# CHOICE BASED CREDIT SYSTEM (CBCS)

Department of Zoology, University of Kalyani
Effective from 2014-2015 Session
**Semester -1**

| **Course Name** | Subject | Points | Credit | Hours/ Week |
|---|---|---|---|---|
| **Hard Core Theory** | | | | |
| ZHT-101 | Non Chordate and Insect Organization | 75 | 3 | 4 |
| ZHT-102 | Parasitology and Ecology | 75 | 3 | 4 |
| ZHT-103 | Developmental Biology and Cytogenetics | 75 | 3 | 4 |
| ZHT-104 | Animal Physiology and Biochemistry and Metabolic Processes | 75 | 3 | 4 |
| **Hard Core Lab** | | | | |
| ZHL-101 | Non Chordate and Insect Organization | 25 | 1 | 3 |
| ZHL-102 | Parasitology and Ecology | 25 | 1 | 3 |
| ZHL-103 | Developmental Biology and Cytogenetics | 25 | 1 | 3 |
| ZHL-104 | Animal Physiology and Biochemistry and Metabolic Processes | 25 | 1 | 3 |
| Library / Field Work / Class Test | | | | 2 |
| Total points & Credits in Semester I | | 400 | 16 | 30 |

**Semester - II**

| **Course Name** | Subject | Points | Credit | Hours/ Week |
|---|---|---|---|---|
| **Hard Core Theory** | | | | |
| ZHT-205 | Structure and Function of Chordates & Fish Biology | 75 | 3 | 4 |
| ZHT-206 | Environment, Wild life and Conservation & Biosystematics and Taxonomy | 75 | 3 | 4 |
| ZHT-207 | Advanced Parasitology & Immunobiology | 75 | 3 | 4 |
| ZHT-208 | Cell Physiology & Human Population Genetics | 75 | 3 | 4 |
| **Hard Core Lab** | | | | |
| ZHL-205 | Structure and Function of Chordates & Fish Biology | 25 | 1 | 3 |
| ZHL-206 | Environment, Wild life and Conservation and Biosystematics and Taxonomy | 25 | 1 | 3 |
| ZHL-207 | Advanced Parasitology & Immunobiology | 25 | 1 | 3 |
| ZHL-208 | Cell Physiology & Human Population Genetics | 25 | 1 | 3 |
| Library / Field Work / Class Test | | | | 2 |
| Total points & Credits in Semester II | | 400 | 16 | 30 |

**Semester -III**

| Course Name | Subject | Points | Credit | Hours/ Week |
|---|---|---|---|---|
| **Hard Core Theory** | | | | |
| ZHT-309 | Arthropod of Economic Importance & Biodiversity and Resource management | 75 | 3 | 4 |
| | | | | |
| ZHT-310 | Environmental Toxicology and Endocrinology | 75 | 3 | 4 |
| **Soft Core Theory Any two** | | | | |
| ZST-301 | Applied Ichthyology | 25 | 1 | 1 |
| ZST-302 | Developmental Dynamics | 25 | 1 | 1 |
| ZST-303 | Human Molecular Genetics | 25 | 1 | 1 |
| ZST-304 | Forest Entomology | 25 | 1 | 1 |
| ZST-305 | Medical & Veterinary Parasitology | 25 | 1 | 1 |
| ZST-306 | Reproductive Biotechnology | 25 | 1 | 1 |
| **Hard Core Lab** | | | | |
| ZHL-309 | Arthropod of Economic Importance & Biodiversity and Resource management | 25 | 1 | 3 |
| ZHL-310 | Environmental Toxicology & Endocrinology | 25 | 1 | 3 |
| **Elective Theory** | | | | |
| ZET-301 | Fish and Fisheries<br>Cytogenetics & Mol.Biology<br>Endocrinology & Rep Biology<br>Parasitology & Immunology<br>Entomology<br>Cell & Development Biology | 50 | 2 | 3 |
| ZET-302 | Fish and Fisheries<br>Cytogenetics & Mol.Biology<br>Endocrinology & Rep Biology<br>Parasitology & Immunology<br>Entomology<br>Cell & Development Biology | 50 | 2 | 3 |
| **Elective Lab** | | | | |
| ZEL -301 | Elective Lab | 30 | 1 | 3 |
| ZES- 301 | Seminar | 20 | 1 | 3 |
| Field Study / Lab visit/ Library/ Class test | | | | 2 |
| Total points & Credits in Semester III | | 400 | 16 | 30 |

**Semester –IV**

| Course Name | Subject | Points | Credit | Hours /Week |
|---|---|---|---|---|
| **Hard Core Theory** | | | | |
| ZHT-411 | Animal Behaviour and Vector Biology | 75 | 3 | 4 |
| ZHT-412 | Molecular Biology & Biotechnology and Tools & Technique | 75 | 3 | 4 |
| **Soft Core Theory Any Two** | | | | |
| ZST-407 | Agricultural Entomology | 25 | 1 | 1 |
| ZST-408 | Cancer Biology | 25 | 1 | 1 |
| ZST-409 | Medical Embryology | 25 | 1 | 1 |
| ZST-410 | Aquaculture Technology | 25 | 1 | 1 |
| ZST-411 | Hormone and Signal Transduction | 25 | 1 | 1 |
| ZST-412 | Parasite and Disease | 25 | 1 | 1 |
| **Hard Core Lab** | | | | |
| ZHL-411 | Animal Behaviour and Vector Biology | 25 | 1 | 3 |
| ZHL-412 | Mol Biolgy & Biotechnology and Tools & Technique | 25 | 1 | 3 |
| **Elective Theory** | | | | |
| ZET-403 | Fish and Fisheries<br>Cytogenetics & Mol.Biology<br>Endocrinology & Rep Biology<br>Parasitology & Immunology<br>Entomology<br>Cell & Development Biology | 50 | 2 | 3 |
| ZET-404 | Fish and Fisheries<br>Cytogenetics & Mol.Biology<br>Endocrinology & Rep Biology<br>Parasitology & Immunology<br>Entomology<br>Cell & Development Biology | 50 | 2 | 3 |
| **Elective Lab** | | | | |
| ZEL -402 | Elective Lab | 30 | 1 | 3 |
| ZEP -402 | Project/Review work | 20 | 1 | 3 |
| Field Study / Lab visit/ Library/ Class test | | | | 2 |
| Total points & Credits in Semester IV | | 400 | 16 | 30 |

## Examination Pattern

| Course | In Semester<br>40 % | End Term<br>60 % | Total Points |
|---|---|---|---|
| Hard Core Theory | 30<br>Attendance (5+5)<br>Class test (10+10) | 45 | 75 |
| Hard Core Lab | 10<br><br>Attendance (4)*<br>Lab Note book +<br>Viva (6) | 15<br><br>(7.5+7.5) | 25 |
| Soft core theory | 10<br>Class test (10) | 15 | 25 |
| Elective | 20<br>Class test (10+10) | 35 | 50 |
| Elective Lab-I | 20<br>Seminar | 30 | 50 |
| Elective Lab-II | 20<br>Project/Review | 30 | 30 |

*Attendance = 80 % and above = 4 ; 70 – 80 % = 3 ; 60 -69 % = 2 ; Less than 60 % = 1

# Question Pattern

| **In Semester** | **End Term Examination** |
|---|---|
| **For written test only**<br><br>2 Pt. X 5 (out of 6) = 10 | **For 15 Points**<br>3 pt x 3 (out of 4) = 9<br>6 pt x 1 (out of 2) = 6 |
| | **For 35 Points**<br>3 pt x 3 (out of 4) = 9<br>5 pt x 2 (out of 3) = 10<br>8 pt x 2 (out of 3) = 16 |
| | **For 45 Points**<br>2 pt x 5 (out of 6) = 10<br>5 pt x 3 (out of 4) = 15<br>10 pt x 2 (out of 3) = 20 |

## SEMESTER -I

## HARD CORE THEORY PAPERS

| ZHT-101 : Non Chordate and Insect Organization | Points 75 |
|---|---|
| **Non Chordate** | **Point 37 Lectures** |
| 1. Cell organelles in protozoa - Golgi, Mitochondria, Kinetoplast, Pellicle and Cuticle | 5 |
| 2. Osmoregulation in Protozoa. | 4 |
| 3. Cell association and cellular differentiation in protozoa | 4 |
| 4. Insect blood : composition, functions, morphology of circulatory system | 4 |
| 5 Morphology of excretory organs and their function in insects | 3 |
| 6. Insect flight: structure concerned, functional mechanism. | 3 |
| 7. Insect visual organs, their structure and functional mechanisms | 3 |
| 8. Structure and function of sound producing organs in insects, significance of sound production. Uses of sound in plant protection. | 4 |
| 9. Photogenic organs in insects : structure, mechanism and significance of light production | 4 |
| 10. Sensory organelles and reaction for stimuli | 3 |
| **Insect Organization** | **Point 38 Lectures** |
| **1.** Evolution of insect classification and modern classification of insects | 4 |
| 2. General organization, segmentation, division of body: | |
| i) Head and mouth parts in general | 4 |
| ii) Thorax and thoracic appendages. Modification of legs and wings. | 4 |
| iii) Abdomen and abdominal appendages. | 4 |
| 3. Integument: Basic structure and functions. | 4 |
| 4. Digestive organs: Structure and functions; Peritrophic membrane, Filter chamber | 4 |
| 5. Morphology of respiratory organs and mechanism of respiration | 4 |
| 6. Morphology of central nervous system. | 4 |
| 7. Metamorphosis: Basic concept (e.g. House fly), | 2 |
| 8. Exocrine glands: Lac gland, Wax gland, Silk gland, Labial gland. | 4 |

| ZHT-102: Parasitology and Ecology | Points 75 |
|---|---|
| **Parasitology** | **Point 37 Lectures** |
| 1. Classification of Protozoa and Helminths. | 6 |
| 2. Mode of transmission of *{Plasmodium, Trypanosoma, Piroplasm)* | 7 |
| 3. Zoonosis with particular reference to *Toxoplasma, Balantidium, Entamoeba, Schistosoma.* | 7 |
| 4. Microspora: Structure and life history of *Nosema bombycis* - impact on sericulture. | 5 |
| *5.* Life cycle, biology, pathogenesis,, epidemiology and control of important human and veterinary helminthes - *Diphyllobothrium latum, Paragonimus westermani, Trichinella spiralis.* | 6 |
| 6. Salient features of plant parasitic nematodes and life cycle patterns of i) *Heterodera rostochiensis,* ii) *Meloidogyne hapla, Anguina* | 6 |
| **Ecology** | **Point 38 Lectures** |
| l. The Ecosystem: concept, Gaia hypothesis, cybernetic nature and stability of the ecosystem, ecosystem management and optimization. | **6** |
| 2. Niche theory : Niche concepts, niche width | **6** |
| 3. Community: Structure and Gradient analysis | **6** |
| 4. Biogeochemical cycle: Nitrogen and phosphorus cycle | **6** |
| 5. Population attributes: Growth forms and mathematics of growth, Life Table - (Cohort and Static); survivorship curves , generation time, net reproductive rate. Life history strategies : Evolution of life history traits, strategies related to longevity; clutch size; life history optimization. | **8** |
| 6. Metapopulation: Concept, models , structure and dynamics | **6** |

| ZHT 103: Developmental Biology and Cytogenetics | Points 75 |
|---|---|
| **Developmental Biology** | **Point 37 Lectures** |
| 1. Basic concepts in Developmental Biology | 3 |
| 2. Sex, Gametes and Fertilization:<br>i) Germ cell migration<br>ii) Gametogenesis<br>iii) Gamate recognition, contact and fertilization, prevention of polyspermy. | 10 |
| 3. Egg organization: Egg polarity, Mosaic and Regulative egg. | 2 |
| 4. Axis specification in vertebrates:<br>i) Early patterning in vertebrates - Symmetry breaking, Nieuwkoop center.<br>ii) Left- right asymmetry in vertebrates - Asymmetric gene expression | 8 |
| 5. The Vertebrate organizer – The amphibian organizer, Early organizer inducing centers, organizer's role, organizer maintenance. | 8 |
| 6. Key molecular components:<br>a. Cell adhesion molecules<br>b. Extra cellular matrix components | 7 |
| **Cytogenetics** | **Point 38 Lectures** |
| 1. Genome organization in eukaryotes: complexity, pseudogenes; satellite DNA, C-value paradox, molecular organization of chromatin structure; | 8 |
| 2. Prokaryotic genome; split genes; overlapping genes; super coiling of DNA. | 5 |
| 3. Eukaryotic cell cycle: cell cycle phases; regulator of cell cycle progression; events of M phase. | 7 |
| 4. Mitochondrial genome organization: protein import and mitochondrial assembly; peroxisome assembly; function of peroxisome. | 8 |
| 5. DNA replication: nature, enzymology of replication, replication fork; leading and lagging strands; Okazaki fragments; termination of replication | 10 |

| ZHT 104: Animal Physiology & Biochemistry and Metabolic Processes | Points 75 |
|---|---|
| **Animal Physiology** | **Point 38 Lectures** |
| 1.Respiratory function of blood:<br>a) Respiratory pigments - distribution and brief chemistry<br>b) Function of hemoglobin-i) in adult and ii) during embryonic life<br>c) Environmental influences. | 10 |
| 2.Physiology of muscles:<br>a) Chemical nature of contractile elements<br>b) Role of structural and regulatory proteins in muscular contraction<br>c) ATP and signal molecules in muscular contraction | 10 |
| 3.Physiology of excretion:<br>a) Formation of urine: glomerular filtration; tubular function; counter current mechanism and urine formation | 10 |
| 4. Synaptic and functional transmission;<br>a) Pre-and postsynaptic structure and function<br>b) Chemical transmission of synaptic activity | 8 |
| **Biochemistry and Metabolic Processes** | **Point 37 Lectures** |
| 1. Proteins: Protein folding and protein stability. | 4 |
| 2. Bioenergetics and oxidative metabolism:<br>i) Thermodynamic principles and steady-state conditions of living organism; standard free energy change in **a reacting** system; energy change for ATP hydrolysis.<br>ii) Pentose-phosphate pathway | 8 |
| 3. Amino-acid metabolism:<br>a) Urea Cycle | 3 |
| 4. Biosynthesis of transport of cholesterol | 3 |
| 5. Enzymes:<br>a). Kinetic analysis of erfeyme-catalyzed reaction<br>b). Regulation of enzyme activity<br>c). Allosteric control of enzyme activity | 8 |
| 6. Brief knowledge of growth factors and their mechanism of action in normal cell growth. | 5 |
| 7. Apoptosis: the concept, mechanism and importance. | 6 |

**HARD CORE LAB**

| ZHL 101: Non Chordate & Insect Organization | Point 25 |
|---|---|
| **Dissection (Non Chordate)**<br>1. Grasshopper : Reproductive; Air sacs<br>2. Cockroach: Male reproductive<br>3. Crab : Digestive and Nervous<br>4. Honey bee: Poison apparatus<br>**Dissection (Insect Organization)**<br>1. Mosquito : Head,mouth parts and wing<br>2. Housefly: Head, mouth parts and wing<br>3. Honey bee : Pollen basket<br>4. Drosophila: Arista | |
| **ZHL 102: Parasitology & Ecology** | **Point 25** |
| **Parasitology**<br>1. Collection, fixation, staining and preservation of protozoa by wet and dry method.<br>2. Staining ureeolarid ciliate by Kelin's silver impregnation technique<br>3. Collection and preservation of endohelminthes of vertebrates.<br>4. Laboratory records<br>**Ecology**<br>1. Determination of Primary Productivity of water<br>2. Determination orthophosphate of water<br>3. Determination of organic carbon of soil<br>4. Laboratory records | |
| **ZHL 103: Developmental Biology & Cytogenetics** | **Point 25** |
| **Developmental Biology** | |
| 1. Preparation of Whole mounts of 24 and 48 hrs. Chick/ Koel embryos.<br>2. Study of serial section of chick embryo of 48 & 72 hrs (emphasis to be given on Brain, Eye, Gut and tail bud region).<br>3. Identification of different developmental stages of Amphibia.<br>**Cytogenetics**<br>1. Study and identification of meiotic stages of the testicular cells of grasshopper / Chrysocoris<br>2. Chromosome preparation from mice bone marrow cells- demonstration<br>3. DNA extraction | |
| **ZHL 104: Animal Physiology & Biochemistry & Metabolic Processes** | **Point 25** |
| **Animal physiology**<br>1. Blood pressure and pulse rate - Effect of exercise.<br>2. Estimation of rate of $0_2$ consumption, $C0_2$ release and RQ in cockroach/mice Laboratory records<br>**Biochemistry & Metabolic Processes**<br>3. Action of insulin on blood glucose level in rat<br>4. Kinetic study of an enzyme - urease/ catalase | |

## SEMESTER -II

## HARD CORE THEORY PAPERS

| ZHT-205 : Structure and Function of Chordate & Fish Biology | Points 75 |
|---|---|
| **Structure and Function of Chordate** | **Point 37 Lectures** |
| 1. Blood and cardiovascular system; Comparative anatomy of heart structure; Cardiac cycle; neural and chemical regulation of functions of heart. | 10 |
| 2. Respiratory system: Comparative account of respiratory system; transport and exchange of gases; neural and chemical regulation of respiration. | 9 |
| 3. Nervous system: Gross neuroanatomy of brain and spinal cord; neural control of muscle tone. | 9 |
| 4. Thermoregulation: Body temperature – Physical , chemical, neural regulation ; acclimation and acclimatization. | 9 |
| **Fish Biology** | **Point 38 Lectures** |
| 1. Excretion and osmoregulation in fish. | 4 |
| 2. Reproduction in fish : reproductive strategies, oviparity, viviparity, ovo-viviparity, parental care, maturity stages, breeding cycle. | 8 |
| 3. Structure and physiology of endocrine glands in fishes | 6 |
| 4. Electroreception in fish | 4 |
| 5. Determination of age of fish by scale and hard parts. | 6 |
| 6. Poisonous and venomous fish. | 4 |
| 7. Fish migration: Types, Theories and Significances. | 6 |

| ZHT-206: Environment, Wild life and Conservation and Biosystematics and Taxonomy | Points 75 |
|---|---|
| **Environment, Wild life and Conservation** | **Point 37 Lectures** |
| Environment<br>1. Concept of Environment: Structure, radiation balance, climate cycle.<br>2. Anthropogenic impact on environment: Green house gases, global warming, ozone depletion, UN movements on environment.<br>3. Environment and agriculture: Green revolution and its impact on environment, organic farming, participatory approach in agriculture.<br>Wild life<br>1. Categories of wild life.<br>2. Wild life and wild life habitat in India: Wild life wealth of India .<br>3. Wild life management: Distribution, status , habitat utilization pattern, threats and survival of – Royal Bengal Tiger, Rhinoceros, Olive Ridley Turtles<br>Conservation<br>4. Theory and analysis of conservation: Stochastic perturbations, population viability analysis, recovery strategy for threatened species.<br>5. National and International efforts for conservation: CITES, IUCN, CBD, Protected area concept. | 13<br><br><br><br><br>12<br><br><br><br><br><br><br>12 |
| **Biosystematics and Taxonomy** | **Point 38 Lectures** |
| **1. Species concept:** Evolutionary and biological species concept; difficulties in application of biological species concept.<br>2. **Theories of biological classification:** classification and phylogeny-types of classification, hierarchic classification; zoological nomenclature, basic knowledge of naming genus and species.<br>3. Phenetic method of classification, numerical phonetics and numerical taxonomy, preparation of data matrix and similarity matrix using distance method (Manhattan distance and Euclidian distance);Cluster analysis (different methods).<br>4. Cladistic method of classification, difference in the application of phenetic and cladistic classification; cladistic and cladogram, eludlstic methods, application of parsimony, cladistic and classification.<br>5. Cytotaxonomy, biochemical taxonomy, immunotaxonomy. | 6<br><br>8<br><br>10<br><br><br><br>8<br><br>6 |

| ZHT 207: Advanced Parasitology and Immunobiology | Points 75 |
|---|---|
| **Advanced Parasitology** | **Point 37 Lectures** |
| 1. Physiology of parasitic amoebae of man. | 8 |
| 2. Mode of transmission, pathogenicity and prevention of tetanus and rabies | 9 |
| 3. Physiology, immunopathology *of Plasmodium sp.*\ immunity of *Plasmodium sp.* | 8 |
| 4. Fish parasites and its control | 8 |
| 5. Parasites of edible oysters | 4 |
| **Immunobiology** | **Point 38 Lectures** |
| 1. Basic concepts of immunology | 2 |
| 2. Cellular basis of immunity: innate and adaptive; primary and secondary response. | 4 |
| 3. The nature of antigen : Haptens, B Lymphocytes, T Lymphocytes | 7 |
| 4. Humoral immune system: structure and assembly of antibodies/immunoglobulin. | 6 |
| 5. Complement system: classical pathway and the alternative pathway | 6 |
| 6. Major histocompatibility complex: T -Cell receptors, MHC genes and gene products | 6 |
| 7. Vaccination and immunization: natural and artificial immunization; active immunization, vaccines. | 7 |

| ZHT 208: Cell Physiology & Human Population Genetics | Points 75 |
|---|---|
| **Cell Physiology** | **Point 38 Lectures** |
| 1) Biomembranes: Transport across cell membrane diffusion; carrier bound transport; active transport and pumps; uniport, symport and antiport | 7 |
| 2) Cell-to-cell signaling: cell surface receptor and nuclear receptor ; Second messenger system ; MAP kinase pathways | 6 |
| 3) Cell-to-cell adhesion; calcium dependent homophilic and calcium - independent homophilic cell-to-cell adhesion; Gap junctions, connexin and related molecules. | 8 |
| 4) Intracellular protein traffic for secretary and non-secretary cells: protein synthesis, intracellular transport, packaging, storage and release | 7 |
| 5) Cell cycle: cyclines and cyclin-dependent kinases (cdks); regulation of cyclin-dependent kinase activity | 10 |
| **Human Population Genetics** | **Point 37 Lectures** |
| 1. Basic concept of human genetics: human karyotype; introduction to the structure of human genome; genetic diversity involving globin genes. | 14 |
| 2. Human genetics and society: genetic testing; human rights; gene therapy; genetic determination. | 13 |
| 3. Quantitative genetics; variance; heritability; inbreeding and cross breeding; QTL. | 10 |

**HARD CORE LAB**

| ZHL 205: Structure and Function of Chordate & Fish Biology | Point 25 |
|---|---|
| **Anatomy of Chordates**<br>1. Cranial nerves of teleosts.<br>2. Accessory respiratory organs of fish,<br>3. Excursion and collection of specimens<br>**Fish Biology**<br>1. Reproductive system in teleost fishes<br>2. Study of scales and otolith in fish age determination<br>3. Display of pituitary gland of fish<br>4. Histological study of endocrine glands offish (from prepared slides) | |
| **ZHL 206: Environment, Wild life and Conservation and Biosystematics and Taxonomy** | **Point 25** |
| **Environment, Wild Life & Conservation**<br>1. Wastewater analyses: determination of hardness and COD of water<br>2. Diversity indices from soil and aquatic fauna.<br>**Biosystematics and Taxonomy**<br>3. Preparation of materials for taxonomic study: Identification of nematodes<br>4. Identification, preparation of taxonomic keys unci taxonomic studies of insects.<br>5. Collection, fixation and staining of protozoa, for taxonomic study.<br>6. Identification from prepared slides. | |
| **ZHL 207: Advanced Parasitology and Immunobiology** | **Point 25** |
| **Advanced Parasitology** | |
| 1. Staining and mounting of platyhelminth parasites<br>2. Protozoan parasites of freshwater fish and Insects of economic importance.<br>3. Identification of some parasitic protozoa.<br>**Immunobiology**<br>1. Analysis of blood group A,B,AB, **O** and Rh factor<br>2. Antigen antibody reaction; immunodiffusion .<br>3. Raising of antibody<br>4. Identification of lymphoid organs | |
| **ZHL 208: Cell Physiology and Human Population Genetics** | **Point 25** |
| **Cell Physiology**<br>**1.** Hemoglobin, and Arneth count of blood.<br>2. Determination of acid number of lipids.<br>**Human Population Genetics**<br>3. Chromosome aberration, micronuclei, sperm head anomaly study<br>4. Solving problems on linkage and chromosomal mapping; population genetics. | |

## SEMESTER -III

## HARD CORE THEORY PAPERS

| **ZHT-309 : ARTHROPOD OF ECONOMIC IMPORTANCE AND BIODIVERSITY AND RESOURCE MANAGEMENT** | **Points 75** |
|---|---|
| **ARTHROPOD OF ECONOMIC IMPORTANCE** | **Point 37 Lectures** |
| 1. Insect pests: pest fauna (names only) of stored grains; Morphology, bionomics and control of: stored rice grain moth *{Corcyra cephalonica)* and stored pulse beetle *(Callosobruchus chinensis)* | **8** |
| *2.* Pest management Mechanical; Chemical ; Biological; Integrated | **4** |
| 3. Lac culture: Life-history of lac insect, culture method, lac processing, lac products, natural enemies of lac insect and their control. | **8** |
| 4. Sericulture: Indigenous races, pure races and commercial races of mulberry silk moth; Rearing of mulberry silk moth (moriculture excluded) | **8** |
| 5. Parasitic insects and Acarines: a) General remarks on *Phlebotomous*, *Glossina*, *Tabanus* and head louse in relation to morphology, habit, habitat, life-cycle and disease caused by them, mode of transmission; | **5** |
| b) General remarks on ticks in relation to morphology, habitat, life-cycle and diseases caused by them. | **4** |

| BIODIVERSITY AND RESOURCE MANAGEMENT | Point 38 Lectures |
|---|---|
| 1.Meanings of Biodiversity:<br>Levels of species diversity and relationship;<br>geographic distribution of biological diversity; biological hotspots;<br>measuring biodiversity; interrelationship between diversity measures;<br>pattern of local and regional biodiversity. | 16 |
| 2.Threats to species diversity;<br>natural and human induced threats and vulnerability of species extinction;<br>Red data book; rarity,endemism,effective and minimum viable<br>population, fragmentation of population and metapopulation; problems of<br>genetic diversity ; bottleneck; genetic drifts; inbreeding depression. | 12 |
| 3.Biodiversity Resource Management:<br>values and uses of biological diversity, invertebrate diversity as<br>bioindicator; putting a price on biological diversity; pollinating insect<br>diversity and their management and utilization in sustainable agriculture;<br>Vermiculture: Types of earthworms and their utilization; use<br>insustainable agriculture. | 10 |

| ZHT-310: ENVIRONMENTAL TOXICOLOGY AND ENDOCRINOLOGY | Points 75 |
|---|---|
| **ENVIRONMENTAL TOXICOLOGY** | **Point 37 Lectures** |
| 1. Basic concept of toxicology : Scope, division, toxicants and toxicity, factors, dose- response relationship, | 5 |
| 2. Toxicity testing : Bioassays, $LC_{50}$, $LD_{50}$, $ED_{50}$, Synergism, Antagonism, Additive Effect | 6 |
| 3. Toxicants of public health hazards: Pesticides, Heavy metals, Radiation, food and additives | 7 |
| 4. Toxicokinetics: Absorption, distribution, elimination | 5 |
| 5. Organ toxicity: Hepato, Nophro, Respiratory, Reproductive. | 5 |
| 6. Plant Allelochemicals .types and its role in insect-plant interaction. | 5 |
| 7. Plant signaling chemicals, insect response. | 4 |
| **ENDOCRINOLOGY** | **Point 38 Lectures** |
| 1. Phylogeny of Endocrine Glands: pituitary and adrenal. | 5 |
| 2. Biosynthesis, secretion and regulation of hormones: biosynthesis of protein and peptide hormones (Growth Hormone and Insulin), Post-Translational event und release; biosynthesis of steroid hormones and their regulations; biosynthesis of $T_3$ and '1 \ and their regulation | 10 |
| 3 Neuroendocrine system and neurosecretion: neural control of glandular secretion; hypothalamic pituitary unit | 8 |
| 4. Physiological role of hormones: hormonal regulation of mineral metabolism and fluid volume; pineal gland hormones and their role in photoperiodic response in vertebrates | 8 |
| 5. Mechanism of hormone action: hormones that acts at the cell surface-properties of the hormones- receptor interaction; Cellular mechanism of action. | 7 |

**SOFT CORE THEORY**

| **ZST 301: APPLIED ICHTHYOLOGY** | **Point 25 Lectures** |
|---|---|
| 1. Biology and importance of finfish and shellfish<br>Finfish: Indian major carps, freshwater catfish, oil sardines, Hilsha, Bombay Duck, Shellfish: Prawns and shrimps. | 5 |
| 2. Composition and nutritive value of fish, fish as source of protein in developing countries. | 5 |
| 3. Nutrition offish : Anatomical modification in relation to feeding habits, natural foods, prepared feed, types of feed, feed storage, energy and growth, food conversion ratio and food conversion efficiency. | 5 |
| 4. Aquaculture methods : concept and significance : Different systems of aquaculture for carps and shrimps : Extensive, Semi-intensive, Intensive, | 5 |
| 5. Ornamental fish culture : background of ornamental fish culture and trade, classification, culture and breeding of ornamental fish, common diseases and control. | 5 |
| **ZST 302: DEVELOPMENTAL DYNAMICS** | **Point 25 Lectures** |
| 1. Common features of development: Genomic equivalence; Cloning of animals; | 5 |
| 2. Developmental processes: Cellular differentiation; Pattern formation; Induction. | 5 |
| 3. Techniques for the study of development:<br>i) Cell labeling<br>ii) Cell sorting | 5 |
| 4. Model organism : *Xenopus*<br>i) Embryonic development, fate maps<br>ii) Experimental methods - for establishing gene product in development<br>iii) Regional specification | 5 |
| 5. Stem cells:<br>i) Embryonic stem cells,<br>ii) Stem cell niches<br>iii) Transdifferentiation | 5 |

| ZST 302: Human and Molecular Genetics | Point 25 Lectures |
|---|---|
| **1.** Structure of human genome: Amount of DNA; single sequence DNA; intermediate DNA and highly repetitive DNA; CpG islands; number size and spacing of human genes; mini-satellite and micro-satellite | **15** |
| 2. Human genome project and the age of genomics: Brief history; genome sequencing; SNPs; nanomedicine. | **10** |

| ZST 304: FOREST ENTOMOLOGY | Point 25 Lectures |
|---|---|
| 1. Indian Forest types, their distribution and importance, Forest insects (pests) - damage and sign categories | **4** |
| 2. Insect pests of Timber yielding trees ( Sal - *Shorea robusta;* Teak - *Tectona grandis;* Mahogony- *Swietenia macrophylla*) Bionomics and nature of damage of Borers - *Haplocerambyx spinicornis,* Defoliators - *Hapalea machaeralis,* | **8** |
| 3. Soil insects and their damage to forest plants and their management. Role ofinsects in tropical forest ecosystem. | **5** |
| 4. General issues in forest entomology: a) Insect damages in plantation *vs* natural forest, b) Pest problems in plantation of indigenous *vs* exotic species. C) Pest problems in monboculturo VA* mixed plantations. | **6** |
| 5. Management of tropical insect forest pests. | **2** |

| ZST 305: MEDICAL AND VETERENARY PARASITOLOGY | Point 25 Lectures |
|---|---|
| 1. *Leishmania donovani* and Leishmaniasis | **4** |
| *2.* Structure, Pathobiology prophylaxis and diagnosis of *Babesia, Anaplasma* and *The Heria* | **6** |
| 3. Generic Differentiation of Intestinal *Amoeba* of man, *Trypanosoma cruzi* and Chagas disease, *Tricomonas foetus* in cattle | **6** |
| 4. Malarial parasites of man, *Eimeria* sp., *Toxoplasmd gondii* - outline structure and life cycles. | **4** |
| *5.* Life cycle, biology, pathogenesis, epidemiology and control of important human and veterinary helminthes - *Diphyllobothrium lactum, Paragonimus westermani, Trichinella spiralis.* | **5** |

| ZST 306: REPRODUCTIVE BIOTECHNOLOGY | Point 25 Lectures |
|---|---|
| 1. Gametogenesis: Genes and markers associated with gametogenesis | **3** |
| 2. *In vitro* gamete maturation | **3** |
| 3. *In vitro* fertilization, cryo-preservation and frozen egg transfer, embryo transfer, Intra Cytoplasmic Sperm Injection (ICSI) | **4** **2** |
| 4. *In vitro* embryo culture | **2** |
| 5. Assisted Reproductive technology | **2** |
| 6. An overview of Cloning techniques | **3** |
| 7. Gene Replacement and Transgenic Technology | **3** |
| 8. Gene knock-out model system and their utility | **3** |

**HARD CORE LAB**

| ZHL 309: ARTHROPOD OF ECONOMIC IMPORTANCE AND BIODIVERSITY AND RESOURCE MANAGEMENT | Point 25 |
|---|---|
| Arthropods of Economic Importance<br>1. Identification of pests and their damage symptoms of agricultural crops and stored grains from theoretical course.<br>2. Sericulture (Mulberry): Silk worm, silk cocoon. | |
| Biodiversity & Resource management<br>1. Preparation of PBR<br>2. Quadrate analysis | |
| **ZHL 310: ENVIRONMENTAL TOXCOLOGY AND ENDOCRINOLOGY** | **Point 25** |
| Environmental Toxicology<br>1. Determination of LC50 / LD50 and 95% Confidence limit of any toxicant to a selected aquatic/ terrestrial organism.<br>2. Effects of toxicants on blood parameters offish.<br>3. Instrumentation AAS/ HPLC for residue analyses of toxicant | |
| Endocrinology<br>4.Performance of castration and ovariectomy in rat /mice<br>5. *in vitro* study of motility of epididymal spermatozoa.<br>6. Evaluation of hypothyroidic stages of rat/ chick comb biopsy. | |

**ELECTIVE THEORY-I**

| ZET 301: FISH AND FISHERIES | Point 50 Lectures |
|---|---|
| **Unit-I**<br>**Inland capture Fisheries Resources of India**<br>1. Introduction to inland capture fisheries resources; estuarine fisheries with | **9** |

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|---|---|
| special reference to biology and fluctuation of *Tenualosa ilisha*<br>*2.* Fisheries of Lakes and reservoirs: Distribution , commercial exploitation of major freshwater lakes and reservoirs, brackishwater lakes.<br>3. Cold water fisheries: Definition, principal zones of cold water fisheries of India, important cold water fisheries of India, food and feeding habit; reproduction and seed resources of Mahaseers | **9**<br><br>**10** |
| **Unit-II**<br>**Limnology**<br>1 . Limnological characteristics of lentic and lotic water systems, morphoedaphic index<br>2. Biological characteristics of inland waters: common planktonic forms algal blooms, zooplankton, zoobenthos, significance.<br>**3.** Biology and culture of some important fish food organisms: Blue green algae, diatoms, rotifers, chironomids, tubifex, brine shrimps | <br><br>**4**<br><br>**8**<br><br>**10** |

| **ZET 301: CYTOGENETICS AND MOL.BIOLOGY** | **Point 50 Lectures** |
|---|---|
| **Unit I.**<br>**Genome organization and gene expression**<br>**1.** Eukaryotic chromosome organization: Packaging of DNA in eukaryotic cell; chromatin structure; histones and nonhistones; nucleosome; higher order structure of chromatin; domains and scaffold; organization of active chromatin and assembly of chromatin during replication.<br>2. Regulation of gene expression: RNA polymerases, promoters, Cis-elements and transacting factors; termination and anti-termination; regulation at transcriptional and translational level; anti-sense RNA.<br>3. Protein folding and processing: Chaperones and folding; enzymes and protein folding, protein cleavage, glycosylation, attachment of lipids. | <br><br><br>**10**<br><br><br><br>**8**<br><br><br>**8** |
| **Unit II.**<br>**Genome and signaling**<br>1. _Current development of chromosome banding techniques and SCE.<br>**2.** _Microbial genetics: organization of prokaryotic genome; single stranded DNA phages; RNA phages; cycle and gene expression in SV40 virus; Lytic and lysogenic phage morphogenesis; bacterial conjugation, transduction and transformation.<br>**3.** _Cell signaling: Modes of cell-cell signaling; steroid hormones and steroid hormone superfamily, neurotransmitters; peptide hormones and growth factors; eicosanoids, functions of cell surface receptors; G-protein coupled receptors, tyrosine kinases, cytokine receptors; pathways of intercellular signal transduction, camp, C GMP pathways; Phospholipids and Ca ion, Ras, Raf and MAP kinase pathway, JAK/STAT pathway | <br><br>**4**<br><br>**8**<br><br>**12** |
| **ZET 301: ENDOCRINOLOGY AND REPRODUCTIVE BIOLOGY** | **Point 50 Lectures** |
| **Unit-I**<br>**Hormone chemistry and metabolism**<br>1. Prohormones and post-transcriptional regulation of peptide hormone production, signal hypothesis<br>2. Hypophysial regulation of steroid hormone biosynthesis and | <br><br>4<br><br>6 |

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| thyroid auto regulation<br>3. Prostaglandin type, chemical nature, biosynthesis and major action<br>4. Hypothalamo-hypophysial unit- structure and mechanism of action of physiologically important neuropeptides<br>a). Vasopressin<br>b). Oxytocin<br><br>**Unit-II**<br>**Hormonal control of growth and calcium homeostasis**<br>1. Physiological action of GH and other hormones regulating growth<br>2. Peptide growth factors: Chemical nature, function and mechanism of action of EGF, IGFs, FGF, TGF-oc and TGF-p.<br>3. Hormonal regulation of calcium and phosphate metabolism: Parathyroid gland, related to kidney, bone and intestine; mechanism of action of PTH.<br>**4.** Calcitonin(CT): chemical nature, site of synthesis and physiological action in calcium metabolism; mode of action of CT .<br>**5.** Calciferol in the regulation of calcium homeostasis | 5<br><br>4<br>4<br><br><br>4<br>6<br>6<br>6<br>5 |
| **ZET 301: PARASITOLOGY AND IMMUNOLOGY** | **Point 50 Lectures** |
| **Unit-I**<br>**Classification and General organization**<br>**1.** Classification of Apicomplexa<br>2. Origin of parasitic protozoa<br>3. Some general consideration of protozoan parasites:<br>a) Population & Communities<br>b) Ecological niche<br>c) Temperature and Climate ,<br>d) Mutualistic intestinal Protozoa<br>4. Arthropods as blood suckers and disease transmitters.<br>**Unit- II**<br>**Protozoology &Host-parasite interaction**<br>5. Primary amoebic meningoencephalitis.<br>6. Parasite -host specificity with reference to protozoan parasites.<br>7. Immunity & resistance with reference to protozoan infection | <br><br>**4**<br>**4**<br><br>4<br>4<br>4<br>4<br>**6**<br><br><br>**6**<br>**4**<br>**4** |

| **ZET 301: ENTOMOLOGY** | **Point 50 Lectures** |
|---|---|
| **Unit-I**<br>**Classification and structural organization**<br>1 Classification up to order in general and up to families of selected orders : Coleoptera, Homoptera, Orthoptera and Hymenoptera; Characters of important families of insects of economic importance.<br>2. Origin of insects: Different theories | <br><br>10<br><br><br>3 |

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| 3. Insect fossils:<br>a) Source of evidence: '<br>b) Extinct insect orders and their characters:<br>4. Origin and Evolution of wings-couplings<br>5. Integument:<br>a) Chemical properties, functions;<br>b) Changes during moulting.<br>6. Mechanorcceptors<br>7. Chemoreceptors<br>**UNIT II :**<br>**Anatomy and physiology**<br>1. Digestion a) Microorganisms: Types, their role and transmission<br>b) Digestion of special substances;<br>c) Nutritional requirements<br>2. Structure and function of neuroendocrine system.<br>3. Composition of urine, mechanism of excretion through malpighian tubules<br>4. Pheromones: Source, chemical nature, transmission, perception and application<br>5. Osmoregulation | 4<br><br><br>4<br>4<br><br><br>2<br>2<br><br><br>8<br><br><br>3<br>4<br><br>3<br><br>3 |
| **ZET 301: CELL AND DEVELOPMENT BIOLOGY** | **Point 50 Lectures** |
| **Unit-I**<br>**Separation and Estimation of macromolecules**<br>**1.** Separation and identification of materials<br>i) Chromatography : Gel chromatography, Ion - exchange Chromatography, Affinity chromatography, High-performance liquid chromatography.<br>ii) Electrophoresis: PAGE, SDS-PAGE, Agarose Gel Electrophoresis of double stranded DNA, Isoelectric Focusing, Immunoeleptrophoresis.<br>2. Spectroscopic methods : Colorimetry, Spectrophotometry, Atomic Absorption Spectrophotometry.<br>3. Sedimentation : Instrument for Ultra centrifugation, Zonal Centrifugation through Density Gradients.<br>**Unit-II**<br>**Tools and Techniques**<br>**1**. Direct observation:<br>i) Light microscopy, Phase contrast microscopy, Interference Microscopy Polarization microscopy, Fluorescence Microscopy<br>ii) Electron microscopy: i) Transmission ii) Scanning<br>**2.** Fixation & staining:<br>**i)** Solutions : Definition, Composition, Expression, Ideal & non-ideal Solution<br>ii) Chemical & physical effects of some primary fixatives: Formalin, alcohol, picric acid, acetic acid,<br>iii) Source and chemical composition of some dyes: Basic fuchsin, carmine, hematin, eosin.<br>3. Special application: Finger printing, Southern, Northern & Western transfers | <br><br><br>8<br><br>6<br><br><br>8<br><br>6<br><br><br><br>6<br><br><br>4<br><br>4<br><br>4<br><br>4 |

**ELECTIVE THEORY-II**

| **ZET 302: FISH AND FISHERIES** | **Point 50 Lectures** |
|---|---|
| **Unit-I** | |
| **Aquaculture** | |
| **1.** Different systems of aquaculture: Monoculture, polyculture, extensive and intensive fish farming. | **6** |
| 2. Qualities of culturable and exotic and indigenous fishes. | **4** |
| 3. Design, criteria and construction -offish farms (carps) : principles of selection, soil characteristics and other parameters | **6** |
| 4. Preparation and management of ponds for culture: use of chemical fertilizers and organic manures, control of weeds, pests and predators, fish toxicants, control of aquatic insects. | **8** |
| 5. Fish pathology: Immune system offish; environment and fish health; fin fish diseases and their control. | **6** |
| **Unit-II** | |
| **Fin fish breeding and biotechnology** | |
| 6. Role of pituitary and gonadotropins, natural breeding, environmental control of spawning, natural collection offish seeds, bundh breeding. b) Induced breeding care of brood fish, secondary sex characters, hypophysation, HCG, pheromones, GnRH, LH-RH and their analogues, new generation drugs, induced breeding and multiple breeding, environmental factors, limitations-inbreeding depressions. | **12** |
| 7. Concept of biotechnology; biofertilization; bioprocessing and biofiltration in aquaculture; cryopreservation of garnets ; transgenesis | **8** |

| **ZET 302: CYTOGENETICS AND MOL.BIOLOGY** | **Point 50 Lectures** |
|---|---|
| **Unit I.** | |
| **Cancer mutagenesis and DNA repair** | |
| **1.** Cancer monoclonal origin; differences of normal cells and cancer cells; cell transformation and factors for cell proliferation; DNA and RNA tumor viruses; concept of oncogene and their role in cancer; tumor suppressor and apoptotic genes. Chromosomal basis of human cancer | 10 |
| 2. Mutations and mutagenesis types of mutation; biochemical basis of mutations; mutagenesis; spontaneous and induced mutation; reversion as a means of detecting mutagens and carcinogens. | 8 |
| 3. DNA repair and retrieval; repair of spontaneous and induced mutations; mechanism of DNA repair; repair by direct reversion; excision repair; SOS response. | 8 |
| **Unit II** | |
| **Human cytogenetics and behavioral genetics** | |
| **1.** Human genetics: karyotype and sex chromosomes; sex determination; role of Y-chromosome; sex mosaics; sex chromosome anomalies; sex influenced and sex limited genes. | 10 |
| 2. Behavioral genetics influence of single defects on behavior; Genetic analysis of behavior in experimental animals, chromosome anomalies and insight into human behavior. | 8 |
| **3.** Environmental effects and gene expression: effects of external and | |

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| internal environment; phenocopies; twin studies; concordance and discordance; identical and fraternal twins. | **6** |

| **ZET 302: ENDOCRINOLOGY AND REPRODUCTIVE BIOLOGY** | **Point 50 Lectures** |
|---|---|
| **Unit-I** | |
| **Endocrine techniques** | |
| 1. Principles and applications of High Performance Liquid Chromatography (HPLC), Ultra-centrifugation, Ion-exchange chromatography and gel electrophoresis in endocrine research. | 4 |
| 2. Recombinant DNA technology- its application in endocrine research | 5 |
| A). Principles and techniques of Southern, Northern and Western Blotting | |
| B). Polymerase Chain reaction (PCR), definition, technique and application | 5 |
| 3. Principles of radio-immuno Assay (RIA) and ELISA | 6 |
| **Unit-II** | |
| **Molecular Biology of endocrine signaling** | |
| 1. Signaling of peptide hormone and epinephrine a). G-protein coupled receptors and their effectors- mechanism of receptor binding, bacterial toxin that modify the G-protein b). Activation of Adenylate-cyclase system | |
| 2. Receptor Tyrosine kinases (RTKs), Ras and Raf a). Auto-phosphorylation of RTKs b). Role of adapter protein and guanine nucleotide exchange factor in activation of Ras | 12 |
| 3. MAP kinase pathway, multiple MAP kinase pathways. | |
| 4. Second Messengers and activation of protein kinases | |
| A). Protein kinase A | |
| B). Protein kinase C | 8 |
| C). Calcium-calmodulin signaling | |
| D). cGMP | |
| 5. Signaling of cytokines and growth hormones. | 3 |
| 6. Ion channel receptor, orphan receptors | 3 |
| **7.** Steroid and thyroid hormone signaling | 4 |
| Signaling pathway for gene expression by peptide hormones. | |

| **ZET 302: PARASITOLOGY AND IMMUNOLOGY** | **Point 50 Lectures** |
|---|---|
| **Unit-I** | |
| **Helminthes** | |
| 1. Classification of helminth. | 6 |
| 2. Origin and evolution of parasitic helminth | 6 |
| 3. Life cycle pattern in trematoda, cestoda, and nematoda | 8 |
| 4. Biology, pathogenesis and control of : *Diphyllobothrium latum, Echinoccocus granulosus and Loa loa* | 8 |

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| **Unit-11**<br>**Epidemiology and Protozoa**<br>5. Epidemiology: General and landscape Malaria, Leishmania and filarial.<br>6. Nosology in relation to protozoa.<br>7. Leishmaniasis with reference to drug resistance.<br>8. Immunity in human trypanosomiasis | 8<br>4<br>5<br>5 |
| **ZET 302: ENTOMOLOGY** | **Point 50 Lectures** |
| **Unit I: Reproduction and Development**<br>1. Different types of. reproduction , and accessory reproductive organs.<br>2. Castration, oviposition, factors controlling fertility and fecundity<br>3. Metamorphosis<br>a) Types of metamorphosis,<br>b) Role of hormones in metamophosis,<br>c) Reversal of metamorphosis,<br>d) Prothetely and metathetely.<br>4. Hormonal control of reproduction<br>5. General idea (Up to the formation of three germinal layers) on embryonic development<br>**UNIT II: Insect response and behavior**<br>1. Parental care: Types; examples.<br>2. Polymorphism:<br>a) Polymorphism and polyphenism; examples from different orders; significance.<br>b) Polymorphism in aphids: significance; factors controlling polymorphism.<br>3. Insect predation and parasitism:<br>a) Prey and host location,<br>b) acceptance,<br>c) manipulation,<br>d) selection and specificity of host/prey.<br>4. Insect societies:<br>a) Subsociality and eusociality:<br>b) Evolution of eusociality<br>5. Insect defence: Defence by hiding, secondary lines of defence, mechanical defence; chemical defence (classification, nature and source of chemicals); defence by mimicry; collective defence. | 4<br>4<br>8<br>4<br>8<br>2<br>4<br>4<br>4<br>4<br>4 |
| **ZET 302: CELL AND DEVELOPMENT BIOLOGY** | **Point 50 Lectures** |
| **Unit-I**<br>**Developmental ramifications**<br>1. Morphogenesis: Meaning of morphogenesis, morphogenetic processes, cell shape, Cell death, morphogenetic movements, cell sorting, morphogenetic field, regionalization.<br>2. Teratogenesis: Genetic teratology, Environmental teratology, Developmental mechanism, Contribution of teratology to Developmental Biology.<br>3. Ageing: Cellular basis of aging, Causes of aging, Free Radical Theory of Aging, Ageing of connective tissue | 9<br>7<br>9 |

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|---|---|
| **Unit-II**<br>**Differentiation**<br>4. Differentiation:<br>i) Processes, determination, induction, competence, mechanism of differentiation,<br>ii) Reversibility of differentiated state, criteria for dedifferentiation, metaplasia and transdifferentiation, modulation.<br>5. Neural crest cell migration basnd differentiation<br>6. Cartilage:<br>a. Structure, differentiation.<br>b. Experimental induction of cartilage and proteoglycan synthesis | 5<br>5<br>5<br>5<br>5 |

**ELECTIVE LAB**

| **FISH AND FISHERIES** | |
|---|---|
| **ZEP 301:LAB** | **Point 30** |
| 1. Assessment of Field studies (Fish Farm, Market, Co-operative societies etc.)<br>2. Limnological parameters of water:<br>Organic carbon, Plankton, Algal Blqom, Bottom Biota<br>3. Preparation of pituitary extracts and induced breeding.<br>4. Identification of fish | |
| **ZES 301: Seminar** | **Point 20** |

| **CYTOGENETICS AND MOLECULAR BIOLOGY** | |
|---|---|
| **ZEP 301:LAB** | **Point 30** |
| **1.** Somatic meiotic chromosome preparation of mouse and/or fish by air drying technique and study of chromosome aberration.<br>2. Setting up of genetic crosses and solving genetical problems.<br>3. PCR analysis, RFLP/RAPD- genetic polymorphism ( demonstration)<br>4. DNA gel, Southern blot (demonstration) | |
| **ZES 301: Seminar** | **Point 20** |

| **ENDOCRINOLOGY AND REP BIOLOGY** | |
|---|---|
| **ZEP 301:LAB** | **Point 30** |
| 1 . Preparation of cryo-cut sections and histochemical demonstration of lipid / cholesterol / 3P-HSD in adrenal of mammal / bird<br>2. Chromaffin reaction in the section of adrenal gland of bird.<br>3. Effect of epinephrine on blood glucose levels in rat.<br>4. Demonstration of steroid RIA/ELISA<br>5. Thjyroid and adrenalectomy in mice/rat<br>6. SDS-PAGE for separation of protein<br>7 Assay of protein phosphorylation catialysed by cAMP dependent protein kinase. | |
| **ZES 301: Seminar** | **Point 20** |

| PARASITOLOGY AND IMMUNOLOGY | |
|---|---|
| **ZEP 301:LAB** | **Point 30** |
| 1. Standardization of Microscope; Drawings of protozoan to scale: of protozoan specimen, measurements<br>2. Fixation,staining and identification of a cephaline gregariana of annelid & insect<br>3. Blood parasites of birds and fishes<br>4. Myxozoan parasites of fishes.<br>5. Ciliate parasites of fishes.<br>6. Coccidia of birds<br>7. Parasites of toads and frogs<br>8. Disease transmitting arthropod parasites<br>9. Identification | |
| **ZES 301: Seminar** | **Point 20** |
| **ENTOMOLOGY** | |
| **ZEP 301:LAB** | **Point 30** |
| 1 Dissection: Cockroach (male reproductive, sympathetic), Blue bottle fly (digestive, nervous), Grasshopper (nervous, reproductive), Chrysocoris (digestive, nervous, reproductive), Honey bee (digestive, nervous, reproductive, sting apparatus), wasp (digestive, nervous, sting apparatus), Butterfly (digestive, nervous, reproductive), Housefly (digestive, nervous), Mosquito (digestive). Termite (digestive) (subject to availability of specimens).<br>2. Mounting: Types of antenna, genitalia, wings, legs, mouth parts, tympanum, internal organ system of available insects.<br>3. Morphometry: I) use of micrometers, ii) use of camera lucida.<br>4. Taxonomic key preparation 5 Physiological experiments:<br>i) Estimation of digestive and other enzymes<br>ii) Studies on haemocytes<br>iii) Determination of chitin.<br>6. Toxicology: i) Toxicological appliances (sprayers, dusters etc) | |
| **ZES 301: Seminar** | **Point 20** |

| CELL AND DEVELOPMENTAL BIOLOGY | |
|---|---|
| **ZEP 301:LAB** | **Point 30** |
| 1 Separation methods:<br>a) Electrophoresis: SDS-PAGE for separation of proteins.<br>b) Agarose gel electrophoresis separation of RNA<br>2. Methods of measurement (Colorimetric)<br>i) Estimation of carbohydrates by anthrone method<br>ii) Quantitative estimation of glycogen<br>iii) Quantitative estimation of proteins by Folin-Lowry method:<br>a) Preparation of standard curve<br>b) Estimation of unknown protein<br>3. Nucleic acid isolation :<br>a) Isolation of RNA and its quantitative measurement<br>b) Isolation of DNA and its quantitative measurement<br>4. Determination of viscosity of unknown solution | |
| **ZES 301: Seminar** | **Point 20** |

## SEMESTER -IV

## HARD CORE THEORY PAPERS

| ZHT-411 : ANIMAL BEHAVIOUR AND VECTOR BIOLOGY | Points 75 |
|---|---|
| **ANIMAL BEHAVIOUR** | **Point 38 Lectures** |
| 1. Introduction to animal behavior : History, foundation, approaches and methods | **5** |
| 2. Learning and memory : Forms of learning, learning and habitat selection - migration, navigation and orientation | **8** |
| 3. Kinship: Relatedness, inclusive fitness? selfishness, altruism | **6** |
| 4. Conflict: Sexual selection, aggression, competition dominance, Infanticide. | **6** |
| 5. Communications: Channels, functions, origin and modification of signal, signal receiving mechanism. | **7** |
| 6. Evolution of feeding behavior: optimal foraging theory. | **6** |
| **VECTOR BIOLOGY** | **Point 37 Lectures** |
| Life cycle, mode of transmission, control and importance of: | |
| 1. Anopheles sp., Culex sp., Aedes sp. | 7 |
| 2. Ticks and mites. | 6 |
| 3. Sand flies | 6 |
| 4. Tabanid fly | 6 |
| 5. Black fly | 6 |
| 6. Flea | 6 |

| ZHT-412: MOLECULAR BIOLOGY AND BIOTECHNOLOGY AND TOOLS AND TECHNIQUE | Points 75 |
|---|---|
| **MOLECULAR BIOLOGY AND BIOTECHNOLOGY** | **Point 38 Lectures** |
| 1. Regulation of gene expression at transcription & translational level.<br>2. protein synthesis: Translation; Post-translational changes; signal and leader sequences.<br>3. Recombinant DNA technology: Restriction enzymes and restriction mapping, Methods of gene sequencing ,cloning of genes ; cDNA technology; vetors of gene transfer; expression of foreign-genes in host.<br>4. Transgenic animals | **10**<br>**10**<br>**10**<br>**8** |
| **TOOLS AND TECHNIQUE** | **Point 37 Lectures** |
| 1. Techniques for Cell Study:<br>i) Fluorescent Microscopes, Phase Contrast Microscopy, Dark- Field Microscopy.<br>ii) Electronic Imaging Systems- Electron Microscopy, TEM Vs. SEM.<br>2. Cell Fractionation Methods:<br>i) Preparative Ultracentrifugation<br>ii) Gradient Centrifugation<br>3. Separation of Cell Costituents:<br>i) Gel filtration Chromatography<br>ii) Electrophoresis-PAGE, SDS-PAGE (One and Two dimentional).<br>4. Spectroscopy: Spectrophotometer.<br>5. Blotting Methods: Southern, Northern & Western blotting<br>6. Pesticide formulation. | <br>4<br>8<br>7<br><br><br>8<br><br><br>4<br>3<br>3 |

**SOFT CORE THEORY**

| **ZST 407: AGRICULTURAL ENTOMOLOGY** | **Point 25 Lectures** |
|---|---|
| **1.** Important insect pests (names only) of: Tea, Vegetables ,Paddy and Sugarcane and damages caused by them | 4 |
| 2. Morphology, bionomics and management of:<br>i) Ricebrown plant hopper (*Nilaparvata lugens)*<br>ii) Sugar cane top borer (*Scirpophaga nivella)*<br>*iii)* Tea mosquito bug *(Helopeltis theivora)*<br>*i)* Brinjal fruit and shoot borer *(Leucinodes orbonalis)* | 7 |
| 3. Plant protection techniques | 5 |
| 4. Natural enemy diversity of agricultural pests in India and their potentiality | 3 |
| 5. Economic decision levels for pest population;<br>a) Concepts of economic levels<br>b) Dynamics of economic injury levels<br>c) Calculation of economic decision levels using economic levels | 6 |
| **ZST408: CANCER BIOLOGY** | **Point 25 Lectures** |
| 1. Major causes of cancer: carcinogens; chromosome and genetic abnormalities associated with cancer | 10 |
| 2. Oncogenes and genetic causes of cancer; tumor suppressors and apoptotic genes | 5<br>5 |
| 3. Diagnosis and treatment: Gene therapy; drug delivery problems; | 5 |
| 4. Concept of nanotechnology and nanomedicine | |
| **ZST409: MEDICAL EMBRYOLOGY** | **Point 25 Lectures** |
| 1. Medical implications : Infertility- Diagnostic infertility, causes of infertility | 3 |
| 2. Assisted Reproductive Technologies : Sperm and ova bank; Artificial Insemination donor (AID); in *vitro* fertilization (IVF), procedures, variations of IVF, Success rates and complications; Gamete Intrafallopian transfer (GIFT), Intracytoplasmic sperm Injection (ICSI), Surrogate mothers. | 7 |
| 3. Genetic errors of human development- Down syndrome, Fragile X syndrome. | 5 |
| 4. Future of medicine: Differentiation therapy, gene therapy *(Ex Vivo* and *In vivo),* germ line gene therapy. | 5 |
| **5.** Techniques used in Medical Embryology : i) Amniocentesis ii) Chorionic villus sampling iii) Ultrasonography iv) DNA Finger | 5 |

| ZST 410: AQUACULTURE TECHNOLOGY | Point 25 Lectures |
|---|---|
| 1. Stock Improvement<br>Induced breeding and bundh breeding, sex reversal and sterility, Selective breeding, Androgenesis and Gynogenesis, Polyploidy, Hybridization, Shell fish reproduction : Endocrine control of reproduction , role of neurotransmitters. | 10 |
| 2. Non conventional aquaculture technology Raceways and recirculatory system, Cages and pen culture,<br>Wastewater aquaculture Organic aquaculture | 5 |
| 3. Coastal aquaculture:<br>Status of coastal aquaculture in India, Culture of prawn : major cultivable species, techniques of larval rearing, growout Technology.Culture of shrimp: major cultivable species<br>Reproduction and rearing<br>Grow out of shrimp | 10 |

| ZST 411: HORMONE AND SIGNAL TRANSDUCTION | Point 25 Lectures |
|---|---|
| **1**. Signaling molecules and cell surface receptors | 4 |
| 2. Subclasses of nuclear receptor ligand, Nuclear Receptor Signaling Mechanism | 4 |
| 3. G-protein coupled receptors and their signaling | 4 |
| 4. Receptor Tyrosine Kinase | 4 |
| 5. Cytokine Receptor | 4 |
| 6. MAP kinase pathway, multiple MAP kinase pathway | 5 |

| ZST 412: PARASITE AND DISEASE | Point 25 Lectures |
|---|---|
| **ZOT-412. Parasites and Diseases** | **Marks 20** |
| 1. Primary amoebic meningoencephalitis. | 4 |
| 2. Important Myxozoan genera of fishes - Structure and life history of any *Myxobolus* sp. | 4 |
| 3. *Entamoeba histolytica* and amoebiasis of man. Important genera of fish parasitic ciliates - *Icthyopthirius* sp. | 4 |
| 4. Some common helminthes of freshwater fishes and their life cycle patterns: a) *Proteocephalus* sp., *b)Camallanus* sp. | 4 |
| 5. Structure, Pathobiology prophylaxis and diagnosis of causative agents of filariasis . | 4 |

**HARD CORE LAB**

| ZHL 411: ANIMAL BEHAVIOUR AND VECTOR BIOLOGY | Point 25 |
|---|---|
| **Animal Behavior**<br>**1.** Demonstration of behavioral change of fish /chick in relation to toxicant / chemicals.<br>2. Study of habituation to light stimulus in the earthworm.<br>3. Demonstration of photo tactic response of house fly. | Point 12.5 |
| **Vector Biology**<br>4. Mouthparts of Anophees mosquito and Tabonid fly<br>5. Mothparts of Culex mosquito<br>6. Mouthparts of Aedes fly<br>**7.** Whole mount of Ticks and Mites | Point 12.5 |
| **ZHL 412: MOL BIOLGY AND BIOTECHNOLOGY AND TOOLS & TECHNIQUE** | **Point 25** |
| **Molecular Biology and Biotechnology**<br>1. Setting up and solving of genetic crosses<br>2. Demonstration of human chromosomes and preparation of karyotypes<br>3. Demonstration of short term tissue culture.<br>4. Identification of meiotic and mitotic stages of mice | Point 12.5 |
| **Tools and Techniques**<br>1. Centrifugation technique: Differential centrifugation for separation of nuclei, cell debris, mitochondria.<br>**2.** Colorimetric estimation of Protein, DNA/RNA<br>**3.** Demonstration of PAGE | Point 12.5 |

**ELECTIVE THEORY-I**

| ZET 403: FISH AND FISHERIES | Point 50<br>Lectures |
|---|---|
| **Unit-I**<br>**Fishing crafts and** gears | |
| 1 . Crafts: Terminology of fishing boats; Inland and Marine crafts, types, mechanization of crafts, trawlers, techniques of trawling. | 8 |
| 2. Gears: Basic knowledge of mesh aid knots, fishing gear materials, different types of nets and their operation, Rods and lines. | 8 |
| 3. Responsible fish harvesting system. | 8 |
| **Unit-II**<br>**Post harvest technology** | |
| 1 . Spoilage of fish- microbial changes, changes in amino acids, protein, oil, Breakdown products, rigor mortis | 8 |
| 2. Preservation, processing and curing offish. | 8 |
| 3. Fish by products. | 10 |

| ZET 403: CYTOGENETICS AND MOL.BIOLOGY | Point 50 Lectures |
|---|---|
| **Unit I**<br>**Recombinant DNA technology**<br>**1** Recombinant DNA technology: enzymes used in molecular cloning; cloning vectors; construction, screening and expression of genomic and cDNA libraries; identification of recombinant clones; RFLP and RAPD; gene cloning in eukaryotes; gene transfer in animals and transgenic animals<br>2. Application of recombinant technology: In research, medicine, agriculture other commercial and industrial application; application against AIDS<br><br>**Unit II**<br>**Transposons and Extra-nuclear inheritance**<br>**1.** Mobile genetic elements: Characteristics of transposable elements in prokaryotes and eukaryotes; AC/DS system in maize; P element in *Drosophila;* Salmonella phase variation; retrosposons<br>**2.** Extra-nuclear inheritance: Streptomycin resistance in chlamydomonus; Kappa particles; criteria for extra-chromosomal inheritance, infectious heredity. | 12<br>8<br><br>12<br>18 |
| **ZET 403: ENDOCRINOLOGY AND REP BIOLOGY** | **Point 50 Lectures** |
| **Endocrinology and Reproductive Physiology**<br>**Unit-I**<br>1. Hormonal regulation of spermatogenesis<br>2. Suppression of testicular activity by steroidal and non-steroidal agents<br>3. Role of carbohydrate and lipids in sperm energetics<br>4. Biosynthesis and regulation of testosterone. | 6<br>6<br>6<br>6 |
| **Unit-II**<br>1. Structural organization of mammalian ovary; physiology, hypothalamic regulation and function.<br>2. Regulation of ovarian follicular development in primates: follicular growth; factors regulating follicular growth; pattern of follicular atresia; follicular selection and dominance.<br>3. Endocrine role in normal development of breast and lactation.<br>4. Endocrinology of pregnancy | 6<br>6<br>6<br>8 |
| **ZET 403: PARASITOLOGY AND IMMUNOLOGY** | **Point 50 Lectures** |
| **Unit-I**<br>**Biology of Parasitic Protozoa**<br>1. Structure and biology of *Trichomonas vaginalis*<br>*2.* Structure and biology of *Trypanosoma evansi* and Surra disease<br>3. Structure, life-cycle, pathology and Control of Myxozoa in fishes and | 5<br>5 |

| | |
|---|---|
| Microspora in insects | 5 |
| 4. General consideration of amoebae in man | |
| 5. Coccidia and coccidjosis in birds (with special reference to *Eimeria tenella)* | 5 |
| | 5 |
| **Unit-II** | |
| **Zoonosis and vector biology** | |
| 6. Avian and simian malarial parasites. | 5 |
| 7. Comparative characterization of human malaria parasites | |
| 8. Zoonoses with special reference to Japanese Encephalitis and Toxoplasmosis | 5 |
| | 5 |
| 9. Ultra structure of Trypanosomes | |
| 10. Structure, biology and control of: Sand fly, anopheles, tick. | 5 |
| | 5 |

| **ZET 403: ENTOMOLOGY** | **Point 50 Lectures** |
|---|---|
| **Applied Entomology** | |
| **Unit-I** | |
| **Insects of Agricultural and Medical Importance** | |
| 1. Morphology, life history and control of major pests of (two of each): Cotton, mango | 4 |
| | 4 |
| 2. Morphology, biology of gall insects (only two sp.) and their control; mechanism of gall formation; significance of gall formation; gall -insects association | |
| 3. Locust: different sp., their distribution, biology and control | 4 |
| 4. Role of insects and acarine in transmission of human diseases | |
| 5. Life history, structures involved and mode of transmission of diseases by the *Xenopsylla cheopis* . | 4 |
| 6. Medicinal insects. | 4 |
| 7. Biological note on Dengue ( Vector and pathogen ); Mode of transmission and symptoms | 4 |
| **Unit-II** | |
| **Insect management** | 4 |
| **1.** Chemical insecticides: classification, properties, pharmacology and mode of action of some commonly used insecticides. | 4 |
| 2. Chemosterilants and hormonal analogues | |
| **3.** Fumigants: Chemical nature, properties, toxicity, mode of action, application and operational precautions. | 4 |
| 4. Biological control: classification, ecological consideration, bioagents, method of bioagerit introduction; examples: merits, demerits | 4 |
| 5. Antifeedants, attractants, repellejits and biopesticides: uses, | 4 |

| | |
|---|---|
| advantages and disadvantages.<br>6. Integrated pest management: importance; components;phases; method of implementation; Example; merits and demerits | 4<br><br>2 |
| **ZET 403: CELL AND DEVELOPMENT BIOLOGY** | **Point 50 Lectures** |
| **Unit-I**<br>**Paradigm of gene expression**<br>**1.** Nucleocytoplasmic interaction in '<br>i) In early development; Importance and role of cytoplasm, biochemical evidence for functional state of genome, hybridization experiments, nature of changes in nuclei, cell hybridization and nuclear transplantation experiments<br>2. Biological specificity : Transplantations and rejection<br>**Unit-II**<br>**Growth and regeneration**<br>**1.** Growth: Definition, Relative growth of parts, growth gradients<br>2. Regeneration: origin of regenerating cells and their potentialities, Field action in regeneration<br>3. Proteins during development:<br>i) Lens crystalline: Classification, ontogeny of crystalline in fish, chick and mammals<br>ii) Hemoglobin: structure, heterogeny and ontogeny<br>iii) LDH : structure, function, ontogeny, heterogeny, control of isozyme patterns<br>4. Statistics in biology :<br>i) Test of hypothesis: Chi- square test, Paired 't' – test<br>Non-parametric tests : Spearman's Rank correlation, Wilcoxon Signed Rank test. | 8<br><br>8<br>8<br><br>8<br><br>8<br><br>10 |

**ELECTIVE THEORY-II**

| **ZET 404: FISH AND FISHERIES** | **Point 50 Lectures** |
|---|---|
| **Unit-I**<br>**Marine Fisheries**<br>1. Survey of marine fisheries: offshore, deep sea, divisions<br>2. Coastal fisheries: Coastal zones, features, EEZ,CRZ.<br>3. Bionomics and production of Sardines, Mackerel, Pomfret and Bombay ducks<br>**Unit-II**<br>**Marketing and conservation**<br>1. Marketing: fish markets in India, strategy, structure, price formation.<br>2. Cooperative societies: principle, organization and function.<br>3. Conservation of fisheries: Declining stock, endangered fish fauna of India, causes of decline, methods of conservation, fisheries act, environment act. | 8<br><br>8<br>8<br><br>8<br>8<br>10 |

| ZET 404: CYTOGENETICS AND MOL.BIOLOGY | Point 50<br>Lectures |
|---|---|
| **Unit I**<br>**Genomics and Proteomics**<br>1. An overview of genomics and proteomics<br>2. Structural genomics: High resolution chromosome map-RFLP RAPD, fluorescence in situ hybridization; radiation hybrid mapping ; physical mapping of genomes ; genome sequencing<br>3. Functional genomics: Study of gene interaction by the yeast two hybrid system; study of developmental regulation by using DNA-chips<br>**Unit II**<br>**Population genetics**<br>1. Inbreeding and heterosis: measurement of inbreeding; panmictic index, inbreeding depression; heterosis; theories of heterosis.<br>2. Genetic structure of populations: Fisher's fundamental theorem of natural selection; genetic variability in natural population; genetic homoeostatis; genetic load and genetic death.<br>**3.** Speciation and evolution at the molecular level: evolution of proteins and nucleotide sequences; regulatory genes and some evolutionary consequences; molecular evolution in the test tube; evolution of genetic systems.<br>**4.** Gene frequencies and equilibrium: gene frequencies; gene frequencies, gene pool, conservation of gene frequencies. | **8**<br>**8**<br>**8**<br>**8**<br>**8**<br>**4**<br>**6** |

| ZET 404: ENDOCRINOLOGY AND REPRODUCTIVE BIOLOGY | Point 50 Lectures |
|---|---|
| **Unit - I** | |
| 1. Infertility in males and females and their remedial measures. | **5** |
| 2. Induction of ovulation and spermeation: Oocyte and sperm maturation substances ; their probable mode of action. | **5** |
| 3. Role of anti-estrogen and anti-androgen in the induction of ovulation and spermeation. | **5** |
| 4. Fertility control i) ovulation suppression by oral and injectable steroidal contraceptive ii) use of implants and IUDs. | **5** |
| **Unit - II** | **5** |
| 1. Impacts of temperature, photoperiod and other factors in the growth, development and functions of gonads. | |
| 2. Role of pineal in the mediation of photothermal effects on reproduction. | **5** |
| 3. Status of thymus as an endocrine organs : chemical nature and biosynthesis of thymic hormone and their probable role. | **5**<br>**7** |
| 4. Neuro endocrine-immune interactions: chemical nature and signaling of cytokines; neuron endocrine regulations of immune processes. | **8** |
| 5. Immunoregulatory effects of some endocrine substances Glucocorticoids, HCG and neuropeptides | |

| ZET 404: PARASITOLOGY AND IMMUNOLOGY | Point 50 Lectures |
|---|---|
| **Unit-1** | |
| **Parasite physiology, biochemistry** | |
| **1.** Membrane transport mechanism in parasites. | **6** |
| 2. Reproductive physiology in parasites. | **6** |
| 3. Energy metabolism in parasitic protozoa and helminths | **6** |
| **Unit-II** | |
| **Immunoparasitology** | |
| 4. Principles of immunity in relation to virus, bacteria, protozoa, helminths | **6** |
| 5. Structure and function of antibody | **6** |
| 6. T-cell receptor organ and functions of immune response | **6** |
| 7. Antigen-antibody reaction and its role in clinical parasitology | **6** |
| 8 Basic immunological changes due to parasitic infection, antigen vaccination, immunopathology | **8** |
| **ZET 404: APPLIED ENTOMOLOGY** | **Point 50 Lectures** |

| | |
|---|---|
| **Unit-I Plant protection and insect host relationship** | |
| 1. Plant protection appliances: sprayers and dusters; heir merits and demerits | **6** |
| 2. Insect and plant diseases: insect as vector , insect borne viruses causing plant diseases; insect yector-plant virus relationship. | **6** |
| 3. Insect plant interaction: a) mechanism of host selection (host habitat finding, host finding, host recognition; host acceptance); b) role of nutritional component in host selection; c) allelochemicals and host selection. | **6** |
| **4.** Co-evolution in insect and plant: types; co-evolution with pollinating insect; mimicry. | **6** |
| **Unit- II Population, forensic and soil entomology** | |
| 1. Principles of population studies:' sampling, objectives and practical application. | **6** |
| 2. Factors controlling population: abiotic (temperature, moisture, rain fall and photoperiodism), biotic (food and natural enemies) | |
| 3. Forensic entomology: types; importance of medico legal forensic entomology, stages of death; importance of insects in medico criminal investigation; estimation of time of death using insects; common arthropods associated with dead body; application and case study. | **6**<br>**6** |
| 4. Population study method: intrinsic rate of increase (rm); life table construction and its application. | **8** |
| 5. Soil insects: types; important role of edaphic factors (moisture, temperature and pesticide) on soil insects. | |
| **ZET 404: CELL AND DEVELOPMENT BIOLOGY** | **Point 50 Lectures** |
| **Unit-I**<br>**Cell Synchronization** | |
| 1. Physiology of cell division: Cell Cycle, synchrony in cell division, inhibition of cell division, source of energy. | **10**<br>**10** |
| 2. Cell signaling: General principles, role of cell surface receptors in cell 4 signaling. | **10** |
| 3. Cancer: Characteristics of tumor cells; Oncogenes and their proteins, classification and characteristics of chemical carcinogen; role of radiation and DNA repair in carcinogenesis. | |
| **Unit-II**<br>**Neurobiology** | |
| 1. Cell -cell adhesion: types of cell binding, adhesive proteins, their role in cell-cell interaction, morphogenesis, differentiation movement of leucocytes into tissues. | **10**<br>**10** |
| 2. Molecular neuron biology; General. organization of nerve fibers, Axon Ultra structure, Neurotubules and neurofilaments.Neurosecretary cell: Occurrence, staining behavior, neurosecretion in invertebrates | |

**ELECTIVE LAB**

| **FISH AND FISHERIES** | |
|---|---|
| **ZEL 402: Lab** | **Point 30** |
| 1. Physico-chemical analyses of soil: pH and available phosphate<br>2. Gut content analyses of fish<br>3. Feed formulation | |
| **ZES 402: Project / Review** | **Point 20** |

| **CYTOGENETICS AND MOLECULAR BIOLOGY** | |
|---|---|
| **ZEL 402: Lab** | **Point 30** |
| 1. Localization of Ag- NORs, C-heterochrornatin in mouse chromosomes<br>2. Isolation of membrane proteins from mammalian cells through different chromatographic techniques. Separation of proteins using native and SDS gel electrophoresis.<br>3. Demonstration of ELISA, tissue culture, cancer cell line<br>4. Model scientific paper writing general rules | |
| **ZES 402: Project / Review** | **Point 20** |

| **ENDOCRINOLOGY AND REPRODUCTIVE BIOLOGY** | |
|---|---|
| **ZEL 402: Lab** | **Point 30** |
| **1.** Bio-assay of LH by OAAD test<br>2. lipids steroid separation by TLC<br>3. Oocyte maturation in fish using germinal vesicle breakdown test by the induction of maturation-inducing steroid<br>4. Determination of the stages of spermatogenesis in rat testis by PAS-Haematoxyline technique, or Cyclic changes in the exfoliate cytology of vaginal epithelium in rat<br>5. Examination and submission of slide testis, ovary, epididymis, prostate and uterus and seminal vesicles | |
| **ZES 402: Project / Review** | **Point 20** |

| **PARASITOLOGY AND IMMUNOLOGY** | |
|---|---|
| **ZEL 402: Lab** | **Point 30** |
| l. Isolation and identification of peritoneal macrophages of rat.<br>2. Parasites of fishes<br>3. Identification of lymphoid tissue (spleen, thymus and lymph node, Bursa od Fabricious.) | |

| | |
|---|---|
| 4. Blood parasites of birds and fishes<br>5. Deposition of collected materials and laboratory note book | |
| **ZES 402: Project / Review** | **Point 20** |

| **ENTOMOLOGY** | |
|---|---|
| **ZEL 402: Lab** | **Point 30** |
| 1. **Study of field and stored grain insects (at least 10 examples)**<br>**2. Ecology:**<br>i) Ecological instruments<br>ii) Soil insects: a) Methods of extraction b) Sorting of material and their identification c) Plotting of results in tables and diagrams.<br>iii) Terrestrial insects : a) light trap b) net sweeping c) Aspirator method<br>iv) Determination of minimum size of a sample and number of samples for an experiment,<br>v) Estimation of population, frequency, relative density, abundance using Quadrate and Mark and release methods<br>vi) Determination of Diversity index of a field population,<br>vii) Estimation of nature of damage and loss of plants and produce.<br>3. **Biology and Life cycle:**<br>submission of life cycle of insects<br>4. **Taxonomy:**<br>Collection and identification of insects up to family<br>5 **Submission of field reports, Life cycles, specimens**. | |
| **ZES 402: Project / Review** | **Point 20** |

| **CELL AND DEVELOPMENTAL BIOLOGY** | |
|---|---|
| **ZEL 402: Lab** | **Point 30** |
| 1 . Study on development of chick embryo<br>2. Examination and submission of slides of chick liver, kidney, testis / ovary, brain of different stages of development.<br>3. Determination, of enzyme activity:<br>Effect of pH, Temperature, Substrate concentration and Time (Titration or Colorimetric method).<br>4 Study of proteins during embryonic development.<br>5 Review on recent developments in cell and developmental biology | |
| **ZES 402: Project / Review** | **Point 20** |