal action

Control of metamorphosis: Morphophysiology of metamorphosis in insects and frog.

Regeneration of tail in Reptiles Limb regeneration in amphibians

Vertebrate lens regeneration, Regeneration in Platyhelminthes and Coelenterates

Concept of growth

### **Unit – IV**

Genetic Control of Development: Nuclear determination of developmental events.

Molecular basis of early embryonic development Nucleus and cytoplasmic interactions during development. Hemopoietic stem cells.

### **Suggested Reading Materials:**

- Balinsky, B.I. (1981). An Introduction to Embryology, Saunders, Philadelphia.
- Bellairs, R. (1971). Development Processes in Higher Vertebrates, University of Miami Press, Miami
- Berrill, N.J. (1971): Developmental Biology. McGraw Hill, New Delhi. Dawnpart, Developmental Biology.
- Ebert, J.D. & Sussex, IM. (1970): Interacting Systems in Development, Holt, Rinehart and Winston, New York.
- Gilbert, F. (1985, 95 & 2000): Developmental Biology, Sinaur.
- Goel, S.C. (1984): Principles and Animal Developmental Biology, Himalaya, Bombay.
- Grant, P. (1978): Biology of Developing System.
- Karp, G. & Berrill, M.J. (1981): Development. McGraw Hill, New Delhi.

### **AUZoo 305 Practical based on Zoo 301 and Zoo 302**

- Determination of human blood group by haemagglutination test and assessment of specificity of antigen-antibody reactions.
- To study the preparation of agar plate.
- To observe human buccal epithelial cells.
- Isolation of milk protein from milk sample.
- Bioassay to demonstrate toxicological effect.
- Study of various components of pond ecosystem.
- Blood film preparation and identification of cells
- To demonstrate antigen-antibody reaction by ELISA to students.
- To perform DOT- ELISA by using kit.
- Simple exercise to teach biotechnological principles.
- Southern blotting technique (Demonstration only).
- Northern blotting technique (Demonstration only).
- DNA fragmentation using restriction enzymes (Demonstration only).

## **AUZoo 306 Practical based on Zoo 303 and Zoo 304**

- Study of mitosis, meiosis through permanent slides/charts.
- To prepare and study the karyotype
- To study the pedigree analysis of family.
- Demonstration of Barr body in the oral epithelium of human beings.
- To study different stages of mitosis in root tips of *Allium cepa*.
- To study permanent slides of:-
- Mitosis in bone marrow cells of rat.
- Stages of meiosis in testis of rat.
- Meiotic stages in testis of grasshopper.
- Polytene chromosomes
- To study meiotic stages in buds of *Allium cepa*.
- To study dermatoglyphics with palms of hands and fingertips.
- Developmental stages of chick, frog through slides/charts.
- Metamorphosis through charts/audio video means in frog and insect.
- Study of Gametes through permanent slides:-
- Spermatogenesis in rat/frog/grasshopper.
- Study of testis (rat/frog/grasshopper).
- Study of Ovary (rat/frog/grasshopper).
- Study of permanent stained slides of different stages of chick embryo.
- Study of permanent stained slides of different embryonic stages of frog.
- To study the effect of thyroxin or iodine on the metamorphosis of frog.
- Studies of different types of eggs with reference to their yolk contents.

**Minor changes in practical syllabus can be there as per the availability of materials. As per the latest UGC guidelines (D.O.No. F. 14-6/2014(CPP-II) dated 01-08-2014) the dissections should not be conducted. The guidelines on this issue are available on the UGC website**

## **AUZoo 401 Techniques in Biology**

### **UNIT – I**

#### Microscopy

Principle and applications of light microscope

Phase - contrast microscope and Fluorescence microscope

### **UNIT – II**

#### Spectrophotometry

Principle of Colorimetry and its applications

Chromatography: Principles and types of chromatography

### **UNIT – III**

#### Electrophoresis

Principle, types and applications of electrophoresis

Flow Cytometry: Principles and Applications of flow cytometry

### **UNIT – IV**

Tissue culture: Design and functioning of tissue culture laboratory

Culture media, essential components and preparations

Serological assays like ELISA, IFA

## **References**

- Freifelder, D. (1982), Physical Biochemistry: Applications to Biochemistry and Molecular Biology, WH Freeman and Company, San Francisco.
- Gupta, M. N. (2002), Methods for Affinity- Based separations of Enzymes and Proteins.
- Kelly, R. A. (1971), the use of English for technical students, second edition. ELBS, London.
- Skoog, D. A. (1985), Principles of Instrumental Analysis, 3rd Edition, Saunders College Publishing, New York.
- Smith, C. N. (1996), Insect colonization and Mass Production. Academic Press, New York.
- Wilson, K. And Walker, J (1994), Practical Biochemistry: Principles and Techniques. Cambridge University Press, Cambridge.
- Sumner, B.E.H. (1988), Basic Histochemistry. John Wiley and Sons Ltd. Chichester, London.. Wilson, K. And Walker, J (1994), Practical Biochemistry: Principles and Techniques.
- Wilson, K. and Goulding, K. H. (1992), A Biologist Guide to principles and techniques of practical Biochemistry. 3rd Edition, Foundation Brothers, New Delhi.

# **AUZoo 402 Specialization Paper: Entomology/Molecular Parasitology/ Animal Behaviour/Genomics/Fish Biology/ Endocrinology**

## **AUZoo 402 Entomology**

### **Unit-I**

Introduction to Entomology, History of entomology in india, insect ecology: biotic and abiotic factors, Morphology: structure and function of insect cuticle, structure of head, thorax and abdomen, wing venation, modifications and wing coupling apparatus, structure of male and female genitalia, sensory organs, types of larvae and pupae.

### **Unit-II**

Structure and function of digestive, circulatory, excretory, respiratory, nervous and reproductive systems in insects

Introduction to apiculture, sericulture and lac culture

### **UNIT – III**

Systematic position, host plants, nature of damage and outlines of the life cycle of the following pests of cereals, legumes, fiber, fruits and vegetables.

Pests of stored food products with particular reference to their habits, nature of damage caused by them and outlines of their life cycles.

Insects of medical and veterinary importance with particular reference to their systematic position, mode of infection and diseases caused by them

### **UNIT - IV**

Methods of pest control: mechanical, cultural, physical, chemical, biological and genetic.

Pest surveillance, categories of pest, concept of injury levels

IPM: introduction, importance, concepts, principles and tools. Constraints of IPM

### **Suggested Reading Materials:**

- Atwal, A.S. and Dhaliwal G. S., Agricultural Pests of South Asia and Their Management, 5<sup>th</sup> ed., Kalyani Publishers, New Delhi (2005).
- Kumar and Nigam, Economic and Applied Entomology, Emkay Publications (1991).
- Matheson, R., Medical Entomology, Comstock Publishing Company, Inc. (1950).
- Metcalf and Metcalf, Destructive and Useful Insects McGraw Hill Book Company, Inc. New York, Toronto, London (1951).
- David D., Integrated Pest Management, Chapman & Hall, London, New York, Tokyo, Madras (1995).
- House, S. J., Insect Pheromones and Their Use in Pest Management Chapman & Hall, London, New York, Tokyo, Madras (1998).



## AUZoo 402 Molecular Parasitology

### UNIT - I

Different types of animal associations: definitions; phoresis, commensalism, parasitism, mutualism, hyperparasitism. Evolution of parasites: Origin of parasitism, possible evolutionary pathways, adaptation to multiple hosts, some evolutionary patterns. Parasite host specificity: Kinds of parasite - host specificity, Diagnosis of parasitic infections: Protozoans parasites and helminthic parasites.

### UNIT - II

Host parasite interactions: Immunity to protozoans and helminths Pathogenesis of parasitic infection Vectors: Brief account of various insect vectors of human parasitic infections. Parasite transmission: Introduction, mechanism for location of host, mechanism for penetrating the host, circadian rhythm associated with transmission. Ecology of parasites

### UNIT - III

Morphology, life-cycle, mode of infection of *Plasmodium*, molecular biology of *Plasmodium* – drug targets, mechanism of drug resistance, vaccine strategies and proteomic approaches; morphology, life-cycle, mode of infection of *Leishmania*, Morphology, biology, life-cycle, mode of infection of *Entamoeba*, morphology, biology, life-cycles, mode of infection of *Giardia*; gastro-intestinal nematodes, morphology, biology, life-cycles, modes of entry of *Schistosoma*, *Wuchereria*, *Brugia*, *Ancylostoma*, *Trichinella* and *Dracanculus*.

### UNIT – IV

Immune response and self-defense mechanisms, immune evasion and biochemical adaptations of parasites; parasites of veterinary importance Parasites of insects and their significance; nematode parasites of plants, morphology, biology, lifecycle and infection of crop plants by plant parasitic nematodes, plant parasitic nematodes, host parasite interactions.

### Suggested Reading Materials:

- Foundations of Parasitology, Roberts L.S. and Janovy J., McGraw-Hill Publishers, New York, USA.
- Modern Parasitology: A Textbook of Parasitology, FEG Cox., Wiley-Blackwell, U. K
- Chandler A.C. And Read, C.P., Introduction to Parasitology, John Wiley, London (1961).
- Smyth, J.D., Introduction to Animal Parasitology, Hodder& Stoughton, London (1976).
- Chappell, L.H., Physiology of Parasites, Blackie, Glasgow&London (1979).
- Cheng, T.C., General Parasitology, 2<sup>nd</sup> ed. Academic Press, College Division, London (1986).
- Noble, E.R. and Noble, G.A., Parasitology: The Biology of Animal Parasites V-  
edition, Lea & Febiger, Philadelphia (1982).
- Chatterjee, K. D., Parasitology: Protozoology and Helminthology, 13<sup>th</sup> ed., CBS publishers and distributors Pvt Ltd (2009)
- James, M.T. and Harwood, R.F., Herins's Medical Entomology, 6<sup>th</sup> ed., Collier Macmillan Canada Ltd., Don Mills, Qutario, (1969).

## **AUZoo 402 Animal Behaviour**

### **Unit-I**

Introduction - definition, historical out line, patterns of behaviour, objectives of behaviour, mechanism of behaviour, asking questions. Reflexes- reflex action, types of reflexes, reflex arch, characteristics of reflexes and complex behaviour. Orientation primary and secondary orientation; kinesis – orthokinesis, klinokinesis; taxis – different kinds of taxis; sun-compass orientation, dorsal- light reaction

### **Unit-II**

Eusociality, social organization in honey bee, polyphenism and its neural control, flower recognition, displacement and translocation experiment, various type of communications, production of new queen and hive, swarming, honey bee as super organism. Fixed action pattern: mechanism, deprivation experiment controversies\ FAP- characteristics and evolutionary features Learning and instincts: conditioning, habituation, sensitization, And reasoning.

### **Unit-III**

Innate releasing mechanisms: key stimuli, stimulus filtering, and supernormal stimuli, open and closed IRM, mimetic releaser, code breakers. Homeostasis and behaviour: motivational system, physiological basis of motivation, control of hunger drive in blow fly and thirst drive in goat, role of hormone, motivational conflict and decision making, displacement activity, models of motivation, measuring motivation. Hormones and pheromones influencing behaviour of animals

### **Unit-IV**

Altruism – reciprocal altruism, group selection, kin selection and inclusive fitness, cooperation, alarm call. Parental care, parental manipulation, evolutionarily stable strategy, cost benefit analysis of parental care with suitable case studies. Sexual selection: intra sexual selection (male rivalry), inter-sexual selection (female choice), infanticide, sperm competition, mate guarding, sexual selection in human, consequences of mate choice for female fitness, monogamous verses polygamous sexual conflict.

### **Suggested Reading Materials:**

- Mechanism of Animal Behaviour, Peter Marler and J. Hamilton; John Wiley & Sons, USA
- Animal Behaviour, David McFarland, Pitman Publishing Limited, London, UK
- Animal Behaviour, John Alcock, Sinauer Associate Inc., USA
- Perspective on Animal Behaviour, Goodenough, McGuire and Wallace, John Wiley & Sons, USA
- Exploring Animal Behaviour, Paul W. Sherman & John Alcock, Sinauer Associate Inc. ,Massachusetts, USA
- An Introduction to Animal Behaviour, A. Manning and M.S Dawkins, Cambridge University Press, UK

## **AUZoo 402 Genomics**

### **Unit-I**

Organization and structure of genomes - size, complexity, gene-complexity, virus and bacterial genomes, organelle genome, architecture of mitochondrial genome, conserved chloroplast DNA; organization and nature of nuclear DNA in eukaryotes; transposable elements, retro-transposons, SINE, LINE, Alu and other repeat elements, pseudogenes, segmental duplications

### **Unit-II**

Mapping genomes - physical maps, EST, SNPs as physical markers, radiation hybrids, FISH, optical mapping, gene maps, integration of physical and genetic maps; sequence genomes: high-throughput sequencing, strategies of sequencing, recognition of coding and non-coding regions and annotation of genes, quality of genome-sequence data, base calling and sequence accuracy.

### **Unit-III**

Bioinformatics - datasets, sequence analysis based on alignment, de novo identification of genes, *in silico* methods. Comparative genomics - orthologs and paralogs, protein evolution by exon shuffling; human genome project, comparative genomics of bacteria, organelles, and eukaryotes

### **Unit-IV**

Large scale mutagenesis and interference - genome wide gene targeting; systematic approach, random mutagenesis, insertional mutagenesis, libraries of knock-down phenocopies created by RNA interference; transcriptome analysis, DNA micro-array profiling, data processing and presentation, expression profiling, proteomics - expression analysis, protein structure analysis, protein-protein interaction.

### **Suggested Reading Materials:**

- Principle of Genome Analysis and Genomics, Primrose, S. B. and Twyman R. M., (7th Ed., 2006), Blackwell Publishing Company, Malden, USA
- Genomes 3, Brown, T. A., Garland Science Publishing, London, UK
- Bioinformatics: Sequence and Genome Analysis, Mount, D. W., Cold Spring Harbor Laboratory Press, New York, USA

## **AUZoo 402 Fish Biology**

### **Unit-I**

Definition of Fish, Fisheries and aquaculture Classification of fishes with distinguishing characters and examples of each group Indian fisheries production, utilization and demand Estuarine, Marine, Riverine and wetland fisheries: characteristic species and their exploitation. Culture fisheries Cultivable organisms for aquaculture Criteria of selection of cultivable fishes Design, construction and maintenance of fish culture ponds. Ecology of fish pond ecosystem Physico chemical conditions of ponds water and soil Biological conditions of waters Weeds and their control Productivity of fish pond Classification of water bodies on the basis of productivity Water pollution its causes and remedy. Aquaculture Ranching and Rational fishery

### **Unit-II**

Fish integument: Exoskeleton and colouration. Fins: origin types and functions. Food and feeding habits of fishes, Digestion in fishes Respiratory system Gill structure and functions, Accessory respiratory organs swim bladder and webberian ossicles Osmoregulation in fishes. Receptors in fishes Chemoreceptors Lateral line organs Eye, Ear. Pineal organ Hormones and reproduction: Induced breeding in carps and catfishes. Identification of different maturity stages of fishes. Migration in fishes Fish diseases and their control Age and growth studies

### **Unit-III**

Introduction to fish biotechnology and methods of fish stock improvement Selection and hybridization Androgenesis and Gynogenesis – natural and induced Polyploidy induced. Sex reversal and sterility Transgenesis, transgenes and application Cryopreservation of gametes and embryo Fish-by products Fish preservation process Nutritive aspect of fish meat and oil

### **Unit-IV**

Different systems for aquaculture: pond culture, cage culture, raceway culture. Culture of important fish species (Mayer carps, common carps, Chinese carps, cat fish and Tilapia culture). Integrated Aquaculture and waste water aquaculture. Pearl Culture Frog culture Prawn culture-Fresh and brackish water Impact of Aquaculture on Environment Methods of Fishing: Crafts and gear technology. Nutrition in Aquaculture Nutrient and non-nutrient diet components Preparation and processing of feed, feed formulae, Natural and supplementary feed and their utilization

### **Suggested Reading Materials:**

- Fishponds in Farming Systems, Zijpp, V. D., Verreth, J. A. J., Tri, L. Q., van Mensvoort, M. E. F., Bosma, R. H., and Beveridge, M. C. M., Wageningen Academic Publishers, Netherlands
- Aquaculture Principles and Practices, Pillay, T. V. R., Blackwell Publishing, USA
- Aquaculture and Fisheries Biotechnology Genetic Approaches, Dunham, R. A., CABI Publishing, USA

## **AUZoo 402 Endocrinology**

### **UNIT-I**

History and scope of endocrinology

Endocrine methodologies

Mechanism of hormone action

Hormones and environment

### **UNIT-II**

Role of hypothalamus and neuroendocrine integration in mammals

Functional significance of Pineal hormones

Parathyroid hormones and gastrointestinal hormones and its significance

Renin and angiotensins and their functional significance

### **UNIT-III**

Male Reproductive System: Differentiation of testes and male genital ducts

Ultrastructure of testes

Structure and ultrastructure of mammalian sperm

Structure and functional role of sertoli cell and Leydig cells

### **UNIT-IV**

Female Reproductive system: Differentiation of Ovary and genital ducts

Histology of Ovary, Uterus, Cervix and Vagina

Ultrastructure of Ovum

Estrous Cycle in Mammals

## **References**

- Hadley, M.E. Endocrinology
- Bentley, P.J. Comparative Vertebrates Endocrinology. Cambridge University Press, Cambridge, U.K.
- Greep, R.O. Handbook of Physiology Vol. 6: Male Reproduction. American Physiological Society, Washington.
- Greep, R.O. Handbook of Physiology Vol. 7: Female Reproduction. American Physiological Society, Washington.
- Turner, C.D. and J.T. Bagnara. General Endocrinology. W./B. Saunders.

## M.Phil./ Ph. D Zoology

Duration: 2 Semesters.

Eligibility: M.Sc. in Zoology and having 55% marks (50% for SC/ST) in post Graduation.

### Semester – I

#### Semester- I

Course Code	Name of Course	Internal Assessment Marks	End Semester Marks	Total marks	Credits
AUZooMP 101	Techniques in Biological Research	40	60	100	4
AUZooMP 102	Recent advances in Zoology	40	60	100	4
AUZooMP 103	Specialization paper	40	60	100	4
<b>AURPE - 04</b>	<b>Research and Publication Ethics</b>	40	60	100	4
	Total Marks	160	2400	400	16

#### Semester- II

Dissertation			150	12
Viva voce			50	2
<b>Total Marks (Semester I &amp; II)</b>			<b>600</b>	<b>30</b>

#### Note: End Semester Theory Examination

Attempt FIVE questions in all. Question No.1 is compulsory of 20 marks with short - type answers covering the whole syllabus. For others two questions will be set from each unit, one to be attempted. Maximum marks for each theory paper will be 60 and time 3 hours. M.Phil. theory course is same for Ph. D students also who need to undertake theory course as per regulations.

## **AUZooMP 101- TECHNIQUES IN BIOLOGICAL RESEARCH**

### **UNIT-I**

Basic concepts of research: Method of writing Dissertation, Preparation of Abstract, Collecting information for Introduction and definition of the research problems- development and standardization of materials and methods. Defining and formulation of research problem- literature collection using internet and journals- way of interpretation of references cited in the Thesis/ dissertation. Data collection technique Selection of problem- stages in execution of research; preparation of Manuscript for journals

### **UNIT-II**

Laws of photometry, Kinds of photometers-colorimeters, spectrophotometers, single/double beam instrument. Principle of electrophoresis, Agarose gel electrophoresis and its limitations, Polyacrylamide gel electrophoresis, Determination of molecular weights by electrophoresis, Isoelectric Focusing (IEF) and 2-D gel electrophoresis, Western blotting, Northern blotting and Southern blotting. Differences between light and Electron Microscope, Specimen block preparation for Transmission Electron Microscopy, Staining for ultrathin sections, Specimen preparation for scanning Electron Microscopy, Negative staining, Freeze – fracture Etching technique

### **UNIT-III**

Principles of adsorptions, Partition, ion exchange and molecular sieve chromatography Paper chromatography, Thin layer chromatography, column chromatography, gas chromatography, high performance liquid chromatography, ion exchange chromatography, their analytical uses and applications. Principle of Centrifugation, Types of Centrifuges (low speed, high speed and ultracentrifuges) Types of centrifugations (Rate, Density gradient- Isopycnic centrifugation). Preparative and analytical ultracentrifugation

### **UNIT-IV**

Radiotracers, isotopes and applications of tracer techniques Autoradiography: Principle, techniques and applications of autoradiography. Principles, methods and importance of histochemistry in Biological research Historical perspective, Principles of fixation, types of fixative and their application. Radial immunodiffusion, double diffusion, Immunoelectrophoresis, Radioimmunoassay, Haemagglutination, Enzyme Linked Immunosorbent assay (ELISA), Immunofluorescence, Western blotting and Migration inhibition factor assay.

### **Suggested Reading Materials:**

- Wilson, K. And Walker, J (1994), Practical Biochemistry: Principles and Techniques. Cambridge University Press, Cambridge.
- Freifelder, D. (1982), Physical Biochemistry: Applications to Biochemistry and Molecular Biology, WH Freeman and Company, San Francisco.
- Gupta, M. N. (2002), Methods for Affinity- Based separations of Enzymes and Proteins.
- Kelly, R. A. (1971), the use of English for technical students, second edition. ELBS, London.
- Skoog, D. A. (1985), Principles of Instrumental Analysis, 3rd Edition, Saunders College Publishing, New York.
- Kuby, Immunology. W.H. Freeman, USA.

## **AUZooMP 102: RECENT ADVANCES IN ZOOLOGY**

### **UNIT-I**

Origin and evolution of life  
Theories of evolution  
Evolutionary time scale  
Evolution of man

### **UNIT-II**

Trends in global and Indian aquaculture  
Culture of Pearl oyster and pearl production  
Integrated Multi Tropic Aquaculture (IMTA)  
Recirculation aquaculture system, Sewage fed farming

### **UNIT-III**

Role of insects in Human society for development of Human culture Aspects include health, food production and storage.  
Introduction of honey bee biology  
Economic importance and control strategies for arthropod pests

### **UNIT-IV**

Zoogeography: Introduction, Speciation and Dispersal  
Island Biogeography  
Diversity and Diversity gradients  
Continental drift and Glaciation

### **Suggested Reading Materials:**

- Origin of Species (1859) by Charles Darwin.
- What Evolution is (2002) by Ernst W. Mayr.
- Principles of Zoology by Hickmann and Hickmann.
- Evolution: The modern synthesis. Julian Huxley.
- H.D. Kumar: Sustainability & Management of Aquaculture & Fisheries.
- Arugun & Natarajan: Fresh water Aquaculture.
- The Insect-Structure and Function. - by R.F. Chapman.
- Imm's General Text Book of Entomology –by O.W. Richards and R.G. Davies.
- The Insect an outline of Entomology- by P.G. Gullan and P.S. Cranston.
- Carter, G. A. (2004) Beekeeping, Biotech Books, New Delhi.
- Brewer, R. (1994), The science of Ecology, Saunders College of Publishing, New York.
- Beeby, A. (1992), Applying Ecology Chapman and Hall Madras.
- Putmann, R. J. and Wratten, S. D. (1984), Principles of Ecology, Crown Helm, London.



## **AUZooMP 103 - ADVANCED TOPICS IN PARASITOLOGY**

### **UNIT-I**

Pathogenesis due to protozoan and helminth parasites

*In vitro culture*

### **UNIT-II**

Physiology of helminth parasites (a) feeding, nutrition (b) carbohydrate, lipid and protein metabolism (c) electron transport

Biology of egg and hatching mechanisms in helminth parasites

### **UNIT-III**

Infective stages and variation in life cycles of helminths

Exsheathing mechanism in parasites

### **UNIT-IV**

Identification of helminth parasites

(a) Characters of taxonomic importance

(b) Problems in speciation in dioecious parasites

(c) Rules of zoological nomenclature

Adaptations of parasitism

### **Suggested Reading Materials:**

- Cheng, T.C., General Parasitology, 2<sup>nd</sup> ed. Academic Press, College Division, London (1986).
- Noble, E.R. and Noble, G.A., Parasitology : The Biology of Animal Parasites V-  
edition, Lea & Febiger, Philadelphia (1982).
- Chatterjee, K. D., Parasitology: Protozoology and Helminthology, 13<sup>th</sup> ed., CBS publishers  
and distributors Pvt Ltd (2009)
- James, M.T. and Harwood, R.F., Herins's Medical Entomology, 6<sup>th</sup> ed., Collier  
Macmillan Canada Ltd., Don Mills, Qutario, (1969).

## **AUZooMP 103 - ADVANCED TOPICS IN ENDOCRINOLOGY**

### **UNIT-I**

Hormonal control of feeding behaviour  
Gastrointestinal tract functioning  
Blood – testis barrier

### **UNIT-II**

Steroid hormone receptor interactions  
Signal transductions  
Biological aspects of vasectomy

### **UNIT-III**

Autocrine, paracrine and Juxtacrine regulations of hormones  
Pineal-hypothalmo-hypophyseal-gonadial axis and Circadian rhythms  
Placental hormones and their significance

### **UNIT-IV**

Stress physiology and adaptation  
Prostaglandin structure, type, synthesis and biological activities  
Genetic basis of hormonal disorders

#### **Suggested Reading Materials:**

- Hadley, M.E. Endocrinology
- Greep, R.O. Handbook of Physiology Vol. 6: Male Reproduction. American Physiological Society, Washington.
- Greep, R.O. Handbook of Physiology Vol. 7: Female Reproduction. American Physiological Society, Washington.
- Hall, J. E., Guyton and Hall Text Book of Medical Physiology, 12th edition, Saunders Company (2010)
- Rhoades, R.A. and Tanner, G.A., Medical Physiology, 2nd edition, Lippincott Williams and Wilkins (2003).
- Hoar, W.S. General and Comparative Physiology, Adaptation and Environment, 3rd edition, Cambridge University, Press (1985).
- Turner, C.D. and Bagnars, W.B., General Endocrinology, Saunders Company (1976).
- Golds Worthy, G.J. Robinson, J. and Mordue, W., Endocrinology, John Wiley and Sons, New York (1981)
- Bentley, P.J., Comparative Vertebrate Endocrinology, Cambridge Univ. Press (1998).

## AURPE - 04 -RESEARCH AND PUBLICATION ETHICS

### Unit-I Philosophy and Ethics

Introduction to philosophy: Definition, nature and scope, concept, branches

Ethics: definition, moral philosophy, nature of moral judgments and reactions. Publication Misconduct: Group discussions: subject specific ethical issues, FFP, authorship, conflicts of interest, complaints and appeals: example and fraud from India and abroad.

### Unit-II Scientific misconduct

Ethics with respect to science and research; Intellectual honesty and research integrity; scientific misconducts: falsification, fabrication, and plagiarism (FFP); redundant publications: duplicate and overlapping publications, salami slicing; selective reporting and misrepresentation of data. Software tools: Use of plagiarism software like Turnitin, Urkund, and other open access software tools.

### Unit-III Publication Ethics

Definition, introduction and importance, Best practices/ standards setting initiatives and guidelines: COPE, WAME, etc. Conflicts of interest; publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types; violation of publication ethics, authorship and contributorship; identification of publication misconduct, complaints and appeals; Predatory publishers and journals. Databases and Research Metrics: Databases: Indexing databases, Citation databases, web of science, Scopus, etc.

### Unit-IV Open access publications

Open access publications and initiatives; SHERPA/RoMEO online resources to check to check publisher copyright & self-archiving Policies; Software tool to identify predatory publications developed by SPPU; Journal finder/ journal suggestion tools viz. UGC care listed journal, Elsevier Suggested journal finder, Springer journal suggester, Impact factor of journal as per journal citation report, SNIP, SJR, IPP, Cite Score; Metrics: h-Index, g- Index, i-10 index, Publons, Google Scholar etc.

### References:

- Bird, A. (2006). *Philosophy of Science*. Routledge.
- MacIntyre, Alasdair (1967) *A Short History of Ethics*. London.
- P. Chaddah, (2018) *Ethics in Competitive Research: Do not get scooped; do not get plagiarized*, ISBN:978-9387480865
- National Academy of Sciences, National Academy of Engineering and Institute of Medicine. (2009). *On Being a Scientist: A Guide to Responsible Conduct in Research: Third Edition*. National Academies Press.
- Resnik, D. B. (2011). What is ethics in research & why is it important. *National Institute of Environmental Health Sciences*, 1–10. Retrieved from <https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfm>
- Beall, J. (2012). Predatory publishers are corrupting open access. *Nature*, 489(7415), 179–179. <https://doi.org/10.1038/489179a>
- Indian National Science Academy (INSA), *Ethics in Science Education, Research and Governance*(2019), ISBN:978-81-939482-1-7. [http://www.insaindia.res.in/pdf/Ethics\\_Book.pdf](http://www.insaindia.res.in/pdf/Ethics_Book.pdf)

**ABHILASHI UNIVERSITY  
DEPARTMENT OF ZOOLOGY  
LIST OF BOOKS**

<b>AUTHOR NAME</b>	<b>TITLE OF BOOKS</b>	<b>PUBLISHERS</b>	<b>COPIES</b>	
1. Barrington, E.U.W. (1967)	Invertebrates structure and functions	Houghton Mifflin Co. Boston	2	
2. Hyman, L.H.	The Invertebrates. Vol. 1 – Protozoa through Ctenophora (1940), Vol II- Platyhelminthes and Rhynchocoela (1951), Vol. III- Acanthocephala, Aschelminthes and Entoprocta (1951)	Mc Graw Hill, New York	1	
3. Gardiner, M.S. (1972)	The Biology of Invertebrates	Mc Graw Hill, New York	5	
4. Prosser, C.L. (1984)	Comparative Animal Physiology	Satish Book Enterprise Books seller & publishers, Agra	1	
5. Smith, H.S.	Evolution of Chordate Structure	Hold Rinehart and Winston Inc. New York	5	
6. Sinha, P.K. (1992)	Computer Fundamentals			
7. Gupta, S.C. (2004)	Fundamentals Of Statistics	Himalaya Publishing House	2	
8. Aggarwal, (2000)	Wildlife of India		1	
9. Brewer	Principle of Ecology		2	
10. Burton, L.D. (2003)	Fish and Wildlife: Principles of Zoology and Ecology		1	
11. Fulbright, Timothy, E. and Hewitt, D.G. (2008)	Wildlife Science: Linking Ecological Theory and Management Applications	CRC Press, Taylor and Francis: BocaRaton, F.L.	2	
12. Gopal, R. (1992)	Fundamental of Wildlife management	Thompson learning Pb.	2	

13. Dasmann, R.F. (1982)	Wildlife Biology	Wiley Eastern, New Delhi	1	
14. Giles, R.H. (1984)	Wildlife Management Technique	Natraj Publisher, Dehradun	5	
15. Edward I. Newman	Applied Ecology and Environmental Management		2	
16. I.C. Shaw and J. Chadwick	Principles of Environmental Toxicology	Taylor and Francis, London by Timbrell, J.	2	
17. Hall, J.E. Guyton	Text book of Medical Physiology	XI Edition, Hercourt asia PTE Ltd./ W.B. saunders Company	2	
18. Bentley, P.J.	Comparative Vertebrate Endocrinology		5	
19. Vander, A.J., Shermann, J.H. and Luciana, D.S.	Human Physiology		2	
20. Norris, D.O.	Vertebrate Endocrinology		2	
21. Wilson and Walker	Principles and Techniques	Cambridge 2000	5	
22. Nelson, D.L. and Cox, M.M.	Lehninger Principles of Biochemistry	IV Edition. W.H. Freeman and Co.	2	
23. Cheng, T.C.	General Parasitology		3	
24. Kuby	Immunology	W.H. Freeman and Company	2	
25. Benjamini	Immunology		2	
26. Paul, W.E.	Fundamental Immunology		2	
27. J. Darnell, H. Lodish and D. Baltimore	Molecular Cell Biology	W.H. Freeman and Company	2	
28. J. Sambrook, E.F. Fritsch and T. Maniatis	Molecular Cloning: a Laboratory Manual		1	
29. Alberts <i>et al.</i>	Molecular Biology of Cell	Garland Publishing Inc.	2	
30. Gilbert, F.	Developmental Biology	VIII Edition, Sinauer	2	

		associates, Inc. Publishers, Sunderland		
31. Balinsky, B.I.	An Introduction to Embryology	Saunders, Philedelphia	2	
32. Freiflder, D. (1982)	Physical Biochemistry : Applications to Biochemistry and Molecular Biology	Freeman, 1982	2	
33. Chatterjee, K.D.	Parasitology: Protozoology and Helminthology		5	
34. Rhoades, R.a. and Tanner, G.A.	Medical Physiology		2	
35. Hoar, W.S.	General and Comparative Physiology, Adaptation and Environment	Academic press, New York	2	
36. Golds Worthy, G.J. Robinson, J. and Mordue, W.	Endocrinology		3	
37. Greep, R.O.	Handbook of Physiology Vol. 6: Male Reproduction		2	
38. Greep, R.O.	Handbook of Physiology Vol. 6: Female Reproduction		2	