

**DEPARTMENT OF ZOOLOGY**  
**M. Sc. Zoology (General and Applied)**  
 Syllabus (Effective from 2007 Admission )

**CORE COURSES**

| Course No. | Course Title                          | L | T | P | C |
|------------|---------------------------------------|---|---|---|---|
| ZOO 511    | Advanced Physiology and Ecophysiology | 2 | 1 | 3 | 4 |
| ZOO 512    | Microbiology and Instrumentation      | 2 | 1 | 3 | 4 |
| ZOO 513    | Genetics and Molecular Evolution      | 2 | 1 | 3 | 4 |
| ZOO 514    | Environmental Biology and Management  | 2 | 1 | 3 | 3 |
| ZOO 521    | Pollution Biology                     | 2 | 1 | 3 | 3 |
| ZOO 522    | Developmental Biology                 | 2 | 1 | 3 | 3 |
| ZOO 523    | Invertebrate Endocrinology            | 2 | 1 | 3 | 4 |
| ZOO 524    | Molecular Biology                     | 2 | 1 | 3 | 4 |
| ZOO 531    | Biodiversity                          | 2 | 1 | 3 | 3 |
| ZOO 532    | Animal Biotechnology                  | 2 | 1 | 3 | 4 |
| ZOO 533    | Vertebrate Endocrinology              | 2 | 1 | 3 | 4 |
| ZOO 534    | Reproductive Physiology               | 2 | 1 | 3 | 4 |
| ZOO 541    | General & Applied Entomology          | 2 | 1 | 3 | 4 |
| ZOO 542    | Mechanisms of Animal Behavior         | 2 | 1 | 3 | 4 |
| ZOO 543    | Conservation Biology                  | 2 | 1 | 2 | 2 |
| ZOO 544    | Dissertation                          |   |   |   | 6 |

**ELECTIVES (Internal)**

|        |                                    |   |   |   |   |
|--------|------------------------------------|---|---|---|---|
| ZOO501 | Term Paper 1                       | 1 | 2 | 0 | 1 |
| ZOO502 | Bioinformatics                     | 2 | 0 | 1 | 2 |
| ZOO503 | Lab Course1                        | 0 | 0 | 3 | 1 |
| ZOO504 | Field Zoology                      | 1 | 1 | 3 | 1 |
| ZOO505 | Wetland Ecology                    | 2 | 1 | 2 | 2 |
| ZOO506 | Lab Course2: Applied Endocrinology | 1 | 0 | 3 | 1 |
| ZOO507 | Habitat Ecology                    | 2 | 0 | 2 | 2 |
| ZOO508 | Field Course: Biodiversity         | 0 | 0 | 3 | 1 |
| ZOO509 | Term Paper2                        | 1 | 2 | 0 | 1 |
| ZOO510 | Lab Course3                        | 0 | 0 | 3 | 1 |

**ELECTIVES (External)**

|         |               |   |   |   |   |
|---------|---------------|---|---|---|---|
| ZOO 51A | Ecophysiology | 2 | 0 | 0 | 1 |
| ZOO 52A | Biodiversity  | 2 | 0 | 0 | 1 |

L- Lecture, T- Tutorial, P- Practical, C- Credits.

## **ZOO 511 ADVANCED PHYSIOLOGY AND ECOPHYSIOLOGY**

### **Part A Advanced Physiology**

#### **Unit 1. Cell and Environment**

Water and salts in cell environment, resistance of cells to changes in pH, Oxygen availability and temperature, Transport of Oxygen, Cellular response to acidosis and ketosis, hypercapnia.

#### **Unit 2. Membrane and Receptor Physiology**

Transport of ions across membranes, sodium, potassium and calcium channels, co transport and anti port mechanisms, Nerve action potential, Mechanism of synaptic transmission, Structure and function of various receptors, Mechanism of sensory perception.

#### **Unit 3. Circulatory Physiology**

Ultra structure of muscle fiber, molecular mechanism of muscle contraction, cardiac cycle, human heart, heart diseases, patterns of circulation, structure and function of blood cells.

#### **Unit 4. Acid-base balance**

Respiratory and renal control of acid-base balance, mechanisms of regulation of intracellular solute concentration, Effect of temperature on acid-base balance.

**Unit 5. Water and mineral balance, Mechanism of osmoregulation, Sodium pump osmoregulatory organs in aquatic and terrestrial animals, Homeostasis of ions and its hormonal regulation, Calcium transport.**

**Unit 7. Immune system- Specific and non specific immune response, cells mediating immune responses, phagocytosis, antigen processing, lymphoid organs, lymphocyte receptors, antibody mediated immune responses.**

### **Part B. Ecophysiology.**

**Unit 1. Concept of ecophysiology - History and Introduction.**

**Unit 2. Environmental and Biological factors, Temperature, pH, photoperiodism, hypoxia, and starvation on physiological processes.**

**Unit 3. Environmental Adaptation: Physiological adaptations-Homeothermy and Poikilothermy, thermal adaptation and migration, pressure adaptation, salinity adaptation, Biochemical basis of physiological adaptation**

**Unit 4. Stress Physiology- endocrinology of stress adaptation, endocrine disruptors, stress adaptation and tolerance, mechanism tolerance, stress proteins**

**Unit 5. Environmental Physiology-**

5.1. Environmental control of acid-base balance and ionoregulation- osmoregulation in fresh water and estuarine and marine and terrestrial animals, hypoxia, sodium pump.

5.2. Environmental influence on growth and metabolism, hormonal and biochemical aspects, Bioenergetics and energy partitioning

5.3. Environmental perturbations of reproduction in fishes and mammals.

**References:**

1. Biochemistry and physiology of cells, Edward and Hassal, Mc Graw Hill , London, 1980
2. Cell Physiology A.G. Giese, W.B. Saunders & Co. New York
3. General and Comparative Physiology, William S Hoar, Printice Hall, New York, 1983
4. Text Book of Medical Physiology, Arthur C. Guyton W.B. Sanders & Co. 1996
5. Animal Physiology, Eckart.
6. Fish Ecophysiology, J. C. Rankin and F.B. Jensen, Chapman and Hall, London, 1993.
7. The Physiology of Fishes, David. H. Evans, CRC press, London, 1993

## ZOO 512 MICROBIOLOGY AND INSTRUMENTATION

### Part A Microbiology

**Unit 1. Principles of Microbiology:** An overview of microbial life, Cell structure and function, Microbial growth, Principles of microbial molecular Biology, Regulation of gene expression, Essentials of Virology, Bacterial genetics.

**Unit.2. Evolutionary Microbiology and Microbial diversity:** Microbial Evolution and systematics, Prokaryotic diversity, Eukaryotic biology, Microbial genomics, Bacterial, Plant and Animal viruses.

**Unit.3. Metabolic diversity and Microbial Ecology:** Metabolic diversity, Methods in microbial ecology, Microbial Habitats, Nutrient cycles, Interaction with plants and animals.

**Unit. 4. Immunology, Pathogenicity and Host Responses:** Microbial growth control, Human Microbe interactions, Clinical Microbiology and Immunology. Microbial diseases.

**Unit. 5. Micro-organisms as tools for Industry and Research:** Industrial Microbiology/Biocatalysis, Genetic Engineering and Biotechnology.

### References:

]

### PRACTICALS

1. Culture transfer Techniques.
2. Techniques for isolation of pure cultures.
3. Cultural characterization of Micro organisms.
4. Microscopic Examination of Stained Organisms.
5. Microscopical examinations of Live Bacterial Preparations.
6. Microscopic Measurements of Microorganisms.
7. Biochemical tests for Identifying Microorganisms.
  1. Urease Test.
  2. Hydrogen sulphide Production Test.
  3. Litmus milk Reactions.

### References:

1. Biology of Microorganisms Masigan, Matinko and Parker, 10<sup>th</sup> Ed. Printice hall Publishres.
1. Microbes and Society- An Introduction to Microbiology, I.E. Alcamo, Jones & Barlett Publishres, London, 2003
2. Microbiology - A Laboratory Manual, Cappuccino and Sherman, Pearson Education Inc., 2004.
4. Microbiology: An Introduction, 7th edition update Gerard Tortora, Berdell Funke and Christian Case Pearson Education 2002.
5. Brock Biology of Microorganisms, Michael .T. Martinko and Jack Parker Prentice Hall and Pearson Education, Inc. 2003.



## ZOO 513 GENETICS AND MOLECULAR EVOLUTION

### Part A Genetics

#### Unit 1. Introduction:

Patterns of gene inheritance, multiple alleles, linkage and crossing over, inheritance of sex and autosomal genes, cytoplasmic inheritance, intracellular symbionts, plasmids (plastid, plasmid, mitochondria)

#### Unit 2. Mendelian Genetics and its application:

Gene mapping, chromosome mapping, recombination frequency, genetics in animal breeding, inbreeding and out breeding, heterosis, expressivity, penetrance, non Mendelian pattern of inheritance, modern Mendelism.

#### Unit 3. Population Genetics:

Genetic variation, polymorphism, polyploidy, gene pool, gene frequency, distribution pattern, Hardy –Weinberg equilibrium, disequilibrium, patterns disrupting gene equilibrium.

#### Unit. 4. Gene Regulation and Gene Activity:

Induction and repression, inducible enzymes, the operon ( lac operon, Histidine operon), sigma factor, signals for gene control, transcriptional signals, TATA Box, CAAT Box, enhancers.

#### Unit. 5. Human Genetics:

Pedigree analysis, karyotype analysis, Lyon Hypothesis, Genetics of ABO system, Rh disease and inheritance, sickle haemoglobin and inheritance, Thalassemias, Human Genome Project, gene therapy, DNA finger printing and foot printing. Genetic disorders- Patan, Edward's, Chriduchat syndrome, Philadelphia Chromosome.

**Unit 6. Immunogenetics:** Immunoglobulin gene, serum protein genetics and antibody diversity, H2, HLA antigens, MHC system, Life Cycle of HIV, HIV genome, autoimmunity, tissue transplantation and tissue rejection.

#### References:

1. Genetics- Eldon J Gardner
2. Molecular Genetics Part I and II – H. Herbert Taylor
3. Principles of Genetics- 3<sup>rd</sup> Edition, E.J. Gardner
4. Gene Structure and Expression- J.D.Hawkin, Cambridge University Press
5. Heredity- A.F.Shull, 4<sup>th</sup> Edition, McGraw hill Book Company, London
6. Genetics- Strick Berger
7. Genes V – Benjamin Lewin, Oxford University Press, New York.

#### PRACTICALS

1. Experimental induction of Beta galactosidase synthesis in Escherichia coli.
2. Demonstration of Genetic Recombination in Bacteria by process of Conjugation.
3. The Ames test: A Bacterial test system for Chemical Carcinogenicity.
4. Techniques of etherisation and sexing of Drosophila.
5. Study of chromosomal disorders in man.
6. Chromosome study –squash Preparation of Grasshopper testis.

## **Part B Molecular Evolution**

**Unit 1** Introduction- Molecular Evolution: a brief history of the pre DNA era, gene structure, genetic code and mutation.

**Unit 2.** Dynamics of genes in population, Random genetic drift, genetic polymorphism, Neo Darwinian theory, Neutral mutation hypothesis, Evolution of finite and structured population, Evolution of dip bit populations.

**Unit.3.** Evolutionary change in nucleotide re-gensis, Nucleotide substitution, Divergence between DNA sequences.

**Unit.4.** Molecular phylogenetics, Methods and examples, Molecular clocks, concerted evolution of multigene families, DNA polymorphism.

**Unit 5.** Factors influencing molecular evolution, Role of mutation and selection in molecular evolution.

**Unit 6.** Genome organization and evolution, Evolution of prokaryotes and eukaryotic genomes, C value Paradox, Tandem Repetitive Sequences.

### **References:**

1. Evolutionary genetics, John Maynard Smith, Oxford University Press, New York, 1998
2. Genes and Evolution, A.P. Jha, Mc Graw Hill Publishers, New Delhi, 1993
3. Molecular Cell Biology 5<sup>th</sup> Edition, Lodish et al., 2004, W.H. Freeman and Company, New York.
4. The World of the Cell Becker, Klein smith and Hardin, 5<sup>th</sup> Edition, 2004, Pearson Education Pvt. Ltd.

## **ZOO 514 ENVIRONMENTAL BIOLOGY AND MANAGEMENT.**

**Unit 1.** Introduction and scope, ecosystem, energy flow, Population ecology, community ecology, succession, biogeochemical cycles.

**Unit 2. Radiation Ecology:** Types of ionizing radiations, Units of measurement, Radionuclide of ecological importance, Sources of radioactive pollution and its effects, Disposal of radioactive wastes.

**Unit 3. Ecology of Space Travel:** Types of life support systems, Exobiology.

**Remote Sensing as a tool for the study and the management of ecosystems:** Physical basis of remote sensing, Process of information extraction, Role of remote sensing in ecological research.

**Unit 4. Primary Amenities of Life:** Health and hygiene, Occupational health hazards, Public health, Sanitation, Epidemiology, Preventive measures.

**Unit 5. Environmental Biotechnology:** Waste treatment, Biomass production, Biogas production, Vermiculture, Biofertilizers.

**Unit 6. Natural Hazards and Precautions:** Flood, Cyclone, Thunderstorms, Earthquakes, Drought, Volcanic eruptions, Landslides, Preventive measures and Precautions, El Nino, La Nino.

**Unit 7. Resource Ecology:** Conventional and Non-Conventional energy sources, Forest, Wildlife with reference to India, Endangered species, Mineral resources with respect to India ,Over-exploitation, Water resources and management.

**Unit 8.** Environmental Protection Strategies and environmental education Environmental Impact Assessment and Environmental Risk Assessment. Wild life conservation and Environmental Management.

**Unit 9.** Environment Impact Assessment and Environmental Education : Environmental Policy, Environmental Laws and their Enforcement, Environmental awareness, Tribal welfare.

### **PRACTICALS**

1. Examination of Physico chemical Parameters of Aquatic Ecosystems.
  1. Temperature
  2. Photoperiodism
  3. Salinity
  4. Alkalinity
2. Sediment analysis  
Organic carbon  
Soil composition.
3. Study of Bioindicators of Water pollution.
4. Identification of Biomarkers in a fish species
5. Preparation of an Environment Impact Assessment Report of an Industry in the Local area.
6. Preparation of a scheme for Environmental awareness programme aiming at Graduate students.

### **References:**

1. Benton, A. H. and Wernaer, W.E.Jr 1974. Field Biology and Ecology, Tata Mc Graq Hill Publishing Co., New Delhi
2. Bindu N.L. et. Al., 1997. Environmental impact Assessment, Asian Development Bank.
3. Brewer, R 1994. The Science of Ecology, Saunders Collins Publishing, New York.
4. Chauhan, T. S and Joshi K.N. 1996. Applied Remote Sensing and Photo-Interpretation. Vigyan prakash, Jodhpur.
5. Connel, D. W. and Hawker, D. W. 1992. Pollution in Tropical Aquatic Ecosystem, CRC Press Inc. London.
6. Cutter. S. L. 1999. Environmental Risks and Hazards, Prentice hall of India, Pvt. Ltd. New Delhi.
7. Ramade, F. 1987. Ecology and Natural Resources. John Wiley and Sons, New York.

## **ZOO 521 POLLUTION BIOLOGY**

### **Unit 1**

**1.1. Water Pollution--** History, origin and source of water pollution, effects of water pollution. Water quality standards- drinking, irrigation, stream, effluents. Minimal National Standards. Eutrophication-Process of eutrophication, effects, critical nutrients, source of nutrients, control of eutrophication. Toxic inorganics and other constituents affecting water quality.

**1.2.** Tastes, odours, colours, suspended solids iron, magnesium, nitrates, nitrites, fluorides, cyanides, toxic gases. Bacteriological examination and purification of drinking water. Treatment, disposal and recycling of waste waters, movement pollutants, their monitoring and control in water bodies.

**1.3. Organic Pollution**—Nature, source and degradation of organic matter, effects and measurements of organic pollution.

**1.4 Pesticide Pollution**—Groups of pesticides, pesticide kinetics, mode of action and toxicity, Accumulation and toxicity to aquatic organisms.

**1.5 Heavy metal Pollution**—Source and accumulation of heavy metals, toxicity of metals-lead, mercury, cadmium, chromium, arsenic and copper.

**1.6. Oil Pollution**—Characteristics and composition of oil, sources of oil in environment, effects of oil on organism, control of oil pollution.

**1.7. Thermal Pollution**—Effects of thermal pollution, standards and control of thermal pollution, beneficial use of thermal polluted waters. Acid pollution- effects on aquatic fauna, effects of acid pollution.

**Unit. 2. Radioactive Pollution**—Isotopes and nature of radiations, sources of radio activity, distribution of man-made radioactivity in environment, fate and movement of radio- activity in environment, mechanism and biological effects of radiation, control of radioactive pollution.

**Unit 3. Air pollution-** Classification of air pollutants, source of emission, effects on plants humans and other animals, prevention and control of air pollution,. Green house gases and green house effects. Noise pollution and its effects.

**Unit. 4. Polychlorinated biphenyls and other toxic organics-** Detergents, Phenols, Plastics, Dioxines and PAHs.Toxic. Xenobiotics- biocides, herbicides, fungicides. Xenobiotic metabolism- uptake, accumulation, biotransformation, and excreting xenobiotics, cytochrome P450

**Unit.5. Risk assessment and biomonitoring-** bioindication and biomarkers, Impact of pollution on bioindicator species, biomarkers of pollution for risk assessment.

**Unit.6. Ecotoxicology-** Bioassay procedures bioremediation, phytoremediation and probiotics, Molecular mechanism of toxicant action and tolerance, pollution fingerprinting.

**Unit. 7. Physiological and biochemical measures in pollution biology-** water quality criteria, haematology, immunology and challenge tests.

## **PRACTICALS:**

Analysis of water samples.

- 1.Determination of salinity.
- 2.Estimation of dissolved oxygen.
- 3.Determination of primary productivity
4. Estimation of dissolved carbon dioxide.
- 5.determination of hardness
- 6.determination of soils
- 2.calorimetric estimation of nutrients.

Phosphate phosphorous

Nitrate-Nitrogen

Nitrite-Nitrogen

3. Analysis of Sediments and Pollutants

Total organic carbon

Hydrogen sulphide

4. Effect of Pollution on the oxygen consumption of fishes.

Study of histopathological changes in selected tissues (blood, gill, liver, kidney) of fish exposed to a given concentration of a pollutant over a period of time –submit two slides at the time of examination

**References:**

1. Marine Pollution. R.B. Clark II Edition, Oxford Science Publication, 1989.
2. Chemical Principles of Environmental Pollution. B.J. Alloway et al., 1993, Blakie Academic and Professional Publication, Glasgow.
3. Oil Pollution Control, S.Z. Prichard, Croom Helm Publishers, London, 1987.
4. Pollution Control and Conservation, M. Kovacs, Ellis Horwood Ltd. Publishers, 1985.
5. Water Pollution- Causes, effects and Control, P.K. Goel, New Age International Publishers, New Delhi, 2001.
6. Environmental Chemistry, Ajay Kumar Bhagi & G. R. Chatwal, Himalaya Publishing House, 2003.

**ZOO 522 DEVELOPMENTAL BIOLOGY**

**Unit 1** Introduction:

Overview of Animal Development, Asexual and Sexual Reproduction, Types of cell reproduction and molecular reproduction, Gene and differentiation, Gametogenesis, Embryological concept of development.

**Unit 2** Patterns of Development:

- 2.1 Fertilization, Embryo, Epigenesis, General and unique features of cleavage, Blastula, Activation of blastula genome, Developmental anatomy of gastrula, Types, Mechanism of germ layer formation.  
Embryogenesis and Differentiation: The genetics of cell lineage, Homeotic mutants, Homeo boxes, Palingenesis, Cenogenesis in vertebrates, Early vertebrate development.

**Unit 3** Mechanism of Cellular Differentiation:

Determination of cytoplasm specification, Progressive determination, Genomic equivalence and differential gene expression, Transcriptional Regulation of gene expression, Changes during development, Mechanism of differential gene transcription, Control of development by RNA Processing, Translational and post-translational regulation of Developmental process.

**Unit 4** Cell Interaction in Development:

The spatial ordering of cells-Role of cell surface, Secondary induction, Pattern formation, Cell interaction with hormones as a mediator of

Development. Patterns of growth and oncogenesis, Sex determination. Vertebrate organogenesis-major organs. Control of nervous element.

## PRACTICALS

1. Induced by Hypophysation or drug administration
2. Vital staining of chick embryo(24-72 hours)
3. Morphogenetic movement of chick blastoderm
4. Preparation of permanent slides of embryos and larva
5. Study of different types of placenta in mammals

### Reference

Developmental Biology—Scott.F.Gilbert

Developmental Biology—Virginia Walvot and Nigel Holder

Developmental Biology—Browder

Embryology-An Introduction to Developmental Biology—Stanley Shostak

Developmental Biology—Patterns, Problems and Principles—John.W.Saunders.

## ZOO 523 INVERTEBRATE ENDOCRINOLOGY

Unit 1 Nervous and chemical co-ordination / neuroendocrine integration –Structure of endocrine organs –Neuro secretory cells –structure, chemistry-staining properties-non neural endocrine components.

Unit Endocrine systems –hormonal principles and action in lower invertebrates – Porifera,Coelentrata –turbellaria, Nemertea/ Nematoda,Echinodermata,Annelida,Mollusca.

Unit 2 Endocrine organs –Structure –Chemistry-Mechanisms in Arthropods-Insects – Growth-Moulting-Differentiation-Juvenile Hormone-Ecdysone –Neuro hormones / Neuro peptides. Endocrine control of vitellogenesis-Spermatogenesis-Diapause-Eclosion-Cuticular tanning –Excretion.

Unit 3 Crustacean Endocrine organs-Sinus gland, X-organ-Androgenic glands-Maxillary glands-Mandibular glands-Hormonal principles-Chemistry-Action Hormonal control of sex Differentiation, Gonadal activity ,Colour change, Retinal pigment Movement control, Heart beat.

## PRACTICALS

1. Dissections:

Insect Neuroendocrine system (Dysdercus / Cockroach /Rhinoceros beetle)

Prothoracic glands (Cockroach-nymphs)

Crustacean endocrine system (Prawn)

Myriapod endocrine system (Jonespeltis)

### References

An Introduction to Invertebrate Endocrinology by A.S. Tombes ,Academic Press.

The Comparative Endocrinology of the Invertebrates by K.C.Highnam & L.Hill, Edward Arnold Publishers

Insect Hormones VJA Novak

Insect Endocrinology KK Nayar

Morphogenetic Hormones of arthropods(Ed by) A.P.Gupta Vol 2&3. Rutgers University Press

Metamorphosis by L.I.Gilbert and E.Frieden .Plenum Press

## **ZOO 524 MOLECULAR BIOLOGY**

### **Unit 1.** Introduction

Overview of cells and cellular components, organization and composition of eukaryotic cells, functional role of organelles, and membrane system.

### **Unit. 2.** Chromatin and protein structure

Structure of nucleosome, scaffold proteins, Structural organization and confirmation of proteins.

### **Unit 3.** Nucleic Acids

Molecular structure of DNA, types of DNA structure, DNA structure and function, molecular structure of RNA, types of RNA, processing of rRNA and t RNA.

### **Unit 4.** Chemistry of DNA

Replication of DNA, Enzymes involved in DNA replication, DNA repair, DNAA recombination, restriction and modification of DNA.

### **Unit 5.** Chemistry of RNA

Enzymes involved in RNA transcription-RNA polymerases, mechanism of transcription, post transcriptional processing, nucleases.

### **Unit 6.** Molecular structure of gene

Molecular basis of mutation, split genes, cistron, intron, exon, hoaxgenes, selfish genes, replicon , okasaki fragments, transposons.

### **Unit 7.** Gene expression

Transcriptional control of gene expression, regulatory sequences, activators and repressors, post-transcriptional gene control and nuclear transport.

### **Unit 8.** Vesicular traffic and endocytosis

Molecular mechanisms of secretory pathway, receptor-mediated endocytosis, sorting and targeting of proteins.

### **Unit 9.** Cell cycle and cell-growth control

Molecular mechanisms regulating mitotic events, cell death and its regulation, apoptosis, Cancer- genetic basis of cancer, tumors cells and the onset of cancer, carcinogens.

## **PRACTICALS**

Mitosis/meiosis – cell cycle- sex chromosomes, bar body, genomic DNA extraction, Plasmid preparation, Transformation, DNA strand restriction digestion, DNA molecular size determination using markers, PCR amplification of DNA.

### **References:**

1. The World of the Cell, Becker, Klein smith and Hardin, Pearson Education Pvt. Ltd. 2004.
2. Cell and Molecular Biology, Gerald Karp, 3<sup>rd</sup> Ed. 2004
3. Cell Biology, Pollard and Earshaw, Saunders, New York, 2002

4. Molecular Cell Biology, Lodish et.al., 5<sup>th</sup> Edn. W.H.Freeman & Co. England, 2004
5. Molecular Biology, Freifelder, Garland Publishing Inc. 2003
6. Molecular Biology of the Cell, Alberts et al., 2003,

### **ZOO 531 BIODIVERSITY.**

**Unit 1. Biodiversity**—Definition, historical and geographical causes for diversity, Genetic diversity, Molecular taxonomy, Species and Population biodiversity, Quantifying biodiversity, Maintenance of ecological biodiversity, Biodiversity and centers of origin of animals, Biodiversity hot spots in India, Collection and conservation of biodiversity, Conservation of animal genetic resources, Assessing, Analysing and documenting biodiversity, Morphological and molecular characterization of biodiversity, Vulnerability and extinction of bio- diversity, Introduction to biodiversity database: endangered animals, endemism and Red data books, Global biodiversity information system, Intellectual Property Rights ( IPR ), Sovereignty rights, CBD, Bioethics and patenting, General agreement on trade and tariffs, Indian subgenres system for animal variety and farmer's rights protection act.

**Unit 2. Biosafety**—Definition, requirement, Biosafety and biodiversity, Biosafety for human health and environment, Social and ethical issues, Biosafety in relation to transgenic research and applications.

### **PRACTICALS/FIELD WORK**

1. Impact of soil pollution in population of macro invertebrates.
2. Assessment of species diversity in a fresh water pond Ecosystem.
3. Assessment of species diversity with reference to changes in temperature and rainfall in a forest ecosystem.

#### **References:**

1. Man and the Ecosystem, J.R.Lloyd, Macmillan Education Ltd. 1984.
2. Ecology and Tropical biology, Ian Deshmukh, Blackwell Scientific Publication, 1986.
3. Ecology-A Bridge Between Wcience and Society, E. P. Odum, Sinauer Associates Inc. Publishers, 1996.
4. MegaDiversity Conservation, A. B. Chaudhary and D.D. Sarkar, Daya Publishing House,2003.
5. Global Biodiversity, R.K.Sinha and D. Singh, INA Shree Publishers, India, 1997.
6. Indian Wildlife-Threats and Prseavations, B.D.Sharma. Anmol Publications Pvt. Ltd. India, 2002.
7. Marine Biodiversity, Ormond et. al. Cambridge

### **ZOO 532 ANIMAL BIOTECHNOLOGY**

**Unit 1.** Introduction. History and concept of biotechnology,

**Unit 2. Tools of Genetic Engineering:** Vectors, Plasmids, Bacteriophage, Cosmids, Shuttle vectors, Yeast vectors, Minichromosomes, Artificial chromosomes, Enzymes, Exonucleases, Endonucleases, Restriction endonucleases, Ligases, Reverse transcriptases,

Polymerases, Terminal transferases, Probes and molecular markers, Properties and type of isozymes, RFLP, RAPD, AFLD, VNTR, Minisatellites, Microsatellites.

**Unit 3. Techniques in Genetic Engineering:** Selection and isolation of desired genes, Gene splicing, Introduction of rDNA into host, Selection of clone containing DNA insert, PCR, DNA finger printing, Blotting techniques, DNA sequencing, Chromosome jumping, HGP, Genomic library, cDNA library,

**Unit 4. Gene cloning:** Cloning techniques in animals, gene cloning, cloning bacteria and eukaryotes, Amplification of DNA by PCR, gene transfer technology, expression of induced genes.

**Unit. 5. Animal Tissue culture and Hybridoma Technology:** Tissue culture, organ culture- techniques, advantages and application, Cell culture, Culture media, Monolayer and suspension culture, cell lines, somatic cell fusion and hybridoma technology.

**Unit 6. Artificial animal Breeding:** Artificial insemination, Transplantation, gene therapy, genetic counseling, invitro fertilization and embryo transfer, Advantages of cell manipulation, Nuclear transplantation, gene injection, selective animal breeding and their potential.

**Unit.7. Transgenic Animal Technology:** Use of transgenic animals, Production of transgenic animals. Biotechnology in Aquaculture- Gynogenesis, androgenesis, ploidy induction, Transgenic fishes, Ethics of transgenic animals.

**Unit.8. Applications of Biotechnology:** Medicine, vaccines, Diagnosis of diseases, Detection of genetic disorders, Treatment, gene therapy, Forensic medicine, metabolites production, Bio control agents, Bio fertilizers, Enzymes in detergents and leather industries, Biofuel, biogas, Bioethanol.

**Unit 9. Immunology and Serology:** Animal health and biotechnology, Antimicrobial drugs and their sensitivity tests, Neoplasia, Human pathogenic viruses and AIDS.

**Unit 10. Problems related to biotechnology:** Social, cultural, economic and legal problems, safety in biotechnology, Bioethics, Intellectual Property Rights, and Patenting.

### PRACTICALS

1. Nucleic acid amplification using PCR
2. Preparation of bacterial smears
3. Simple staining
4. Negative staining
5. Gram staining
- 6 Identification of antigen –antibody reaction using an enzyme labeled antibody

References:

1. Animal Biotechnology M.M. Ranga, Agrobios Publishers, India, 2003
2. A Text book of Biotechnology, Dubaey, R. C. 1993, S. Chand & Co. New Delhi
3. Principles of Gene Manipulations: An Introduction to Genetic Engineering, Blackwell Sci. Publ.
4. Biotechnology, Kalyani Publishrs, New Delhi

### ZOO 533 VERTEBRATE ENDOCRINOLOGY

**Unit 1** Introduction:

Concept of Endocrinology, Historical perspective, classes of chemical messengers, peptide hormones, steroid hormones, bioamines, eicosanoids,

chalcones, neurotransmitters, neuropeptides, neurosteroids, neurohormones, phytohormones, synthetic hormones, prohormones, paracrine, merocrine, cytogenic secretion.

**Unit 2** Vertebrate endocrine glands:

Morphology and anatomy of endocrine glands, evolution of endocrine glands, Biosynthesis of hormones, hypothalamus and hypophyseal secretion, hypothalamo hypophyseal interaction, endocrine axes, function of hormones, disorders of hormonal imbalance, Regulation of hormone secretion, synthesis and metabolism of hormones, half-life of hormones metabolic clearance rate, miscellaneous hormones, eicosanoids, prostaglandins, prostacyclins, thromboxanes, leukotrienes.

**Unit 3** Mechanism of hormone action:

General and molecular mechanism of action of amines, polypeptide and steroid hormones –Mechanism of signal transduction in vertebrates, hormone receptors–as mediation of endocrine signals, classes of endocrine receptors, receptor-ligand interaction, cell surface receptors-structure and regulation of receptor units. Second messengers of hormonal action, cyclic nucleotides, inositol triphosphate, cAMP as second messengers, genomic action of cAMP, G protein and its dual control on adenylate cyclase, receptor crosstalk, ligand-gated ion channels, non-genomic actions of steroid hormones.

**Unit 4** Cell Growth Factors:

Types of growth factors, mechanism and its functional role in cellular activities, somatomedins, IGF, epidermal growth factor, transforming growth factor, platelet derived growth factor, fibroblast growth factor, Nerve growth factor, hepatocyte growth factor.

**Unit 5** Hormones and Cancer:

Hormonal control of development of cancer, hormone therapy in cancer Treatment, Oncogenes and hormonal function, Breast cancer and Hormone receptor status, Etoposide production of hormones by tumour cells.

**Unit 6** Functional Endocrinology:

Hormones as signal transducers, hormones in developmental process, Role of hormones in behaviour of animals, Hormonal control of reproduction, Hormone therapy in reproductive impairments, Hormonal involvement in evolution.

**PRACTICALS**

1. Dissection of Endocrine glands in fish and chick (any two vertebrates)
2. demonstration of glandectomy experiments in (any two vertebrates)
3. Simple experiments to study the effects of Thyroxine, Insulin and Cortisol on blood glucose / total protein in fish /frog.
4. Preparation of single cell suspension of any one tissue for in-vitro study.
5. Historical study of endocrine glands using Haematoxylin eosin stain in any two vertebrates.
6. Disorders of endocrine glands.

## References

- Endocrinology—Mac.E.Hadley  
Vertebrate Endocrinology—Norris.  
Endocrinology—Mary Jean.W.Paxton.  
Endocrinology—Vol.1,2,3. –Leslie.J.DeGroot.  
Williams Textbook of Endocrinology—Wilson and Foster.

## ZOO 534 REPRODUCTIVE PHYSIOLOGY

- Unit 1** Development of Gonads, Sex differentiation, Differentiation of testes and ovary, morphological, biochemical and hormonal aspects. Development and morphogenesis of male and female sex organs.
- Unit 2.** Male reproductive tract, testes, structure, spermatogenesis, Endocrine, paracrine and autocrine regulation, Accessory sex organs, prostate, seminal vesicles, bulbourethral gland, structure function and regulation, Female reproductive tract, ovary structure, folliculogenesis.
- Unit 3.** Ovulation, Steroidogenesis endocrine, paracrine, autocrine regulations. Fallopian tube structure, function, hormonal regulation, Sex cycles. Hypothalamo-hypophysial regulation of reproductive function, Neuroendocrine perspectives of mammalian reproduction, Reproductive pheromones.
- Unit 4** Pregnancy and Foetal Development:  
Process of Fertilization, Mechanism of fertilization, Cell division and Implantation of blastocyst, Placenta-its role, Hormonal and physical changes during pregnancy.
- Unit 5** Developmental stages of foetus, Parturition  
Lactation-its hormonal control.
- Unit 6.** Sexual Physiology:  
Sexual determination and differentiation, Abnormalities of sexual Differentiation, Human sexual response, Sexual dysfunction -Infertility  
Anatomical, hormonal, chromosomal, immunological and Physiological factors.
- Unit 7.** Contraceptive Methods:  
Chemical methods, surgical methods, New approaches of contraception.

## PRACTICALS

1. Histology of testes of any two animals
2. Histology of ovary of any two animals
3. Staining vaginal smear of frog
4. Staining of sperms smear
5. Dissection of male and female reproductive system of frog and chick

## Reference:

- Human physiology- Rhoades and P flanze.  
Anatomy and Physiology-Guyton  
Human anatomy and physiology-Van Wynsberghe, Noback, Carola  
Essentials of Human Anatomy and Physiology- Elaine N.Marieb

Fundamentals of Anatomy and Physiology- Martini.

## **ZOO 541 GENERAL & APPLIED ENTOMOLOGY**

Unit 1. Origin of Insects, classification, Phylogeny, Morphology and Anatomy.

Unit. 2 Structure and Function of Insects ,integument, nervous system, muscular system, alimentary canal and nutrition, reproduction & development, sensory mechanisms, locomotion, behavior and ecology, circulatory system, insect populations and their physical-chemical and biotic environment, insect –host plant reaction

Unit 3. Growth and metamorphosis, Metamorphosis, Different larval types  
Different pupal types.

Unit. 4. Ground dwelling insects and Aquatic insects

Unit. 5. Insect and plants, insect societies, Insect predation and parasitism and Insect defence.

Unit. 6. Beneficial and harmful insects, Insect products, Use of insects in medicine

Insects in biological research, Pollination by insects, Forensic entomology, Agricultural entomology, Aquatic entomology, Harmful insects.

Unit.7. Stored Products, House hold goods and structural materials, People and their animals, Insects and animal hosts, Biological control, Genetic control, Ecological control, Microbial agents, natural products, Insecticide resistance, Physical control, Regulatory control, Integrated pest management, Molecular Entomology.

Unit. 8. Medical and Veterinary entomology, Insects as vectors, forensic entomology.

Unit. 9. Insecticides: Classification of insecticides, Anti feedants, Insect attractants  
Insect repellants, Sterility methods, Hormones mimics as pesticides

Unit.10. Methods in entomology: Collection, preservation, curation and identification of insects.

### **PRACTICAL/LAB WORK**

Dissection and display-Neuroendocrine system (*Dysdercus* /Cockroach/*Achaea*)

Ligature experiment in *Drosophila* to demonstrate hormonal control of metamorphosis

Collection, Identification and preservation of insects from the forest/agriculture area.

### **References**

1. Fundamentals of Applied Entomology Robert E.Pfadt (ed). Mac Millan Company, New York 692 pp.
2. Applied Entomology. D.K.Varma. Mital publications, New Delhi .262 pp.
3. The Insects: Structure & Function. R.F.Chapman. 4<sup>th</sup> Ed.Cambridge University Press. 800 pp.
4. Fundamentals of Entomology. R.J. Elzinga, 5<sup>th</sup> Ed. Prentice Hall College, New Jersey.528 pp.
5. The Science of Entomology. W.S. Romoser & J.G. Stoffolano Jr. 4<sup>th</sup> Ed Mac Graw Hill.
6. General and Applied Entomology .V.A. Little, Oxford & IBH Publishing Co.
7. General and Applied Entomology. T.N. Ananthakrishnan and B.V. David. Tata Mc Graw - Hill Publishing Co. New Delhi, 1161 pp. II edn.

8. Entomology at a Glance. R.C. Saxena & R.C. Srivastava. Agroteh Publishing Academy, Udaipur.

## **ZOO 542. MECHANISMS OF ANIMAL BEHAVIOUR**

Unit I. Introduction, Brief History, Stimulus and Response, Causal Factor~

Reflexes and Fixed action patterns.

Unit II. Behaviour and Neurophysiology - Latency, Summation, Fatigue, After discharge, Inhibition, Mammalian Brain and coordination.

Unit III. Motivation - General Aspects, Motivation as illustrated by Breeding Behaviour of Guppies, Newts and Rhesus Monkey. Causal Factors And Motivation, Interaction of Activities. Models of Motivation.

Unit IV. Learning – Learning and Memory, Types of Learning, Classical Conditioning, Instrumental conditioning, Imprinting, Instinct.

Unit V.

Perception and Communication - Visual System, Auditory System, Echolocation. Visual Communication, Acoustic Communication, Pheromonal Communication. Electrical Communication.

I

Unit VI. Complex Behaviour - Orientation, Navigation, Homing, Migration,, Biological Rhythms.

## **ZOO 543 CONSERVATION BIOLOGY (2 Credits)**

**1. Conservation Biology, Introduction to Biodiversity:** Overview and causes of recent extinctions, Tropical wild life and conservation – South America, Asia and Africa. International Treaties, Convention and regulation.

**2. Evaluation of priorities for species and habitats:** Choosing species to protect : species quality, Conservation indices, Hotspots for conservation, Major tropical wilderness areas and ecoregions, World heritage sites

**3. Management of natural habitats.** Continental biomes, Management of oceanic islands, Management of aquatic habitats, Management of fragmented habitats, zonation and biosphere reserves

**4. Management of species:** Metapopulations, Conservation Genetics, Population viabilities, *In situ* methods, *Ex situ* methods

**5. Restoration, Translocation and Mitigation:** Re-introduction, Control of introduced species, Restoration management, Translocation of Habitats, Mitigation, Urban Wildlife Measuring success and cost effectiveness

## **ZOO 544 Dissertation ( 6credits)**

## **Departmental electives ( Internal)**

### **ELECTIVES**

## ZOO 501 Bio-instrumentation

**Unit 1. Microscopy-:** Light microscopy, phase contrast microscopy, Confocal laser scanning microscopy, scanning and transmission electron microscopy, Darkfield microscopy, Micrometry, Imaging.

**Unit 2. Electrophoresis and Centrifugation:** Gel electrophoresis, Immuno electrophoresis, Differential and Ultra centrifugation, Cell fractionation.

**Unit 3. Histology and Histological Techniques:** Histology methods, Cryostat, Staining techniques, Histochemistry, Immunocytochemistry.

**Unit 4. Chromatography and Photometry:** TLC, Column Chromatography, HPLC, GC, Colorimetry, Spectrophotometry, NMR, Infrared spectrometry.

**Unit. 5 Techniques in Molecular Biology:** Micromanipular sequencing with PCR, Probes, Vectors, Plasmids, Southern Blot, Northern, Western Blots, Dot Blot, Slot Blot.

### References

1. Bioinstrumentation L Veerakumari, MJP Publishers, Chennai, 2006
2. Research Methodology for biological science, Gurumani, MJP Publishers, Chennai, 2006
3. Biophysical Chemistry: Principles and Techniques, Avinash Upadhyay et al., Himalaya Publishing House, 1997
4. Biophysical Chemistry: Techniques for the study of biological structure and functions, Charles C. R. & Paul. S. R. W.H. Freeman & Co. New York, 2004
5. Research Methods in Biological Sciences, Palanichamy and Shunmughavelu., Palani Paramount Publishers, Tamil Nadu, 1997.

## ZOO 502 BIOINFORMATICS (2 CREDITS)

Review of Biological Preliminaries - Central Dogma of Molecular Biology - String view of DNA: Reading frames +1,+2,+3 and -1,-2,-3. codon-genetic code-transcription & translation-mRNA, sense/coding as anti-sense/template strands, rRNA, tRNA, upstream and downstream -genomic DNA as complimentary DNA- introns and exons, alternative splicing, prokaryotic DNA vs eukaryotic DNA junk DNA, EST, Sequence Data Bases, detailed study of GenBank of NCBI - typical Gen Bank(D D B J + EMBL) entry and for DNA as RNA concepts of similar homologous, orthologous and paralogous sequence, TIGER, BLAST & FASTA file formats

Sequence alignments: The concepts and need for sequence alignments, concepts of similar homologs .orthologs and paralogs sequence, dot plots-dotlet software-types alignments- local and. global. Pair wise and multiple, sequence similarity and distances Hamming and levenshtein distances, similarity scores, match, mismatch and gap scores and PAM and BLOSUM matrices, the Needleman-Wunch algorithm for global alignment, Smith-Waterman algorithm for local alignment, statistical significance of alignments- e values - BLAST & FASTA algorithm- using and interpreting BLAST results. Specificity and sensitivity. multiple sequence alignment, need, complexity of the problem- scoring MSA- the SP measure- n dhensional dynamic programming- heuristic methods, Clustal X software

Sequence Representation & Analysis: Basic gene status - base counts, word(nmer)frequencies, Codon usage bias, tandem and inverted repeats, ORfs, gene finding, splice site recognition, Molecular Phylogenetics: Concept of phylogenetics -Application of Phylogenetic trees-

Molecular clock hypothesis, Distance based methods-UPGMA, NJ algorithm, Character based methods-Maximum parsimony methods. Study of Phylip, NJ plot, ClustalX and other popular softwares.

Preliminaries: Proteome and proteomics -Proteins as workhorse molecules of life, classification of proteins. Protein Databases-PDB-PIR. Typical entries-Protein visualization tools-Swiss PDB Viewer Protein structure prediction-primary, secondary and tertiary structure of proteins-Alpha helices, Beta sheets and turns-Protein Domains-Chou-Fausman method (GOR) method- Threading-Homology modeling, CASP, Abinitio prediction, Introduction to Drug Discovery.

### **References**

1. Dan E. Krane and Michael L. Raymer, fundamental concepts of Bioinformatics, Pearson Education (low Priced Edition).
2. C. kuppuswamy & C. Subramanian, Encyclopedia of Bioinformatics
3. Claverie & Notredame, Bioinformatics - A Beginners Guide, Wiley-Dreamtech India Pvt Ltd, 2003
4. Lesk, Introduction to Bioinformatics, Oxford University Press, Indian Edition, 2003

### **ZOO 503 Lab Course 1**

### **ZOO 504 Field Zoology**

### **ZOO 505 WETLAND ECOLOGY ( 2 CREDITS)**

1. Wetlands: an overview: Definition and distributions, wetland classification, wetland types, Wetland functions, Zonation and Succession: shorelines as a prism, Shorelines as a model system for the study of wetlands, Mechanisms of zonation, some relevant theory: ecological and physiological response curves, empirical studies of zonation.
2. Diversity|: Dominance and diversity factors controlling the number of species in wetlands, Biomass and diversity: a general model for herbaceous plant communities, Species pools and biodiversity.
3. Wetland conservation, management and research: Change in wetlands, perspectives on conservation, Priorities for action, Indicators: setting goals and measuring performance, ecosystem management, Goals, tactics and strategies.
4. Wetlands in India, Wetland management, Wetland policy and law, Ramsar: Wetlands Future prospects of wetlands, Environmental impact assessment of wetlands,
5. Wetlands of Kerala, Wetland agriculture –Problems and prospects, Back waters of Kerala, Management of river wetlands, Avi fauna of wetlands of Kerala, Flora and fauna of wetlands, Wetland pollution, Constraints, management and conservation of wetlands, Coral reef ecosystem, Mangrove ecosystems of India, Wetland planning and monitoring Economic assessment of wetland management, People’s participation in wetland conservation.

### **References**

1. Wetland ecology principles and conservation /Paul Keddy.2000, Cambridge university press, 2000.
2. Production & Ecology of wetlands. DF West Lake et al, Cambridge University press.
3. Wet land Indicators –Ralph W. Tirur CRC Press
4. Wetland Management Policy & law, 2002 |P.C Sinha & R. Mohanty 436p

### **ZOO 506 Lab Course 2: Applied Endocrinology**

## **ZOO 507 HABITAT ECOLOGY ( 2 Credits)**

**Unit 1. Habitat and Niche**—Concept of habitat, microhabitat. Niche-Tropic and species niche, multidimensional hypervolume niche, fundamental and realized niche, niche overlap and competition, Gause's Principle, concept of guild.

**Unit 2. Habitat Ecology**—Classification of biosphere into Hydrosphere, Lithosphere and Atmosphere and sub-divisions of each. Terrestrial Ecology-Biomes(Tundra, Forest, Grasslands, Deserts and Cave).

**Unit 3. Aquatic Ecosystems**—Freshwater ecology ( Lentic and Lotic systems and adaptations). Marine Ecology(Pelagic and Benthic realm).Estuaries. Wet lands

**Unit 4. Terrestrial Ecosystems:** Tropical rain forests, deserts, grass lands and other terrestrial habitats.

## **ZOO 508 FIELD COURSE- BIODIVERSITY**

1. Biodiversity indices: a. population abundance b. distribution
2. Study tour to various Wildlife Reserves and National parks

## **ZOO 509 Term Paper 2**

## **ZOO 510 Lab Course 3**

## **Extra Departmental Electives**

### **ZOO 51 A Ecophysiology (Credit 1)**

1. Concept of ecophysiology –History and introduction.
2. Factors: Chemical, physical and biological factors influencing physiology.
3. Chemical co-ordination centers-Signal transducers- Neuroendocrine system.

4. Environmental Adaptation: physiological adaptation, Homeotherms, poikilotherms, Thermal adaptation, salinity adaptation, Biomarkers and Bioindicators.
5. Stress physiology –Endocrinology of stress, Endocrine Disruptors, Stress adaptation and tolerance, Stress proteins.
6. Environmental Physiology –Water and mineral balance, acid- base balance, energy metabolism and environmental influence on reproduction.

## **ZOO 52 A Biodiversity – (Credit 1)**

1. Biodiversity : An introduction  
Biodiversity Convention, objectives Biodiversity of the world, Biodiversity of India, endemic species, biodiversity resource, resource utilization and conservation.
2. Methodology in biodiversity studies
3. Ecological monitoring-purpose means ground monitoring population studies, cyclic changes in behavior, Indices of species diversity.
4. Managing natural areas in tropics  
Features of areas to be protected, categories of protected areas, in gene banks, island biogeography theory and protected area management.
5. Economics of biodiversity  
Threatened categories, red data books, threatened mammals of India, economics of biodiversity conservation.