

# **DEPARTMENT OF ZOOLOGY**

**SYLLABUS FOR M.Sc. IN ZOOLOGY**

**(CHOICE BASED CREDIT SYSTEM)**

**W.E.F. 2015-16**



**RAJIV GANDHI UNIVERSITY**

**RONOHILLS: DOIMUKH**

## Back ground of the Department

The Department started in 1997. The course curricula in semester pattern were introduced in Zoology from the academic session 2000 – 01 and continued with the same system through several revisions till 2015. At present the faculty strength in the Department is nine with six numbers of Assistant Professor, and three numbers of Professors. The student strength is twenty five in each semester. The course structure is being followed and subsequently revised as per UGC guidelines and accordingly the Department introduced the **Choice Based Credits System** (CBCS) since 2015. The students are offered with five Departmental Elective Courses under current CBCS system during the 3<sup>rd</sup> and 4<sup>th</sup> Semester on the backdrop of distinguished expertise of the faculty members and launched one Open Elective Courses for the students of other Departments. The Department is also running M.Phil and Doctoral Programme as the regular academic activities and the students get admitted in the M.Phil and Ph.D programme through entrance test specially designed for the purpose. A Ph.D course work of one semester duration is mandatory for all the doctoral candidates in Ph.D programme of the department.

The Department of Zoology is actively involved in research in frontier areas of life sciences via several sponsored research projects since its inception. It has also been recognized as Center with Potential for Excellence in Biodiversity (CPEB) by the University Grants Commission, New Delhi since, 2003. The major research thrust under CPEB scheme includes (i) Validation of herbal reproductive medicines (ii) Wild life and avifauna (iii) Fisheries, fish biology and fish parasites (iv) Edible insects and insect fauna

March, 2016

Ronohills, Itanagar

Prof. D.N. Das

Head of the Department

## **REGULATIONS RELATING TO CHOICE BASED CREDIT SYSTEM**

Under the Credit Based Semester System (CBCS), the requirement for awarding and conferring a degree is prescribed in terms of number of credits to be completed by the students. Regulations on Choice Based Credit Systems (CBCS) of Rajiv Gandhi University apply to all postgraduate degree, diploma and certificate courses conferred by the Rajiv Gandhi University. The CBCS provides choice for the students to select from a pool of Open Elective Courses offered by other Departments/ Centres/Institutes.

### **1. COURSE OFFERED BY THE DEPARTMENT**

Usually a course refers to a ‘paper’ and is components of an academic programme. The Department of Zoology, RGU offers two years (4 semesters) M.Sc. programme consisting of **Core (C) courses, Departmental Elective (E) Courses and Open Elective (OE) Courses.**

**NOTE:** Each students has to register for one (1)open elective (OE) course during III Semester offered by other Department/Centers/Institutes. Students are not allowed to register for open elective (EO) course offered by the parent department.

### **2. REGISTRATION PROCESS FOR OPEN ELECTIVE COURSE**

**Step 1:** Immediately after joining M.Sc. programme, the student shall fill up **two copies** of open Elective course application for (Annexure II). Student advisor ( a faculty from the Department nominated by HOD) will advise and assist in choosing a suitable Open Elective Course.

**Step 2:** Copy 1 to be submitted to Head, Department of Zoology and copy 2 to be submitted to Department where the student is applying for open Elective Course.

**NOTE:** Late registration for open Elective Courses shall be allowed up to two weeks after the commencement of the semester.

### **3. WITHDRAWAL PROCESS FOR OPEN ELECTIVE COURSE**

Withdrawal from an open Elective course shall be allowed within two weeks from the date of commencement of classes.

### **4. COURSE CODING**

- The course offered by the department carry a three letter departmental code (ZOO) that is followed by a single letter code like **C** for Core, **E** for departmental Elective and **EO** for open elective. Next three digit number refers to course code series; 4XX for M.Sc. first year while 5XX for M.Sc. 2<sup>nd</sup> year. However, the code numbers of different E or EO courses serial of code will be changed accordingly by first digit ( 504....XO4 etc).
- The numbers of credits is given in the form of L: T: P: C, where L indicates the number of contact hours of lecture, and T the number of contact hours for tutorials, P stands for laboratory credits and C for total credit per course. Each lecture credit

corresponds to one lecture hour per week, while each laboratory credit corresponds to a 2-hour laboratory class. For example, 3:1:0:4 credit indicates that the course would have 3 lecture hours along with one tutorial session and no laboratory each week, while 1:1:2:4 credits indicates a course with one lecture hour, one tutorial session and two 2 hour laboratory.

### 5. GRADE POINT AND GRADE LETTER

| % of Marks       | Grade point | Grade letter               | Division |
|------------------|-------------|----------------------------|----------|
| 90-100%          | 10          | O (Outstanding)            | First    |
| 80-less than 90% | 9           | A <sup>+</sup> (Excellent) | First    |
| 70-less than 80% | 8           | A (Very good)              | First    |
| 60-less than 70% | 7           | B <sup>+</sup> (Good)      | First    |
| 50-less than 60% | 6           | B (Average)                | Second   |
| 45-less than 50% | 5           | P (Pass)                   | Pass     |
| 44% and less     | 0           | F (Fail)                   | Fail     |
| Absent           | 0           | AB (Absent)                |          |

### 6. SEMESTER GRADE POINT AVERAGE (SGPA)

Semester Grade point average (SGPA) is the sum of the products of the course credit and grade points scored by a student divided by the sum of all course credits in a semester. It can be calculated in the following manner.

$$SGPA (S_i) = \frac{\sum(C_i \times G_i)}{\sum C_i}$$

Where  $C_i$  is the number of credits of the  $i^{\text{th}}$  course and  $G_i$  is the grade point scored by the student in the  $i^{\text{th}}$  course. For example, an illustration of computation of SGPA is shown below:

| Courses in the Semester | Marks obtained (Internal Assessment + End semester exam) | Grade Letter   | Grade Point (G) | Credit | Credit Point $\sum CG$ |
|-------------------------|----------------------------------------------------------|----------------|-----------------|--------|------------------------|
| Course 1                | 78                                                       | A              | 8               | 3      | $3 \times 8=24$        |
| Course 2                | 65                                                       | B <sup>+</sup> | 7               | 3      | $3 \times 7=21$        |
| Course 3                | 82                                                       | A <sup>+</sup> | 9               | 4      | $4 \times 9=36$        |
| Course 4                | 49                                                       | P              | 5               | 4      | $4 \times 5=20$        |
| Course 5                | 53                                                       | B              | 6               | 5      | $5 \times 6=30$        |
|                         |                                                          |                |                 | 21     | 131                    |

Thus,

$$SGPA = \frac{131}{21} = 6.23$$

## 7. CUMULATIVE GRADE POINT AVERAGE (CGPA)

Cumulative Grade Point average (CGPA) is the sum of the products of the total number of credits of all courses taken by a student in a semester with the SGPA in that semester divided by the total number of credits of all courses taken in all four semester. It can be calculated in the following manner.

$$\text{CGPA} = \frac{\sum(C_i \times S_i)}{\sum C_i}$$

Where,  $S_i$  is the SGPA of the  $i^{\text{th}}$  Semester and  $C_i$  is the number of credits in that semester.

|                     | Semester I | Semester II | Semester III | Semester IV |
|---------------------|------------|-------------|--------------|-------------|
| <b>Total Credit</b> | 21         | 21          | 21           | 27          |
| <b>SGPA</b>         | 7.8        | 5.8         | 6.3          | 8.0         |

Thus

$$\text{CGPA} = \frac{21 \times 7.8 + 21 \times 5.9 + 21 \times 6.3 + 27 \times 8.0}{90} = 7.07$$

## COURSE STRUCTURE

- The listing of each course consists of the semester, course code, course title, the number of credits, the set of topics.
- Each course of theoretical nature with 4 credits consist 4 modules/ units while each practical paper is of 5 credits except one practical of 4<sup>th</sup> semester having 11 credits.
- In terms of marks, each course is of 100 marks; 20 marks for internal assessment and 80 marks in final examination. Each module/unit in a course of theoretical nature carries 20 marks.
- Each students of M.Sc. (Semester III and IV) shall have to opt for the respective Departmental combinations of Elective Courses (I, II, III and IV) of their chosen branch of specialization.
- Each students of M.Sc. Semester IV shall have to opt for project work and Seminar along with lab activities and literature survey. Project work would be assigned by Elective course in-charge on merit basis and total number of students (seat capacity) for each Departmental elective (E) courses would be decided at the departmental level.
- For project work, the area of the work would be to be decided by the concerned course in-charge. On completion of the project work, students have to submit the work in the form of a dissertation followed by oral presentation ether in the presence of faculty members or external experts as decided by the department.

## **SEMESTER-I**

### **ZOOL C 401: Taxon, Phylogeny and Evolutionary Biology**

**Total marks: 80 + 20 = 100**

**End semester examination=80**

**Credit=04**

**Internal assessment=20**

#### **UNIT 1:**

Concept of Systematics and Taxonomy; Importance and application of Taxonomy; Modern trends in systematic; Taxonomic characters – morphological, ecological, ethological, geographical, biochemical and molecular characters; Characters with high and low taxonomic weight; Theories of classification.

#### **UNIT 2**

Species concept- Typological, Biological and Evolutionary species concept; Merits and difficulties in applying biological species concept; Subspecies, Race, Cline, Inceptient species; Principles of Zoological Nomenclature; International code for Zoological Nomenclature

#### **UNIT 3**

Origin of life: Concept of prebiotic environment; Neo-Lamarckian and Neo-Darwinian theory of evolution; Forces of evolution – mutation, selection, random genetic drift and migration; Speciation: Mode of speciation and factors responsible for speciation; Hardy-Weinberg law.

#### **UNIT 4**

Genetic polymorphism (DNA) and natural selection, selection coefficient; C-value paradox and Genomic evolution; Evolutionary history of proteins and nucleic acids; Concept of molecular clock; Molecular phylogenetics

## **SEMESTER-I**

### **ZOOL C- 402: Cell Biology & Histology**

**Total marks: 80 + 20 = 100**

**End semester examination=80**

**Credit=04**

**Internal assessment=20**

#### **Unit 1**

Structure chemical composition and function of cell membrane ;  
Membrane transport: diffusion osmosis, ion channels and active transport  
Nucleus, Organization of chromosome in nucleus and structure of nucleosome  
Structural organization of nuclear membrane; Structure and diversity of microtubules and microfilaments

#### **Unit 2**

Mitochondria – Structure; Glycolysis and Krebs cycle reactions and Electron transport chain. High energy phosphate compound, oxidative phosphorylation.  
Structure and Functions of ER and Golgi, protein translocation, processing and glycosylation in endomembrane system; lysosomes and exocytosis  
Structure and Functions of Peroxisome, Ribosome

#### **Unit 3**

Cell Cycle- Mechanism and its regulation;  
Cell division: Mitosis, mitotic apparatus and Meiosis  
Characteristics and origin of cancer cells, oncogenes and chemical carcinogens, metastasis and angiogenesis  
Cell death pathway, apoptosis, apoptotic markers, benign and malignant tumors, characteristics of malignant tumors

#### **Unit 4**

Histological structures of epithelial tissue: characteristics, organization of epithelial cell and surface modifications,  
Muscle tissue: types, characteristics, & ultra structure and function;  
Connective tissue and bone – structure and function  
Neuronal anatomy: types, structure and function

## **SEMESTER-I**

### **ZOOL C-403: Animal Forms and Function**

**Total marks: 80 + 20 = 100**

**End semester examination=80**

**Credit=04**

**Internal assessment=20**

#### **UNIT 1**

Protozoan and helminthes parasites : *Plasmodium*, *Ascaris* and *Fasciola* - their life history, biology, mode of transmission and control. Molecular, cellular and physiological basis of host parasite interaction;

Mode of transmission of diseases by flies, lice and ticks- symptoms and control

#### **UNIT 2**

Characteristics and classification of Arthropods upto order. Insect morphology- structure and type of mouth parts, antennae and legs; Collection and Preservation of Insects.

Reproduction in insects & Metamorphosis, Exoskeleton in insects : types; Silk producing insects

#### **UNIT 3**

Development of osmoregulatory, circulatory systems in invertebrates. Neuroendocrine system in Invertebrates & Neurosecretory hormones-Allatotropin, allatostatin, prothoracicotropic hormone, Bursicon, proctolin, Ectonon hormones ;Diapause hormones-chemical structure and function

JH structure and function, JH as gonadotropin. Ecdysone-synthesis and metabolism. Ovarian ecdysone-structure and function

#### **UNIT 4**

Chordates: Characteristics; Classification of different phyla upto classes: Salient features with examples; Characteristics of Phylum Chordata; Classification of Chordates upto orders with examples. Comparative anatomy of circulatory systems in vertebrates; Development of brain and endocrine systems in vertebrates.



## **SEMESTER-I**

### **ZOOL C-404 Genetics & Developmental Biology**

**Total marks: 80 + 20 = 100**

**End semester examination=80**

**Credit=04**

**Internal assessment=20**

#### **Unit 1**

Ovulation, Oocyte maturation, formation of germinal vesicle and polar bodies  
Spermatogenesis, structure of sperm; Sperm acrosome reaction and fertilization;  
establishment of diploidy, zygote formation  
Nucleocytoplasmic interaction during zygote formation

#### **Unit 2**

Cleavage pattern and fate map; formation of morulla and blastula  
Gastrulation , formation of three germinal layers.  
Viviparity in mammals; development of extraembryonic membrane and formation of  
placenta in mammalian embryo; structure and types of placenta and its function  
Organogenesis in mammal : development of eye and heart

#### **Unit 3**

Mandelian Laws: Gene interaction; Extension of Mendelism -Dominance relationship,  
epistasis, pleiotropy. Expressivity and penetrance.  
Sex determination and Sex linked inheritance;  
Studies on metaphase chromosomes; linkage, crossing over and recombination  
Multiple allelism, pseudoallelism, polygenic inheritance/ interaction  
Extranuclear inheritance; mutations in mitochondrial DNA

#### **Unit 4**

Numerical & structural Changes in chromosomes (aneuploidy, euploidy, auto and allo  
polyploidy) ; chromosome anomalies & diseases;  
Human genome project : History, Organisation, Goal & characterization of chromosomes  
Drosophila embryogenesis & development; Zygotic genes and segment formation in  
drosophila  
Development of Caerhabditis elegans : genetic analysis of vulva formation

## SEMESTER-I

Total marks: 80 + 20 = 100  
End semester examination=80

Credit= 5 (L:T:P=0:0:5)  
Internal assessment=20

### ZOOC- 405: Practical

Total Marks: 100  
Time – 5 hrs

|                                                                                          |           |
|------------------------------------------------------------------------------------------|-----------|
| <b>A. Taxonomy/ Experiments/Demonstration/assay</b>                                      | <b>55</b> |
| 1. Identification and classification of Invertebrate and Vertebrate with reasons         |           |
| 2. Identification of economically important Insects and Fish.                            |           |
| 3. Study of Mouth Parts of Insects                                                       |           |
| 4. Study of blood film for plasmodium and trypanosome                                    |           |
| 5. Study of stored grain and agricultural pest (Tea, Rice, Maize and Citrus)             |           |
| 6. Taxonomic identification and morphological characteristics of Nematode and Helminths. |           |
| 7. Study of bar body                                                                     |           |
| 8. Karyotyping and differentiation of X and Y chromosome in drosophila                   |           |
| 9. Banding pattern and metaphase chromosome                                              |           |
| 10. Chromosomal aberration in human buccal epithelium of smokers                         |           |
| 11. Determination of banding pattern (G band) in metaphase chromosome)                   |           |
| 12. Preparation of meiotic/ mitotic chromosomes from grasshopper /tadpole /rat           |           |
| 13. Study of sex chromatin from buccal epithelium                                        |           |
| 14. Histological studies of important organ (Liver,G.I. Tract and Endocrine gland)       |           |
| 15. Study of histology through permanent slides (Liver, G.I. Tract and Endocrine gland)  |           |
| <b>B. Internal assessment</b>                                                            | <b>20</b> |
| <b>C. Practical record</b>                                                               | <b>10</b> |
| <b>D. Sessional submission</b>                                                           |           |
| (Slides and photographs of prepared slides)                                              | <b>05</b> |
| <b>E. Viva voce</b>                                                                      | <b>10</b> |



## **SEMESTER-II**

### **ZOOL 411: Ecology & Environmental Biology**

**Total marks: 80 + 20 = 100**

**End semester examination=80**

**Credit=04**

**Internal assessment=20**

#### **Unit 1**

Concept of Ecology.

Autecology and synecology; Ecosystem : structure & types

Trophic structure and function, Food chain, food web, ecological pyramids, ecological

Energy flow and productivity in the ecosystem

#### **Unit 2**

Population ecology: Population structure, growth and fluctuation.

Species interaction – interspecific and intra-specific competition, predation, parasitism, mutualism and commensalisms.

Community structures and stability and community succession

Ecological succession, Mechanism and causes of succession

#### **Unit 3**

Pollutants (Mercury, Arsenic, PAN, Lead, Organochlorine, CO<sub>2</sub>, Methane) and their effects on organism

Environmental impact assessment

Greenhouse effect and global warming

Concept of habitat loss and ecological balance

#### **Unit 4**

Major terrestrial Biomes: freshwater, forest- Vegetation types in Arunachal Pradesh, grassland and tundra

Environmental Biotechnology: Definition, Scope and role in environmental protection

Bioremediation and Eco-restoration: Definition and Scope

Concept of habitat and ecological niches; Niche overlap and species coexistence,

## SEMESTER-II

### ZOOL C-412: Endocrinology and Behavioral Biology

**Total marks: 80 + 20 = 100**

**Credit=04**

**End semester examination=80**

**Internal assessment=20**

#### **Unit 1**

Endocrine system in vertebrates; Hormones: Definition and types

Paracrine and autocrine action of hormone

Structure of hypothalamus & Pituitary in mammal; Hypothalamic and hypophyseal hormones;

Neurohypophyseal octapeptides : structure and function in vertebrates

#### **Unit 2**

Structure and physiological functions of steroid hormones

Mechanism of hormone action (steroid, peptide); hormone receptors and cell signalling

Hormones of metabolism: Thyroid and parathyroid hormones & Calcium metabolism

Endocrine pancreas & carbohydrate metabolism

Structural Organization of Adrenal gland; Physiological role of glucocorticoid,

Mineralocorticoid, catecholamine

#### **Unit 3**

Pineal gland and circadian rhythm, **Biological clock**

Courtship and mating behavior among birds and mammals: sexual selection, sexual behaviour in higher vertebrates; Pheromones in vertebrates and behavioral implications

#### **Unit 4**

Pattern of behavior -Innate behavior, Taxes, Kinesis, Reflexes

Territoriality, aggression and conflicts behavior

Threat display and **physiological changes** in conflict situation

Imprinting; Learning & motivation

Biological communication; Social behavior

## SEMESTER-II

### ZOOL C- 413: Physiology and Immunology

**Total marks: 80 + 20 = 100**

**Credit=04**

**End semester examination=80**

**Internal assessment=20**

#### **Unit 1**

Physiology of digestion and absorption of Macronutrients, balance diet  
Structure of GI tract :Gastro intestinal hormones and functions,  
Pattern of nitrogen excretion, Urea synthesis and formation of urine, Countercurrent mechanism and hormonal regulation of excretion.  
Thermoregulation, hibernation in vertebrates  
Physiology of Bioluminescence in invertebrates (Firefly) & vertebrates

#### **Unit 2**

Physiology of Reproduction in insects, sexual dimorphism, parthenogenesis  
Physiology of Reproduction in vertebrates: seasonal and nonseasonal breeders,  
Reproductive cycles, spermatogenesis & Oogenesis  
Physiology of respiration: Transportation of Oxygen and CO<sub>2</sub>, acid base balance  
Nerve impulse conduction through neurons and synapse, neuromuscular junctions  
High altitude acclimatization

#### **Unit 3**

Antigen: chemical nature, and antigenic determinants  
Antigen-antibody binding sites and reaction  
Immunoglobulin heterogeneity-Allotype, idiotype  
Antigen and Immunogen, Hapten  
Adjuvant- properties and mechanism of action  
Complement system activation: classical and alternate pathways

#### **Unit 4**

Cellular immunity: origin and maturation of T & B lymphocytes & their functions  
T-cell activation- molecular mechanism  
Allograft reaction, prevention of graft rejection  
Hybridoma and monoclonal antibodies-applications and therapeutic uses  
Hypersensitivity and autoimmunity-factors responsible for autoimmunity  
Histocompatibility antigen (MHC)-structure, Biological significance HLA antigens

## SEMESTER-II

### ZOOL C- 414: Biochemistry

**Total marks: 80 + 20 = 100**  
**End semester examination=80**

**Credit=04**  
**Internal assessment=20**

#### Unit 1

Water as solvent, Chemical bonds- Van- Der Waals, electrostatic, hydrogen bonding and hydrophobic interaction.

**Energy rich bonds**, coupled reaction, group transfers.

Concept of  $p^H$  and buffers, Handerson-Hasselbalch equation

Thermodynamic principle in Biology: free energy concept and calculation of free energy

Carbohydrate: Structure and nomenclature of monosaccharide and oligosaccharide and polysaccharides. Glycosidic bonds and glycosides; Gluconeogenesis;

#### Unit 2

Classification and chemistry of lipids; Biosynthesis and oxidation of fatty acids;

ketogenesis : formation and utilization of ketone bodies

Protein: Structure and properties of amino acid, formation of peptide bond.

Conformation of protein and polypeptide; Primary, secondary, tertiary and quaternary structures, prosthetic group and conjugated proteins

Ramachandran Plot

#### Unit 3

Enzyme classification and Nomenclature. Thermodynamic principle of enzyme catalysis and enzyme specificity. Enzyme-substrate complex. Active sites and allosteric site

Enzyme Kinetics: Michaelis- Menten Equation and its derivation

Various plots for determination of  $k_m$  and  $V_{max}$  and their physiological significance

Vitamins and coenzymes: Biological and biochemical functions

#### Unit 4

Nucleotides and nucleic acids : Structure of nucleotides

Properties of nucleotide bases, hydrogen bonding patterns in the base pairs

Amino acid – general properties, catabolism ; Biosynthesis of purines and pyrimidines

Transamination, deamination and decarboxylation

## SEMESTER-II

**Total marks: 80 + 20 = 100**  
**End semester examination=80**

**Credit= 5 (L:T:P=0:0:5)**  
**Internal assessment=20**

**ZOOL 415: Practical**

**Total Marks: 100**  
**Time – 5 hrs**

1. Water analysis (pH, dissolved oxygen, hardness, CO<sub>2</sub>, and alkalinity)
  2. Analysis of soil (pH, temperature, moisture, organic carbon, nitrate, phosphate and potassium)
  3. Calculation of diversity indices from a community
  4. Plankton analysis – quantitative.
  5. Study of action of salivary amylase on carbohydrate
  6. Separation of carbohydrate by paper chromatography
  7. Preparation of buffer (Acetate, phosphate and Hepes)
  8. Preparation of standard curve and estimation of carbohydrate
  9. Preparation of standard curve and estimation of protein
  10. Effect of substrate concentration of enzyme (Urease/ phosphatase) and find out its Km
  11. Determination of total count (RBC, WBC) and differential count (WBC) in Mammalian blood
  12. Determination of hematocrit in mammalian blood
  13. Estimation of blood glucose and cholesterol in mammalian blood
  14. Study of antigen - antibody interaction in vitro
  15. Study of B-lymphocytes in Bone marrow
  16. Blood Group and Rh factor
- |                                                                  |    |
|------------------------------------------------------------------|----|
| Internal assessment                                              | 20 |
| Practical record                                                 |    |
| 10                                                               |    |
| Sessional submission (slides and photographs of prepared slides) | 5  |
| Viva voce                                                        |    |





## SEMESTER-III

### ZOOC-501: Biological Techniques

**Total marks: 80 + 20 = 100**

**End semester examination=80**

**Credit=04**

**Internal assessment=20**

#### **Unit 1**

Microscopy: Fluorescence and phase contrast – Principles and application; TEM and SEM: Principles, sample preparation and use in biological science.

Principles and applications of Confocal microscopy

Spectroscopy: UV-VIS, IR, Atomic absorption spectroscopy and its application

Centrifugation: Principles, types and applications

#### **Unit 2**

Electrophoretic technique for protein and nucleic acid separation : SDS-PAGE agarose gel electrophoresis; isoelectric focusing

Principles and applications of gel filtration

Chromatography : Thin layered, Ion exchange and affinity chromatography;

HPLC & GC : Principles and applications

#### **Unit 3**

Principles and application of Radio tracer techniques

RIA, ELISA: Methods, principles and application in biological study

Basic histological techniques for paraffin embedded sections and cryosection; staining methods

Immunohistochemical studies : Basic principles; use of antibodies ; concept of primary and secondary antibodies; use of fluorescence tags

#### **Unit 4**

Principles and methods of nucleic acid extraction, amplification. Construction of cDNA libraries. RT-PCR and Q-PCR

Principles and techniques of In-situ hybridization of nucleic acids

Principles, methods and application of blotting techniques

Sequencing of protein (Edman's degradation, Sanger's method) and nucleic acids (Maxam – Gilbert and Sanger's method)

## **SEMESTER-III**

### **ZOOC-502: Molecular Biology**

**Total marks: 80 + 20 = 100**  
**End semester examination=80**

**Credit=04**  
**Internal assessment=20**

#### **Unit 1**

DNA and RNA as the genetic material, Physico-chemical properties of DNA.  
Organization of genome in prokaryotes and eukaryotes. Structure and forms of eukaryotic DNA, Chromatin structure & nucleosomes, DNA supercoiling,

#### **Unit 2**

DNA replication: mechanism of replication in prokaryotes & eukaryotes, Enzymes in replication.  
DNA Recombination: Molecular basis of recombination and genetic exchange, Chimeric DNA; Enzyme in recombination, homologous and site specific recombination; DNA methylation.

#### **Unit 3**

Transcription : RNA Polymerases in eukaryotes and prokaryotes; Types of RNA;  
Transcription in prokaryotes and eukaryotes,  
RNA processing and splicing; Catalytic RNA. Reverse transcription and its significance

#### **Unit 4**

Translation: Genetic code, Role of Ribosome and t RNA; Elongation and Termination in Prokaryote and Eukaryote.  
Genetics of Virus: Double and single stranded DNA and RNA virus  
Gene mutation and type. Mutagenesis: Type of mutation, molecular basis of mutation  
DNA damage and repair site directed mutagenesis.  
Regulation of gene expression in prokaryotes: Operon concept  
Attenuation and antitermination

## SEMESTER-III

Total marks: 80 + 20 = 100  
End semester examination=80

Credit= 5 (L:T:P=0:0:5)  
Internal assessment=20

ZOOCB- 503: Practical -III

Total Marks: 100  
Time – 5 hrs

|                                                                                                 |           |
|-------------------------------------------------------------------------------------------------|-----------|
| <b>A. Experiments/Demonstration/assay:</b>                                                      | <b>55</b> |
| 1. Separation of amino acids by TLC                                                             |           |
| 2. Colorimetric estimation of ammonia/ urea                                                     |           |
| 3. Extraction and estimation of protein from mammalian tissue                                   |           |
| 4. Subcellular fractionation of tissues by differential Centrifugation                          |           |
| 5. Demonstration of available instrument in the department                                      |           |
| 6. Study of cell viability using trypan blue                                                    |           |
| 7. Cytochemical localisation of nucleic acids, carbohydrates, lipids and enzymes (ALP)          |           |
| 8. Preparation of standard curve and estimation of Nucleic acids (DNA, RNA)                     |           |
| 9. Study of absorption spectra of protein and nucleic acids                                     |           |
| 10. Isolation of DNA from biological sample                                                     |           |
| 11. Digestion of DNA by RE and separation by agarose gel                                        |           |
| 12. Demonstration of PCR                                                                        |           |
| 13. Demonstration of ELISA                                                                      |           |
| 14. Blotting techniques (Southern blotting)                                                     |           |
| 15. Gram positive and gram negative Bacteria                                                    |           |
| 16. Molecular weight determination by SDS PAGE                                                  |           |
| <b>B. Internal assessment</b>                                                                   | <b>20</b> |
| <b>C. Practical record</b>                                                                      | <b>10</b> |
| <b>D. Sessional submission*</b><br>(Slides and photographs of prepared slides or field reports) | <b>5</b>  |
| <b>E. Viva voce</b>                                                                             | <b>10</b> |

- **Field study/visiting advance lab may be undertaken either inclusive of all 3<sup>rd</sup> semester students together or in groups of different Departmental Elective courses. Not conducted in the current semester as per last DBS resolution**



**DEPARTMENTAL ELECTIVE COURSES (PAPER- I)**

**Paper Codes: ZOOE-504/ ZOOE- 604/ ZOOE-704/ ZOOE-804/ZOOE-904/ZOOE-1004**

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**SEMESTER-III**

**ZOOE-504: Cell and Molecular biology –I**

**Total marks: 80+20=100**

**Credit = 04**

**End semester examination =80**

**Internal Assessment = 20**

**Unit 1**

Immuno-cytochemistry and FACS

Fluorescent In Situ Hybridization (FISH)

ELISA

PCR: Principle, Variance and Application in molecular diagnostic and taxonomy

**Unit 2**

Blotting Techniques (southern, northern and western blotting)

DNA microarray

DNA fingerprinting and foot prints, chromosome walking.

**Unit 3**

Principle of extraction of genomic DNA, RNA and total protein from cells/ tissues

Isolation of gene (Primer design, selection and gene amplification)

Enzymes and Vectors for cloning (plasmid: selection, isolation, natural and artificial)

**Unit 4**

Protein purification and sequencing of proteins

DNA sequencing (Edmann's degradation and Sanger's chain termination method)

Gene mapping (Genetic and Physical mapping)

**DEPARTMENTAL ELECTIVE COURSES (PAPER- I)**

**Paper Codes: ZOOE-504/ ZOOE- 604/ ZOOE-704/ ZOOE-804/ZOOE-904/ZOOE-1004**

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**SEMESTER-III**

**ZOOE-604: Molecular Endocrinology and Reproductive Biology –I**

**Total marks: 80+20=100**

**Credit = 04**

**End semester examination =80**

**Internal Assessment = 20**

**Unit 1**

Gland: Definition and different types (Endocrine and Exocrine)

Autocrine, Paracrine, Juxtacrine, Lumicrine mode of Hormone action

Structural and Function of Endocrine Glands in Mammals –Thyroid & Parathyroid-role in calcium metabolism.

Adrenals –structure & functions, Endocrine Pancreases-role in metabolism.

Gastro Intestinal tract hormones and its functions;Renin-Angitensin system-role in osmoregulation.

**Unit 2**

Hypothalamus –Structure, hypothalamic neutral centre; Hypothalamus hormones: Structure &

Function releasing and inhibiting Hormones; Pattern of hormone release: Pulsatile &Episodic;

Hypothalamus pulse generator and pulsatile release of GnRH, LH& FSH.

Structure of Pituitary: Cell types and hypophyseal hormones; Hypothalamus-Hypophyseal interrelationship .Structure and Function of hypophyseal hormones.

**Unit 3**

Biological clock and the pineal:Synthesis and Regulation of Melatonin

Neurotransmitters: Acetylcholine, Epinephrine Norepinephrine Dopamine, Serotonin, Somatostatin, Nitric Oxide (NO)

Biosynthesis of hormones (steroids, thyroid hormones & thyroid hormones binding proteins)

Eicosanoids, Structure of Prostaglandins (PGE<sub>2a</sub> and PGE), role in Reproduction

**Unit 4**

Cell signaling Mechanism :Receptors & Second messenger system ;GPCR,RTK,MAP kinase

Cascade ;Nuclear receptors and mechanism of action ;transcriptional factors

Receptors Assay and Receptors kinetics :scatchard analysis

Basis of siRNA and miRNA.

Endocrine disruptors (Environmental and Chemical); Hormone agonist and antagonist.

## DEPARTMENTAL ELECTIVE COURSES (PAPER- I)

Paper Codes: ZOOE-504/ ZOOE- 604/ ZOOE-704/ ZOOE-804/ZOOE-904/ZOOE-1004

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### SEMESTER-III

#### **ZOOE-704: Aquaculture and Fish Biology–I**

**Total marks: 80+20=100**

**Credit = 04**

**End semester examination =80**

**Internal Assessment = 20**

#### **Unit 1:**

Aquaculture: Concept; History, Status & Scope in India

Aquaculture Systems; Freshwater, Brackishwater & Marine

Taxonomy and Biology: Aquaculturally important fin fishes, shell fishes, algae, crustaceans

Identification of eggs, Juveniles of cultivable major carps and prawns

Methods in fish Identification: Diagnosis and Taxonomic description

#### **Unit 2:**

Food habits and feeding mechanisms in fishes

Digestive systems of Cultivable fishes; digestion and absorption

Concept of fish Nutrition and bioenergetics

Determination of age and growth of fishes

Length-weight relationship and condition Factor

#### **Unit 3:**

Fish Reproduction: Anatomy of Reproductive Systems

Reproductive Strategy: Modes of reproduction, Role of hormones in fish reproduction,

Fecundity, breeding and parental care in fishes

Developmental stages of carps and prawn: Embryo, hatching and metamorphosis

#### **Unit 4:**

Respiration: aquatic mechanism and aerial adaptation

Swim Bladder in fish: Structure and function

Comparative anatomy of hearts in fish, Fish blood

Excretion: Kidney, Osmoregulation; Fish migration



## DEPARTMENTAL ELECTIVE COURSES (PAPER- I)

Paper Codes: ZOOE-504/ ZOOE- 604/ ZOOE-704/ ZOOE-804/ZOOE-904/ZOOE-1004

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### SEMESTER-III

#### **ZOOE-804:– Ecology & wildlife Biology –I**

**Total marks: 80+20=100**

**Credit = 04**

**End semester examination =80**

**Internal Assessment = 20**

#### **Unit 1**

Concept of ecology-Autecology and synecology, structure and kinds of ecosystem, Energy flow model, Productivity of ecosystem, Laws of limiting factors law of minimum and Shelford's law of tolerance

#### **Unit2**

Habitat and niche, resource partitioning, species interaction, trophic structure-food chain and food web, Ecological pyramids, Ecological foot prints

#### **Unit3**

Concept of biogeography, zoogeographical zones in India and world. Ecogeographical rules, Ecological adaptation –mimicry and camouflage, major terrestrial biomes, Vegetation types in Arunachal Pradesh

#### **Unit4**

Concept of ecotoxicants and its effect on ecosystem, ecotoxicological monitoring and risk assessment, Concept of ecosystem restoration and restoration strategies, concern in restoration, restoration plan and rehabilitative measures

## DEPARTMENTAL ELECTIVE COURSES (PAPER- I)

Paper Codes: ZOOE-504/ ZOOE- 604/ ZOOE-704/ ZOOE-804/ZOOE-904/ZOOE-1004

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### SEMESTER-III

#### **ZOOE-904: Entomology –I ( Insect morphology, Ecology and Developmental Biology)**

**Total marks: 80+20=100**

**Credit = 04**

**End semester examination =80**

**Internal Assessment = 20**

#### **Unit 1:**

Origin and evolution of insects; Characteristics and classification of insects upto order; Taxonomic collection and preservation of insects; Insect morphology- structure and type of head, antennae, wings, leg and genitalia.

#### **Unit 2:**

Insect pollination; Strategies of adaptation in insects; Phenotypic plasticity in insects and endocrine control of insect polyphenism; Co-evolution plants and insects; Sampling methods for estimating population density; Molecular and neural control of insect circadian rhythms; Luminescence in fireflies; Biosensors on the basis of insect olfaction.

#### **Unit 3:**

Human disease vectors, major insect pests of rice, tea and maize and their control; Status of sericulture in Arunachal Pradesh; Silk gland development and regulation of silk protein gene; Biotechnologies based on silk; Diversity of honey bees in India

#### **Unit 4:**

Reproductive system in insects; Types of eggs, larvae and pupae; Development of *Drosophila melanogaster*; *D. melanogaster* mutants; Insect metamorphosis; Hormonal interactions during development; Regulation of insect development by TGF- $\beta$  signaling.

## DEPARTMENTAL ELECTIVE COURSES (PAPER- I)

Paper Codes: ZOOE-504/ ZOOE- 604/ ZOOE-704/ ZOOE-804/ZOOE-904/ZOOE-1004

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### SEMESTER-III

#### ZOOE-1004: Biochemistry & Nutritional Biology –I

**Total marks: 80+20=100**

**Credit = 04**

**End semester examination =80**

**Internal Assessment = 20**

#### Unit 1

Chemical interactions, electrostatics forces, covalent bond, non covalent bond,

Atomic weight, molecular weight, mole concept, density and specific gravity, solution concentration (Molarity, PPM, Mole fraction)

Acid base concept, pH, Hesselbach equation, Sorenson's, pH scale. Calculation related to buffer preparation.

#### Unit 2

Protein: factors influencing protein structure, forces stabilizing tertiary structure

Protein purification and amino acid sequencing

Prosthetic groups, conjugated protein, protein as enzyme

#### Unit 3

Kinetics and mechanism of enzyme action

Enzyme inhibition

Regulation of enzyme activities (Allosteric and covalent modification)

Carbohydrates of physiologic significance

Lipids of physiologic significance, membrane lipids

#### Unit 4

Informational macromolecules; structure and synthesis of nucleic acids

Isolation and purification of DNA and RNA

Nucleosome and DNA – protein interactions

Plasmid and colony hybridization

Concept of genomics, proteomics and metabolomics

## **ELECTIVE OPEN COURSES**

**PAPER CODES: ZOOEO-505/ ZOOEO-605/ ZOOEO-705/ ZOOEO-805**

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### **SEMESTER III**

#### **ZOOEO-505: Ecology and Biodiversity**

**Total marks: 80+20=100**

**Credit = 04**

**End semester examination =80**

**Internal Assessment = 20**

##### **UNIT 1. Ecosystem ecology**

Concept of ecosystem, ecosystem structure

Kinds of ecosystem, Energy flow

Productivity in ecosystem

Ecosystem services

Valuation of ecosystem

##### **Unit 2. Fundamentals of biodiversity.**

Concept of Biodiversity, level of biodiversity, Biodiversity hotspot

Biodiversity of the world, Eastern Himalayan Biodiversity hotspot

Threats to biodiversity, values of biodiversity.

IUCN red list categories and criteria, Red data book.

##### **Unit 3. Basic of wildlife biology**

Concept of wild life, wildlife of India

Threats to wildlife, threatened wildlife of India

Values of wildlife Conservation strategies of wildlife

Protected area network in Arunachal Pradesh

##### **Unit 4. Environmental law and organisation**

IUCN, WWF, UNCBD and CITES

Biological diversity Act 2002

Wild life protection Act 1972

Environmental Protection Act, 1986

EIA, Dams in Arunachal Pradesh

## SEMESTER-IV

### ZOOL C-511: Biostatistics, Biotechnology & Bioinformatics

**Total marks: 80 + 20 = 100**

**End semester examination=80**

**Credit=04**

**Internal assessment=20**

#### **Unit 1**

Concept of statistics-types of data, methods of data collection. Sampling technique ; classification and tabulation of data- diagrammatic and graphical representation of data. Measures of central tendency - mean, median and mode  
Measures of dispersion : , Standard deviation, Coefficient of variation (CV), Standard error of mean(SEM),

#### **Unit 2**

Probability distribution and its application in biological studies  
Test of significance- t- test, Chi square and Goodness of fit, F-test- Analysis of Variance (ANOVA)  
Correlation analysis ( Karl Perason's and Spearman's Rank) and Regression analysis.

#### **Unit 3**

Introduction to animal tissue culture : Principle of animal cell culture: Primary culture, cell line, and cell clones; Basic techniques in mammalian cell culture  
Types of growth media, component  
Transgenic animal-its application; Stem cell culture, applications in medicine and Biotechnology  
Cloning vectors ( Plasmid, cosmid, Phasmid) Lytic and Lysogenic cycle  
Genomics and proteomics-concept of transcriptome and proteome ; RAPD, RFLP, DNA fingerprinting and barcoding

#### **Unit 4**

Introduction & scope of bioinformatics,  
Knowledge discovery and data mining,  
Biological databases & bioinformatics, important servers in bio-informatics,  
Protein & nucleotide sequence databases,  
Access to molecular biology databases, Sequence alignment and phylogenetic trees,  
Application of available software (GENEIOUS pro.5.5, PHYLIP, SWISS pdbvor, LUSTAL W)

## **SEMESTER-IV**

### **ZOOL C- 512: Economic Zoology and Farm Development**

**Total marks: 80 + 20 = 100**  
**End semester examination=80**

**Credit=04**  
**Internal assessment=20**

#### **UNIT 1**

Animal farms : Maintenance of animal farms and animals : Cattle, Mithun, Yak, Sheep, Pig and Goat. Basic concept of their breeding and maintenance: animal products: meat, milk & skin. Vector borne human and farm animal diseases and their control measures, Drugs and vaccination against parasitic diseases : Infection in eye, brain, liver, intestine and blood

#### **Unit 2**

Basic concept : Inland fisheries, Marine fisheries & Aquaculture  
Sports and ornamental fishes. Problems of aquaculture : Fish parasites, identification, classification and control measure  
Natural breeding and induced breeding of Carps. Composite fish culture & Integrated farming ; Types of fish food: Natural food organisms and artificial fish feed.

#### **UNIT 3**

Major insect pests of rice, tea and maize: Biology, damage and their control; Defoliators and borers of forest trees and their control. Pests of crops and vegetables and its control. Different groups of pesticides and their mode of action;  
Pest Control: Mechanical, Biological, Genetical, Pheromonal, Insect growth regulators; Integrated Pest Management: Principle and strategies

#### **UNIT 4**

Sericulture in N.E. India, Mulberry and non-mulberry silk worms, their host plants, life history and commercial culture; Diseases of silkworm-Prophylaxis, symptoms and control; Apiculture - Different species of honey bees, Social organization, Life history, Commercial culture, Commercial products and Economic importance, Diseases of honey bee: prophylaxis, symptoms and control

## DEPARTMENTAL ELECTIVE COURSES (PAPER- II)

Paper Codes: ZOOE-513/ ZOOE- 613/ ZOOE-713/ ZOOE-813/ZOOE-913/ZOOE-1013

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### SEMESTER-IV

#### ZOOE-513: Cell and Molecular Biology –II

**Total marks: 80+20=100**

**Credit = 04**

**End semester examination =80**

**Internal Assessment = 20**

#### **Unit 1**

Genomic, Transcription and Proteomics

Gene therapy: concept and applications

Protein sorting, Post- translational modification of proteins

Molecular Chaperone and its role in protein folding

#### **Unit 2**

RNA types and expression

Transcriptional and post transcriptional control of gene expression

RNA interference technology and gene expression

#### **Unit 3**

Cell signalling: signalling molecules, receptors for signaling molecules, intracellular signalling pathways

Apoptosis and necrosis, mechanism of apoptotic cell death

Autophagy: concept and applications

#### **Unit 4**

Phagocytosis, complement activation

Humoral and cell mediated immunity

Immunosuppression and immunodeficiency

Interferon (IFN) and Tumour Necrosis Factor (TNF)

**DEPARTMENTAL ELECTIVE COURSES (PAPER- II)**  
**Paper Codes: ZOOE-513/ ZOOE- 613/ ZOOE-713/ ZOOE-813/ZOOE-913/ZOOE-1013**

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**SEMESTER-IV**

**ZOOE-613: Molecular Endocrinology and Reproductive Biology –II**

**Total marks: 80+20=100**

**Credit = 04**

**End semester examination =80**

**Internal Assessment = 20**

**Unit 1**

Mechanism and factors (hormonal and non-hormonal) of sex determination; Structure of Y chromosome, SRY gene and other genetic factors

Bipotential gonad; Differentiation of gonads and the genital tract during early embryonic development; factors of genital tract differentiation; source of AMH and its role

Sexual dimorphism of brain –role of gonads; Gonadal dimorphism-primary and secondary hermaphroditism

**Unit 2**

Maturation of hypothalamic-pituitary-gonadal interrelationship

Onset of puberty “The Gonadostat Hypothesis” Concept of Hormonal feed back regulation.

Pubertal activation of H-P-G hormonal axis and biosynthesis of hormones

Factors modulating timing of puberty-environmental factors somatic growth

Internal and external determination of timing of puberty

Brain and behavioral dimorphism: human and non human primates.

**Unit 3**

Mechanism of spermatogenesis, spermatogenic cycle; structure of mature sperm

Structure and function of Leyding cells and sertoli cells

Movement and maturation of sperm in genital tract (epididymis)

Molecular basis and biochemistry of Capacitation and Acrosome reaction; Fertilization and establishment of diploid

Male sterility: Azoospermia, Oligozoospermia, Asthenozoospermia, Varicocele

Sperm culture and Cryopreservation

**Unit 4**

Principles for study of hormones function in animals: Ovariectomy and castration

Principles for study of hormones function in vitro: Important cell line-Reporter gene and transfection in Reproduction technologies

Assisted reproductive techniques: Superovulation & Oocyte collection & culture; IVF and embryo transfer, Intracytoplasmic sperm injection (ICSI), Surrogacy, Gamete Intra-fallopian transfer (GIFT), Intrauterine Insemination

Embryonic stem cells (Generation of Transgenic animal); Basic of Knockout



## DEPARTMENTAL ELECTIVE COURSES (PAPER- II)

Paper Codes: ZOOE-513/ ZOOE- 613/ ZOOE-713/ ZOOE-813/ZOOE-913/ZOOE-1013

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### SEMESTER-IV

#### ZOOE-713: Aquaculture and Fish Biology–II

**Total marks: 80+20=100**

**Credit = 04**

**End semester examination =80**

**Internal Assessment = 20**

#### **Unit 1**

Construction & site selection of different types of ponds in a typical fish farm,  
Dyke and channel design; Water qualities, soil quality, and other biotic and abiotic  
Factors of pond;

Preparation of Nursery pond, Pre and Post stocking management

#### **Unit 2**

Cold water aquaculture; Species, principles and methods

Composite culture: Ponds; Periphyton based aquaculture

Brackish water aquaculture: Methods & cultivable fish

Integrated fish farming: Rice – fish, Pig cum & Bird cum fish

#### **Unit 3**

Fish seed production: Brood stock management

Induced breeding: Hypophysation, striping, LINPE method and multiple breeding

Aquarium management; Techniques of ornamental fish (OF) breeding; Market potentials OF

Fish seed industry vs. natural collection; seed transportation

#### **Unit 4**

Pond fertilization, manuring and liming: Process, needs and significance

Supplementary feeding: feed ingredients, feed formulation

Fish diseases: Occurrences, symptoms, prophylaxis & treatments

Harvesting: Fish catching methods and fishing gears

Post harvesting technology: Processing and preservation of fish & prawns

Fish bye products

**DEPARTMENTAL ELECTIVE COURSES (PAPER- II)**

**Paper Codes: ZOOE-513/ ZOOE- 613/ ZOOE-713/ ZOOE-813/ZOOE-913/ZOOE-1013**

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**SEMESTER-IV**

**ZOOE-813:- Ecology & wildlife Biology –II**

**Total marks: 80+20=100**

**Credit = 04**

**End semester examination =80**

**Internal Assessment = 20**

**Unit1**

Population ecology –characteristics, age structure, growth, and regulation; Life history strategic, concept of metapopulation, life table

Community ecology –Structure and kinds; Ecological succession-types and mechanism; ecotone and edge effect

**Unit2**

Classification of amphibian and reptiles upto order, endemic and threatened herpetofauna in India with special to Arunachal Pradesh, Aestivation and hibernation in amphibian, role of tempters in sex determination reptiles, characteristics of venomous and non- venomous snake

**Unit3**

Classification of birds upto with examples, Birds migration and threats to migrant ,Endemic and threatened birds in India ,Ecological services of birds ,Important birds areas i Arunachal Pradesh

**Unit4**

Classification of mammals' upto order with examples, Ecological important of mammals, Endemic and threatened mammals of India, threats to mammals and its habitat

## DEPARTMENTAL ELECTIVE COURSES (PAPER- II)

Paper Codes: ZOOE-513/ ZOOE- 613/ ZOOE-713/ ZOOE-813/ZOOE-913/ZOOE-1013

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### SEMESTER-IV

#### **ZOOE-913: Entomology –II ( Insect Physiology and Molecular Biology)**

**Total marks: 80+20=100**

**Credit = 04**

**End semester examination =80**

**Internal Assessment = 20**

Credit Distribution: L:T:P (3:1:0)

#### **Unit 1:**

Insect cuticle; Insect cuticular proteins, cuticular sclerotization and tanning; Chitin metabolism in insects; Insect hearing and sound production; Insect CYP genes and P 450 enzymes; Insect proteases; Extraction and purification of protein, DNA and RNA from insects

#### **Unit 2:**

Anatomy of digestive system; Biochemistry and molecular biology of digestion; Salivary gland development and programme cell death in insects; Anatomy and physiology of excretory, circulatory and respiratory system; Insect immunology, immunological techniques in insect biology.

#### **Unit3:**

Evolution of neuroendocrine system and nuclear hormone receptors in insect; Feedback regulation of prothoracic gland activity, Hormonal control of reproductive processes; Molecular receptors in insects; GABA receptors in insects, Insect G-protein coupled receptors.

#### **Unit 4:**

Insect micro RNAs; Insect transposable elements; Transposable elements for insect transformation; Transposable element vector and other methods to genetically modify *Drosophila* and other insects; Insect genomic system; Insect transgenesis-Methods and applications; Insect culture and recombinant protein expression systems; Insect cells for heterogeneous production of recombinant protein.

## DEPARTMENTAL ELECTIVE COURSES (PAPER- II)

Paper Codes: ZOOE-513/ ZOOE- 613/ ZOOE-713/ ZOOE-813/ZOOE-913/ZOOE-1013

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### SEMESTER-IV

#### ZOOE-1013: Biochemistry & Nutritional Biology –II

**Total marks: 80+20=100**

**Credit = 04**

**End semester examination =80**

**Internal Assessment = 20**

#### Unit1

Carbohydrates metabolism – Regulation of cellular glucose uptake; Pentose phosphate pathway , characteristics of oxidative and non oxidative phases, regulation; Disease related to carbohydrates metabolism with special reference to Diabetes mellitus and Hyperglycemia

#### Unit 2

Amino acid metabolism – inter-organ relationship , indispensable amino acids , catabolic pathways of amino acids and derivatives synthesis , vitamins as coenzymes in amino acid metabolism; Gluconeogenesis , coordinated regulation of gluconeogenesis and glycolysis. Urea cycle and its importance with reference to Hyperglycemia

#### Unit 3

Lipid metabolism – plasma lipoprotein classes and functions (IDL, LDL, VLDL, HDL), essential fatty acids metabolism pathways Linoleic acid derivatives , biosynthesis of cholesterol and sterol derivatives , beta oxidation; Hypercholesterolemia and Obesity

#### Unit 4

Regulation of metabolism – types of regulatory mechanisms, non covalent interactions (substrate availability, allosteric regulation, protein – protein interaction), covalent interactions (phosphorylation and de- phosphorylation, limited proteolysis, enzyme cascade), change in abundance in enzyme, receptors, signal transduction pathways (cAMP ,DAG, IP3 and cGMP)

## DEPARTMENTAL ELECTIVE COURSES (PAPER- III)

Paper Codes: ZOOE-514/ ZOOE- 614/ ZOOE-714/ ZOOE-814/ZOOE-914/ZOOE-1014

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### SEMESTER-IV

#### ZOOE-514: Cell and Molecular Biology –III

**Total marks: 80+20=100**

**Credit = 04**

**End semester examination =80**

**Internal Assessment = 20**

#### Unit 1

Telomerase: Structure and role in cellular aging and cancer

Cancer Biology: differences between normal and cancer cells

Oncogene and role in cancer development

Tumour viruses and tumour antigen, Cancer therapy

#### Unit 2

Cardiovascular system: anatomy and function

Blood pressure and its regulation, hypertension and mechanism of drug action

Atherosclerosis and coronary heart disease

#### Unit 3

Ions channel and regulation of acid secretion in stomach, drug target of ion channels

Diabetes; types, causes and therapeutic approaches

Thalassemia and cystic fibrosis

HIV: Structure, pathogenesis and molecular target of therapy

#### Unit 4

Stem cells: types, properties, application in modern biological research and medicine

Pathophysiology of neurological diseases (Alzheimer, Parkinson and Dementia)

Liver structure and functions, liver cancer types

Xenobiotics and their effect on liver

## DEPARTMENTAL ELECTIVE COURSES (PAPER- III)

Paper Codes: ZOOE-514/ ZOOE- 614/ ZOOE-714/ ZOOE-814/ZOOE-914/ZOOE-1014

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### SEMESTER-IV

#### ZOOE-614: Molecular Endocrinology and Reproductive Biology –III

Total marks: 80+20=100

Credit = 04

End semester examination =80

Internal Assessment = 20

#### Unit 1

Reproductive cycle in female-The Estrous cycle of rat & mice –cellular characteristics  
Ovarian function during estrous cycle –Stages of follicular development, Structure of Graffian follicle; chemical constituent of estral fluid;Oocyte maturation and Ovulation  
Neuroendocrine and hormonal control of Estrous cycle and menstrual cycle; Feedback regulation of female reproductive cycle by H-P-G hormone axis; ovarian hormone: Estrogen progesterone & Inhibin  
Reproductive cycle of farm animals: sheep as a model system: Estrous and enestrous phase

#### Unit 2

Structure of mammalian Uterus  
Growth of pre implantation mouse embryo, Uterine receptivity and implantation window;  
Decidual cell reaction; Mechanism of Embryo implantation –attachment and invasive phase  
Formation of placenta; Adhesion molecules during implantation  
Hormone profile during pre and post implantation period in rat/mice; placental hormone  
Structure of Zona Pellucida

#### Unit 3

Implantation factors and their role in development: Growth factors: Insulin like Growth Factor (IGF-I, IGF-II) & IGFBP; VEGF-classes of VEGF & their role in development  
TGF- $\beta$  superfamily: member of the family, their role in embryo development  
Cytokines (Leukemia inhibiting factors) & Developmental factors (HOX & Wnt)

#### Unit 4

Parturition –hormone and foeto-placental mechanism  
Initiation and maintenance of Lactation  
Role of Prolactin in lactation, mechanism and regulation of Prolactin release during lactation  
Concept of Reproductive health, dynamics of Reproductive health; Infertility and Endometriosis;  
method of contraception

## DEPARTMENTAL ELECTIVE COURSES (PAPER- III)

Paper Codes: ZOOE-514/ ZOOE- 614/ ZOOE-714/ ZOOE-814/ZOOE-914/ZOOE-1014

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### SEMESTER-IV

#### ZOOE-714: Aquaculture and Fish Biology–III

**Total marks: 80+20=100**

**Credit = 04**

**End semester examination =80**

**Internal Assessment = 20**

#### Unit I

Molecular taxonomy of fish: Principle and approaches

Fish genomics and chromosome study: Overview

Phenomenon of sex reversal in fish

Genetics techniques for brood stock management; Genetic markers in fish

Techniques of Hybridization in carps: Intergeneric hybrid, intraspecific hybrid, Natural hybrids

#### Unit 2

Fish population: changes in gene and genotype frequencies; Inbreeding stress and genetic drift, Assessment of heritability, repeatability and correlation.

Evaluation of ploidy status, Gynogenesis, Androgenesis and induced polyploidy;

Isolation of genomics DNA: Quantification and quality checking.

Cloning and transgenesis in fish

#### Unit 3

Method of carp milt cryo- preservation, multiple breeding of carps

Basics of fish immunology; Fish vaccine and methods of immunization

Disease diagnosis: Serological techniques, agglutination test

Genotoxicity assays: Micronucleus test, chromosome aberrations & single cell gel electrophoresis

#### Unit 4

Probiotics for Aquaculture

Microbial Biofertilizer

Micro- algae

Use of sewage: Treatment, sewage fed aquaculture

## DEPARTMENTAL ELECTIVE COURSES (PAPER- III)

Paper Codes: ZOOE-514/ ZOOE- 614/ ZOOE-714/ ZOOE-814/ZOOE-914/ZOOE-1014

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### SEMESTER-IV

#### **ZOOE-814:– Ecology & wildlife Biology –III**

**Total marks: 80+20=100**

**Credit = 04**

**End semester examination =80**

**Internal Assessment = 20**

#### **Unit1**

Concept of wildlife ,wildlife in India ,value of wildlife ,threats to wildlife ,concept of keystone ,umbrella ,cryptic ,rare, endemic and exotic species.

#### **Unit2**

Influence of water and soil on wildlife, Diseases of wild mammals and birds birds and its contrl, management of protected areas in Arunachal Pradesh

#### **Unit 3**

In situ and ex-situ conservation of wildlife, IUCN conservation categories and criteria's, IUCN Red Data Book, Conservation organition-IUCN, WWF, CITES and Birdlife

International, Conservation Acts, 1986; Project tiger and project Elephant

#### **Unit4**

Census and survey techniques for wildlife ,Shanon –wiener index ,simson index ,Pielou eveness index, Margalef index, Application of :radio collaring ,satellite telemetry, camera trapping ,remote sensing ,Global Positioning System (GPS) ,Geographical information system(GIS) ,DNA finger printing and DNA bar coding



## DEPARTMENTAL ELECTIVE COURSES (PAPER- III)

Paper Codes: ZOOE-514/ ZOOE- 614/ ZOOE-714/ ZOOE-814/ZOOE-914/ZOOE-1014

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### SEMESTER-IV

#### ZOOE-914: Entomology –III (Insect Pest Management)

**Total marks: 80+20=100**

**Credit = 04**

**End semester examination =80**

**Internal Assessment = 20**

Credit Distribution: L:T:P (3:1:0)

#### **Unit 1:**

Categorization of pest; Organochlorine, carbamate and organophosphate pesticides and their mode of action; Pesticides of plant origin; Pesticide resistance in insects; Monitoring pest population biology; Diversity of predators and parasites in agroecosystems.

#### **Unit 2:**

Application of gene technology in pest management; Genetic modification of pest and beneficial insects for pest management programs; Molecular methods to identify the mode of action of active ingredients; Insect pest- host plant relationship

#### **Unit 3:**

Insecticidal macrocyclic lactones; Neonicotinoid insecticides; Spider toxins and their potential for insect control; *Bacillus thuringiensis* in pest control - Mechanism and use; Mosquitocidal *Bacillus sphaericus*- toxins, genetics, mode of action, use and resistance mechanism, Baculovirus in pest control, Entomopathogenic fungi and their role in regulation of insect population.

#### **Unit 4:**

Azadiractin in insect control; Andoxxcarb and sodium channel blocker insecticides; Endocrine disruption; Definition and screening aspect; Ecological modeling in pesticide risk assessment; Use of metabolomics in vivo for the development of agrochemical products; Safety evaluation of new pesticide ingredients.

## DEPARTMENTAL ELECTIVE COURSES (PAPER- III)

Paper Codes: ZOOE-514/ ZOOE- 614/ ZOOE-714/ ZOOE-814/ZOOE-914/ZOOE-1014

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### SEMESTER-IV

#### **ZOOE-1014: Biochemistry & Nutritional Biology –III**

**Total marks: 80+20=100**

**Credit = 04**

**End semester examination =80**

**Internal Assessment = 20**

#### **Unit 1**

Basic concept of nutrition and nutrients,  
Recommended dietary allowances (RDA),  
Malnutrition (over nutrition and under nutrition),  
Special conditions – starvation, exercise

#### **Unit 2**

Conventional and Non – conventional food an overview  
Elements of nutrients – macro and mico nutrients.  
Dietary requirements of carbohydrate, protein and fat.  
Essential amino acids and fatty acid and daily dietary requirements  
Biological value of proteins, concept of protein quality and far quality

#### **Unit 3**

Vitamins: classification and Dietary sources  
Nutritional functions: vitamin as Co- enzyme and their significance  
Deficiency diseases associated with vitamins B complex , C,A,D,E and K

#### **Unit 4**

Minerals: Dietary Sources, Nutritional functions; Dietary requirements.  
Nutritional significance of dietary calcium, phosphorus, magnesium, iron, iodine, zinc and copper  
Free redicals and anti- oxidants  
Deficiency diseases associated with mineral  
Nutrition requirement of special populations – pregnant women, lactating mothers, infants.

**DEPARTMENTAL ELECTIVE PRACTICAL COURSES (PAPER- IV)**  
**Paper Codes: ZOOEP-515/ ZOOEP- 615/ ZOOEP-715/ ZOOEP-815/ZOOEP-915/ZOOEP-1015**

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**SEMESTER –IV**

**ZOOEP-515: Cell and Molecular Biology-IV**

**Total Marks: 80+20 =100**

**Credit= 9+2=11(L: T: P=4:2:5)**

**End Semester Examination =80**

**Internal Assessment = 20**

**A. Experiments/Demonstration/assay:**

**30**

1. Study of different types of cells
2. Micrometry and its application
3. Histological preparation of different tissues
4. Histochemical detection of cellular organelle
5. Polytene chromosome: preparation and detection of RNA activity at the puffs.
6. DNA: isolation, quantitative estimation, digestion by restriction endonuclease, and separation by GEL electrophoresis
7. Protein: isolation, quantitative estimation and separation by SDS-PAGE
8. Cell culture: lymphocytes culture, preparation of karyotype
9. Estimation of LDH, ALT, ALP, glycogen, LPO in tissues or biological fluid.
10. Immuno histochemistry: demonstration
11. Micronuclei analysis in the bone marrow of rat/mice
12. Comet assay for detection of DNA damage
13. Isozyme analysis by differential staining procedure in gel.

**B. Project work & Seminar Presentation\***

**40**

**C. Internal assessment**

**20**

**D. Practical record book**

**10**

\* Includes viva voce at the time of end semester seminar presentation

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**DEPARTMENTAL ELECTIVE PRACTICAL COURSES (PAPER- IV)**  
**Paper Codes: ZOOEP-515/ ZOOEP- 615/ ZOOEP-715/ ZOOEP-815/ZOOEP-915/ZOOEP-1015**

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**SEMESTER –IV**

**ZOOEP-615: Molecular Endocrinology and Reproductive Biology-IV**

**Total Marks: 80+20 =100**

**Credit= 9+2=11(L: T: P=4:2:5)**

**End Semester Examination =80**

**Internal Assessment = 20**

**A. Experiments/Demonstration/assay:**

**30**

1. Study of estrous cycle in rat/mice
2. Ovariectomy and study of effect of estrogen in rat or mice
3. Histological study of hypothalamus, pituitary, adrenal, testes, ovary, uterus and epididymis in mammal
4. Study of sperm mobility and survivality
5. Study of blood glucose and liver glycogen in alloxan diabetes
6. Study of implantation site in rat or mice
7. Determination of testosterone estrogen and progesterone in serum (Rat/Mice)
8. Electrophoretic separation of endometrial protein/ testicular protein
9. Extraction of nucleic acids (DNA, RNA) from animal tissue and separation by agarose gel
10. Determination of steroid dehydrogenase in adrenal and gonad
11. Chromatographic separation of steroids/ peptides using TLC

**B. Project work & Seminar Presentation\***

**40**

**C. Internal assessment**

**20**

**D. Practical record book**

**10**

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**DEPARTMENTAL ELECTIVE PRACTICAL COURSES (PAPER- IV)**  
**Paper Codes: ZOOEP-515/ ZOOEP- 615/ ZOOEP-715/ ZOOEP-815/ZOOEP-915/ZOOEP-1015**

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**SEMESTER –IV**

**ZOOEP-715: Aquaculture and Fish Biology-IV**

**Total Marks: 80+20 =100**

**Credit= 9+2=11(L: T: P=4:2:5)**

**End Semester Examination =80**

**Internal Assessment = 20**

**A.Experiments/Demonstration/assay:**

**30**

1. Taxonomy of edible & ornamental fishes (with special reference to Arunachal Pradesh): Cat fishes, carps, prawns, glassfishes, mahaseers, Minnows & barbs, loaches, perches, eel,
2. Morphology and sexual dimorphism: Cat fishes, Carps, Tilapia, Prawn
3. Dissection & anatomy: Digestive and reproductive system – Carp, cat fishes & prawns
4. Identification of major fish food organisms
5. Analysis of water – B.O.D, phosphate, organic matter
6. Analysis of soil – nitrogen, phosphate & potassium
7. Analysis of freshwater plankton-qualitative, quantitative and Zooplankton diversity
8. Study of gut contents of fish
9. Field practical: Collection of pituitary for breeding through hypophysation, Stripping, Artificial fertilization, Estimation of gonadosomatic index
10. Study of fish parasites
11. Proximate analysis of Biochemical constituents of fish feed: Protein, carbohydrate, lipid

**B. Project work & Seminar Presentation\***

**40**

**C. Internal assessment**

**20**

**D. Practical record book**

**10**

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**DEPARTMENTAL ELECTIVE PRACTICAL COURSES (PAPER- IV)**  
**Paper Codes: ZOOEP-515/ ZOOEP- 615/ ZOOEP-715/ ZOOEP-815/ZOOEP-915/ZOOEP-1015**

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**SEMESTER –IV**

**ZOOEP-815: Ecology and Wildlife Biology-IV**

**Total Marks: 80+20 =100**

**Credit= 9+2=11(L: T: P=4:2:5)**

**End Semester Examination =80**

**Internal Assessment = 20**

**A. Experiments/Demonstration/assay:**

**30**

1. Calculation of the ecological footprint.
2. Study of density, size and age structure of population.
3. Taxonomic studies of amphibian, reptile, birds and mammals with reference to Arunachal Pradesh.
4. Study the topography and types of feathers in birds
5. Isolation of DNA from scat, hair, feather, blood and tissue of wild animal samples.
6. Study interspecific genomic variation by RFLP techniques.
7. Demonstration of DNA barcoding techniques to identify a species.
8. Demonstration of wildlife photography technique
9. population study by quadrat and line transect methods
10. Study of biotic component of pond ecosystem
11. Habitat mapping with GPS instrument.
12. Species diversity of amphibian/reptile/birds/mammal in national park and wildlife sanctuary or reserved forest in Arunachal Pradesh and calculation of diversity, richness and evenness of species.
13. Orientation tour to Wildlife/National Park/Biosphere Reserve/ wildlife Institute in Arunachal Pradesh or India.

**B. Project work & Seminar Presentation\***

**40**

**C. Internal assessment**

**20**

**D. Practical record book**

**10**

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**DEPARTMENTAL ELECTIVE PRACTICAL COURSES (PAPER- IV)**

**Paper Codes: ZOOEP-515/ ZOOEP- 615/ ZOOEP-715/ ZOOEP-815/ZOOEP-915/ZOOEP-1015**

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**SEMESTER –IV**

**ZOOEP-915: Entomology-IV**

**Total Marks: 80+20 =100**

**Credit= 9+2=11(L: T: P=4:2:5)**

**End Semester Examination =80**

**Internal Assessment = 20**

**A. Experiments/Demonstration/assay: 30**

1. Identification of important insects in Arunachal Pradesh.
2. Identification of insect hemocytes.
3. Preparation of permanent/temporary slides of insect antennae and arolium.
4. Dissection of male/female reproductive organ of insect.
5. Dissection of neuroendocrine system of silkworm.
6. Dissection of digestive system of housefly.
7. Estimation of population density of insect community.
8. Quantification of protein/DNA from insects or insect products.

**B. Project work & Seminar Presentation\* 40**

**C. Internal assessment 20**

**D. Practical record book 10**

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**DEPARTMENTAL ELECTIVE PRACTICAL COURSES (PAPER- IV)**  
**Paper Codes: ZOOEP-515/ ZOOEP- 615/ ZOOEP-715/ ZOOEP-815/ZOOEP-915/ZOOEP-1015**

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**SEMESTER –IV**

**ZOOEP-1015: -Biochemistry and Nutritional Biology-IV**

**Total Marks: 80+20 =100**

**Credit= 9+2=11(L: T: P=4:2:5)**

**End Semester Examination =80**

**Internal Assessment = 20**

**A. Experiments/Demonstration/assay:**

**30**

1. Preparation of buffer
2. Titration of amino acid to determine of pKa value
3. Determination of glucose by Anthrone reagent from animal tissue
4. Estimation of cholesterol from suitable source
5. Sub- cellular fractionation of rat liver and marker enzyme assays.
6. Extraction of protein from animal tissue and separation by SDS-PAGE
7. Calculation of percentage purity and percentage yield during protein purification
8. Kinetic characterization of any one enzyme
9. Study the effect of temperature on enzymatic activity
10. Paper chromatographic separation of amino acids
11. Thin layer chromatography for separation of amino acids
12. Isolation of DNA from animal tissue and separation by agarose gel electrophoresis
13. Digestion of DNA molecule by restriction endonuclease
14. Proximate analysis of food (Total protein, Carbohydrate, Fat, Ash , dilatory fibre and Amino acid by TLC)
15. Estimation of ascorbic acid from suitable source

**B. Project work & Seminar Presentation\***

**40**

**C. Internal assessment**

**20**

**D. Practical record book**

**10**

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