Syllabus for the M. Sc. In Zoology

(Four-Semester Course)

Department of Zoology

Netaji Subhas University, Jamshedpur

A brief description of the course:

Purpose:

 To understand the importance of taxonomy and the biodiversity of fauna (non
chordate and chordate) and their conservation.
 To study comparative structure and function of the different organ systems and
theirphysiological importance in relation to habit and habitat of the organism.
 To understand the biochemical integrity of various life processes.
 To have advanced knowledge on animal genetics, molecular biology and developmental biology and their applications
 To prepare the students for pursuing advance studies in various fields of animal
sciences by research.

Department of Zoology

TWO-YEAR FULL-TIME PROGRAMME

PROGRAMME STRUCTURE

The M.Sc. Programme is divided into two Parts as under. Each part will consist of two Semesters as given below.

		Semester-Odd	Semester-Even
Part I	First Year	Semester – 1	Semester – 2
Part II	Second Year	Semester – 3	Semester – 4

The schedule of papers prescribed for various semesters shall be as follows:

PART I: Semester – 1

SEM	CODE	NAME OF PAPER	FULL NUMBER
1	FC 101	Computer fundamentals	100
2	CZOOL 102	Systematic ,Biodiversity ,Evolution	100
3	CZOOL 103	Chordates & Non- Chordates	100
4	PZOOL 104	Practical & Project	100

PART I: Semester – 2

SEM	CODE	NAME OF PAPER	FULL NUMBER
1	CZOOL 201	Reproductive physiology ,Developmental biology	100
2	CZOOL 202	Immunology & Comparative Endocrinology	100
3	CZOOL 203	Molecular cell biology ,Cell structure & function	100
4	PZOOL 204	Practical & Project	100

PART I: Semester – 3

SEM	CODE	NAME OF PAPER	FULL NUMBER
1	CZOOL 301	Classical genetics and Microbiology	100
2	CZOOL 302	Vertebrate diversity, Ethology & Animal behavior	100
3	CZOOL 303	BASIC ECOLOGY & HABITAT ECOLOGY & POPULATION ECOLOGY	100
4	PZOOL 304	Practical & Project	100

PART I: Semester – 4

SEM	CODE	NAME OF PAPER	FULL NUMBER
1	CZOOL 401	Fish and Fisheries	100
2	CZOOL 402	Entomology	100
3	CZOOL 403	Ecology	100
4	PZOOL 404	Practical & Project	100

SEMESTER - I

FC-101 :- COMPUTER FUNDAMENTALS

UNIT - I

- Evolution of Computers - Generation , Types of Computer , Computer system Characteristics ,
- Basic Components of a Digital Computer - Control Unit , ALU , Input /out put functions and memory , memory addressing capability of a CPU , World length of a Computer , Processing Speed of a Computer , Computer Classification .

UNIT - II

- Input / output Units :- Keyboard , Mouse ,Trackball , Joystick , Digitizing tablet , Scanners , Digital Camera , MICR ,OCR , OMR , Bar- code Reader , Voice Recognition , Light pen , Touch screen .
- Monitors & types of Monitors - digital , analog , size resolution , refresh Rate , Dot pitch , Video standard - VGA , SVGA ,XGA etc .
- Printers & types - Daisy wheel , Dot Matrix , inkjet , laser , LinePrinter , Plotter , Sound Card and Speakers .

UNIT - III

- *Memory - RAM ,ROM , EPROM , PROM and other types of memory .*
- Storage fundamentals - primary vs. Secondary data storage .
- Various storage Devices - Magnetic Tape , Magnetic Disks , Cartridge Tape , Hard Disk Drivers, Floppy Disks (Winchester Disk), Optical Disks , CD, VCD, CD-R,CD-RW, Zip Drive

UNIT - IV

- Introduction to internet ,Connecting to the internet hardware ,Software & ISPs , search Engines , web portals , online shopping .
- Email - Types of email , Compose and send a message . Reply to a message , working with emails .

SEMESTER-I

CZOOL -102: SYSTEMATICS , BIODIVERSITY , EVOLUTION

UNIT – I :- SYSTEMATICS & BIODIVERSITY

1. Basic concept of taxonomy and systematic – definition and role in biology
2. Biological classification –, Type of taxonomy , Linnaean concept and modern concept of Taxonomy .
3. School of Systematic :- Numerical phonetics, cladistics , Evolutionary systematic .
4. Concept of Biodiversity :- Definition , significance and Ecological role, Problems and scales of biodiversity Extinction .Biodiversity in bio geographical regions ,Diversity clines in relation to area , latitude , attitude and deep sea . Biodiversity indicators, surrogate species .

UNIT :-II :- EVOLUTION

1. Origin of life , Origin of cells and first organisms , evolution of eukaryotic cell from prokaryotes – a case of symbiosis .

2. Evidences of Evolution , Theories of evolution :- Lamarckism , Darwinism , Modern theories
3. Populations as a unit of Evolution :- Gene frequencies in , Mandelian population, Hardy - Weinberg equilibrium , Genetic drift.
4. Natural selection :- concept , types .

Isolating mechanisms
Concept of species,
Modes of speciation .

5. Patterns of Evolution :- Micro, Macro and Mega evolution .
6. Evolution of Man :- anatomical , geographical and cultural , Ancestry of Homo sapiens .
Evolution of Horse : - Phylogeny of history

Suggested Literature:

1. Evolution, Barton, N. H., Briggs, D. E.G., Eisen, J. A., Goldstein, A. E., Patel, N. H., Cold Spring Harbor Laboratory Press, New York, USA
2. Evolution, Hall, B. K. and Hallgrimsson, B., Jones and Bartlett Publisher, Sudbury, USA
3. Evolution, Futuyma, D. J., Sinauer Associates, Inc., Sunderland, USA
4. What Evolution Is, Mayr, E., (2001), Basic Books, New York, USA

SEMESTER-I

CZOOL -103 : Chordates & Non- Chordates

UNIT – I :- NON – CHORDATES :-

1. Synopsis of Diversity of Non – chordate group
2. Protozoa :- Locomotion , Reproduction
3. Origin of Metazoa
4. Helminths :- Parasitic adaptation
5. Annelida :- Nephridia & celomic System
6. Arthropoda :- Respiration , Excretion
7. Mollusca :- Respiration .
8. Diagnostic Characters and Disstribution :-

Rotifera , Rhychocoela , Bryozoa , Brachiopoda , Pogonophora , Sipuncula , Echiura , Phoronida .

UNIT – II CHORDATES :-

1. Synopsis of Diversity of chordate groups .
2. Characteristic features and affinities of

- Protochordata :- Hemichordata , Urochordata , Cephalochordata

3. Fishes :- Electric Organ and Electrorecepters
4. Amphibia :- Origin of Amphibia.
5. Reptiles :- Skull in Reptile, venom in Ophidians, Characteristic features and affinities of Sphenoden, Turtle.
6. Birds :- Parental Care in Birds, Nest building in birds .
7. Mammals :- Dentition, Aquatic Mammals .
8. Comparative anatomy :-
    - 8.1. Integument and its derivatives.
    - 8.2. Heart and kideny.

PZOOL- 104: PRACTICAL DETAILS

Dissections :-

General anatomy and nervous system of :- Leech , Prawn, Squilla , Scorpion , Unio , Pila , Sepia , Earthworm

Specimen :- Study of Various living invertebrate phyla along with their larva .

Whole Mount : Euglena , Amoeba , paramecium , Binnary Fission , Conjugation in Paramecium .

Evolution :-

Study of Living Fossils .
Study of various connecting link [peripatus , amphioxus

Biodiversity :-

1. To Submit a Project report on any related topic of animal Biodiversity

SEMESTER-2

CZOOL- 201: **REPRODUCTIVE PHYSIOLOGY , DEVELOPMENTAL BIOLOGY**

1. Sperm maturation in Male reproductive tract , role of testicular harmones , capacitation in female reproductive tract.

2. Bizzarre phenomena in mammalian reproduction : Bruce effect , Lee boot effect , Whitten effect.

3. Uterine cycles : - Estrus and menstrual cycle , hormonal regulation of uterine cycles

4. Implantation, Delayed implantation , sterility due to hormonal defects , IVF , Super Ovulation , Variations in IVF.

5. Early Embryonic development :

5.1 cleavage and blastulation , characteristics of cleavage , physiology of cleavage.

5.2 Fate maps and cell linkage

5.3 Gastrulation , morphogenetic movements , Neurulation : neurogenesis , notogenesis and mesogenesis, Morphogenesis.

6. Differentiation: Cell commitment, determination and cyto differentiation , molecular biology of differentiation , control , levels of differentiation , tissue maintenance and replacement.

7. Blastogenesis , Regeneration (Morphalaxis and Epimorphosis) , Regeneration of amphibian limb and lens.

8. Metamorphosis : Hormonal regulation of amphibian metamorphosis.

9. Stem cells and their applications.

SEMESTER -2

CZOOL- 202: IMMUNOLOGY & COMPARATIVE ENDOCRINOLOGY

UNIT - I , IMMUNOLOGY

1. Vertebrate Immune System : Innate and specific /Acquired

   Innate Immune System : Composition , organization and structure of Lymphoid organs , cells of innate immune system and their functions , inflammation.

   Acquired immune system : B – cells (types and receptors), T – cells (Types and receptors) , Antigen – Antibody interaction , Epitopes and haptens , Types , structure and functions of Antibodies , Antigen – presenting cells , Cell – Mediated and Humoral immunity.

2. MHC and their role , Self and Non – self discrimination.
3. Cytokines : Structure and function , Cytokine receptors.

4. Regulation of Immune response .

UNIT - II, COMPARATIVE ENDOCRINOLOGY

1. Hormones : Classification , Mechanism of action of hormones (Receptor types and structure) second messenger
   System , cytosolic receptors and their action via gene expression .
2. Vertebrate endocrine glands and physiological role of their hormones : Adenohypophysis ,Neurohypophysis,Urophysis , Thyroid , Parathyroid, corpus of stannous , Adrenal , Testes , Ovary ,Placenta , Thymus , Kidney , Heart , Liver .
3. Endocrine Hypothalamus , its hormones and their physiological role
4. Pineal gland : Melatonin and photo-periodism, biological clock .
5. Endocrinology of calcium regulation ,
6. Comparative anatomy and physiological role of hormones of

   1. Pituitary complex
   2. Adrenal gland
   3. Thyroid gland .

SEMESTER 2

CZOOL -203 *UNIT :* - I Molecular cell biology ,Cell structure & function

1. MOLECULAR ARCHITECTURE AND PROPERTIES OF DNA :
   Stability SEMESTER-II , and thermal denaturation
   Physical properties
   Types of DNA
   Denaturation and renaturation of DNA.
2. DNA replication:

   Enzymes and accessory proteins involved in replication
   Mechanism of DNA replication in Prokaryotes and Eukaryotes.

3. Transcription and Post – transcriptional events :

RNA polymersases in Prokaryotes and Eukaryotes , Transcription factors.
Mechanism of transcription in Prokaryotes and Eukaryotes :- Assembly of pre-initiation complex and initiation , elongation and termination.
Post – transcription modifications in RNA : 5' – cap formation , 3' end processing and poly adenylation , RNA splicing , RNA editing , Post – transcriptional gene silencing (RNA interference) , Catalytic RNA and it's role , Nuclear export of mRNA.

4. Translation

Prokaryotic and Eukaryotic translation : Mechanism of initiation , elongation and termination.
Post – translational modifications of proteins.

5. Regulation of Gene expression

Regulation of Gene expression in Prokaryotes : Operon concept , Inducible and repressible system , Positive and Negative control , Enhancers and silencers , Tryptophan – Operon , Lac – Operon ,

Regulation of Gene expression in Eukaryotes.

UNIT : - II CELL STRUCTURE AND FUNCTION

1. Cell membrane

1. 1 Structure :- Model cell membrane structure , lipid bilayer , Membrane proteins .
1. 2 Transport across cell membrane :- channels , carriers , pumps , mechanism of diffusion.

2. Sorting of Proteins

2. 1 Signal peptide and SRP –dependent targeting of translational complex

2. 2 Processing of proteins in RER

2. 3 Processing through Golgi complex, targeting to plasma membrane & Lysosome

2. 4 Structure and biogenesis of Ribosomes

3 Nucleolus :- Structure and Function

4 Cytoskeleton :- Organization of Microtubules , microfilaments and Intermediate filaments ,role of cytoskeleton elements In cell shape , motility and cell division .

5 Cell signalling and Intercellular junctions

5. 1 Intercellular junctions , extracellular matrix , cell-cell adhesion, gap junction .

5. 2 Receptor classes :- Membrane receptors , Intracellular receptors

6 Cell Cycle :-

6. 1 Cell cycle and it's regulation :- role of cyclins and cdks . checkpoints in mammalian cell cycle .

6. 2 Apoptosis :- Mechanism and significance

SEMESTER 2

PZOOL : 204 PRACTICAL

1 .Dissection :-

- Afferent & efferent branchial vessels of bony fish.
- Accessory respiratory organ of air breathing fish .
- Neck nerves of mammals .

2 Hematology :-

- Preparation and study of various blood corpuscles of vertebrates .
- Determination of Hb % , ESR , TC DC , haematocrit value , PCV of blood of any

vertebrate in normal and experimental condition .

3 Cell Biology :-

- Study of meiotic stages from temporary Acetocarmine aquash preparation of Grass Hopper Testis .
- Study of salivary gland polytene chromosomes from temporary acetocarmine aquash preparation .

4 Physiology & Biochemistry :-

- Measurement of arterial blood pressure in man with help of of sphygmomanometer by Auscultation method .

Estimation of glucose , cholesterol , lipid in the serum of any mammals

SEMESTER-3

CZOOL : 301 - CLASSICAL GENETICS, MICROBIOLOGY

UNIT - I Classical Genetics

Extension of Mendelian principles – codominance, incomplete dominance, gene interactions, pleiotropy, sex limited and sex influenced characters, dominant epistasis, recessive epistasis, multiple alleles, lethal alleles

Gene mapping – linkage maps.

Extra chromosomal inheritance – inheritance of mitochondrial and chloroplast gene

Gene therapy , application of genetic engineering

UNIT :- II MICROBIOLOGY

1 . The characterization , classification and identification of microorganisms
2. The morphology and structure of bacteria - the size, and arrangement of bacterial cells, bacterial structure, spores and cysts.
3. the cultivation of bacteria – types of media, physical condition required for growth, acidity and alkalinity
4. reproduction and growth – modes of cell division, growth and growth curve, quantitative measurement of bacterial growth.
5. microbiology of food , milk and dairy products.

6 . Viruses -

General characteristics of viruses, structure of Viruses , TMV, Bacteriophages, Virus reproduction, cultivation of virus , virus purification and Assays .Viroids , virusoids, Prions, Viruses and cancer

7 . Applied and Industries microbiology :

SEMESTER-3

CZOOL :302 - VERTEBRATE DIVERSITY, ETHOLOGY & ANIMAL BEHAVIOR

UNIT - I Vertebrate Diversity
Neomorphic air breathing organs in fish
Electric organ & Electro-Receptors in fishes
Organs of Distance Touch Orientation in fishes
Reproductive adaptations - Internal fertilization, Viviparity, Paedomorphosis and neoteny
Endocrine control of metamorphosis of the tadpole
Aerodynamics and energetic of flying and gliding in birds
Nest building and Parental care in Birds
Sensory system in birds - Vision, Olfaction, Hearing, Special senses used in navigation
Dentition in mammals, Aquatic mammals.

UNITY - II Ethology
General concepts of Ethology: Motivation; Fixed Action Pattern; Sign or key stimulus or release; Innate Releasing Mechanism;Action specific energy; Learning or Experience Imprinting; Physiological Basis; Behavioral genetics; Evolution of Behaviour;
Behaviour and its types: Individual and social interaction , Social organization , Innate and

learned behavior,
Orientation in animals - its nature and types
Biological rhythms – occurrence and significance:

UNIT :- III , ANIMAL BEHAVIOR

1. Animal Behaviour :- Definition , objectives , significance . Patterns of behaviour :- Innate and Learned behaviour , concept of FAP, concept of Key or sign stimulus , innate releasing Mechanism , concept of Learning , imprinting , concept of evolution of behaviour .
2. Orientation in Animals :- Kinesis ,Types of Kinesis , Taxis Types of taxis Echolocation ,Language of honey bees .
3. Biological rhythms: - occurrence and significance , circadian , circannual , circatidan ,circalunar , circasyzygie Clocks (with examples) .
4. Social behaviour in insects .

SEMESTER-III

CZOOL :303 -- BASIC ECOLOGY & HABITAT ECOLOGY & POPULATION ECOLOGY

UNIT - I , BASIC ECOLOGY & HABITAT ECOLOGY

1 : Basic Ecology
1.1. concept of ecosystem
1.2. The processes of ecosystem
1.3. Types of ecosystem
1.4. Food chain ,food web
1.5. Structure of the ecosystem
1.6 Habitat and Ecological niche
2 : Fresh water Ecology
2.1. Origin and classification of lakes .
3. Function of ecosystem
3.1 Energy flow ecosystem
3.2 Bio geo chemical cycle
4: Terrestrial Ecology : Major biomes
5. Energy flow in ecosystem
6. Animal association : Inter specific association ,Intra specific association
7. Community Ecology
7.1 Composition of community
7.2. Commu nity structure
7.3. Concept of ecological dominance .

7.4. Concept of species diversity .
7.5. Ecotype and ecotone

UNIT - II

POPULATION ECOLOGY

1. Population characteristics : density, natility, mortality, survivorship curves, age distribution, Population fluctuation, biotic potential, population interaction

2.Population Growth : Exponential , Sigmoid
3. Theories of population growth
4. Population dispersion : emigration ,immigration ,migration
5. Population dynamics
6. Population limiting factors
6.1. Role of density dependent factors
6.2. Role of and density independent factors .

SEMESTER-3

PZOOL – 304 , PRACTICAL DETAILS

1 Vertebrate diversity

Anatomical observation of:
Accessory respiratory organs in fish- Channa, Heteropneustes, Clarias, Anabus
Cranial nerves and blood vessels in Labeo / Wallago
Flight muscles and air sacs in chick
Museum studies:
Models – Latimeria, Sphenodon, Ostrich, different types of beaks and feet in birds, nest of birds,
Specimens – Petromyzon, Myxine, Electric ray, Acipenser, Caecilian, Hyla/ Rhacophorus,
Axolotl larva/ Salamander, Draco,Turtle, Snakes: Cobra, Krait, Rattle snake,
Sea snake, Water snake, Bat
Bones – Skeleton of a bony fish, Chelonia, Snake, Dentition in mammals

2. BIOTIC ANALYSIS :-

• Qualitative , Quantitative assessment and working of indices of diversity and dominance of :-
PLANKTON.

3.WATER ANALYSIS :-

- **Estimation of carbonate , and Dissolved o_2 & Co_2 in sample water .**
- Estimation os chloride in sample water .
- Estimation of hardnss & OMC of Sample water .
- Estimation of Magnesium and calciumin sample water

4.ECOLOGICAL ADAPTATION STUDY :-

- **Aquatic insect , Terrestrial insects .**
- Higher Vertebrates .
- Ecological Equipments .
- **Ecological significances of earthworm .**
- **Identification of Aquatic plants and weeds .**

SEMESTER-4

CZOOL 401 -Biotechnology

Group-A

1. Basic principles of genetic engineering
    I. Enzymology – restriction enzymes, DNA ligase, polymerase,
    II. Cloning vehicles – Plasmids, Cosmids, λ (lambda) – phage, Shuttle vectors, Ti – plasmids, YAC.
2. Introduction of cloned genes into host cells.
    I. Transformation, Transduction, Particle gun electroporation, Liposome.
3. Analysis and expression of cloned genes in host cells
    i. RFLP, RAPD, AFLP analysis.
    ii. PCR, DNA probes, expression of genes.
    iii. Immunological screening

4. Gene libraries
    I. Construction and analysis of C- DNA library, application of gene library, YACs,
    II. Genomic DNA library,
5. Changing genes
    i. Site directed mutagenesis.
    ii. Protein engineering

Group-B

6. Molecular biotechnology of Microbial system

I. Production of pharmaceutical enzymes,
II. Monoclonal antibody
III. Production of vaccines:
IV. Production of single cell protein.

7. Transgenic animals
8. Human gene therapy
    i. Viral gene delivery system,
    ii. Non viral gene delivery system
    iii. Prodrug activation therapy
    iv. Nucleic acid as therapeutic agent.
    v. Oligonucleotide correction of genetic system.
9. Patenting biotechnology inventions, ethical issues and biosafety regulations.

SEMESTER-4

CZOOL 402 -**Entomology**

Classification and phylogeny of Insects
Classification of the Apterygote Orders : Thysanura, Diplura, Protura and Collembola
Classification of Exopterygote Orders : Orthoptera, Dictyoptera, Hemiptera
Classification of Endopterygote Orders : Lepidoptera, Diptera, Hymenoptera and Coleoptera

- Structures and life processes :

Integument: Structure and chemistry, cuticular modifications, Apolysis, Ecdysis and sclerotization
Head and Thorax : Its appendages and their modifications
Digestive system : Alimentary canal, salivary glands, mechanism of digestion, micro-organisms of the intestine.

- Sense organs and perception:

Mechanoreceptors, Auditory organs, Chemoreceptors,
Thermoreceptors. Humidity receptors and visual organs
Effector organs : The sound and light producing organs

- Insect Physiology:

Respiration - Respiration in aquatic, terrestrial and endoparasitic insects
Excretion - Malphighian tubules and other organs of excretion, Metabolic pathways of nitrogenous excretion i.e. urea, uric acid, ammonia and aminoacids.

- Reproductive Physiology:

Oogenesis, yolk formation, ovulation and oviposition spermatogenesis, transfer of sperms and spermatophores, Mating and fertilization , Endocrine system and hormones & pheromones

SEMESTER-4

CZOOL :403 -**ECOLOGY**

POLLUTION ECOLOGY & CONSERVATION AND MANAGEMENT

UNIT - I , POLLUTION ECOLOGY

1. Water Pollution .
1.1. Types and source pollutants and their effect .
1.2. Eutrophication .
1.3. Biodegradable and non - degradable pollutants .
1.4. Bio - indicators of pollution .
1.5 Carcinogens
1.6 Food additives
1.7 Poison

2. Air pollution

2.1. Sources and effect of air pollutants
2.2. Aerosol , Smog .
2.3. Green house effect
2.4. Ozone depletion.
2.5. Acid rain
2.6 Xenobiotics
2.7 Radiation

3. Eco-toxicology

3.1. Effect of agriculture waste , heavy metals , organic wastes and industrial wastes on aquatic organisms.
3.2. Biomagnifications
3.2 Environmental toxicology
3.3 Anthropogenic activity and environment
3.4 Statistical method of toxicology

UNIT - II , CONSERVATION AND MANAGEMENT

4.Conservation & Biodiversity
4.1. Concept of conservation
4.2. conservation of natural resources & their importance .
4.3. Concept of biodiversity .
4.4. Causes of biodiversity depletion .
4.5. Hot spots and mega biodiversity zones .
4.6. Priority fixation of biodiversity conservation.

5. Resource management

5.1. Concept of natural resources.

5.2. Management of air & water resources.

6. Wildlife and forest Management

6.1. Concept of endangered ,Critically endangered species ,endangered species , Valnerable & Rare Species.

6.2. Importance of wild life and causes of Extinction .

6.3. Biological basis of wild life management .

7. Environmental biotechnology

7.1. Concept of bioremediation and its application.

7.2. Solid waste management: both organic and inorganic.

8. **Ecology**

8.1 Ecological succession

8.2 Light as an ecological factor

8.3 Temperature as an ecological factor

8.4 Environmental impact assessment

8.5 Toxic metals

SEMESTER-4

PZOOL -404 : PRACTICAL DETAILS

1. Study of Some photographs of biotech Importance and Molecular Biology
1. Isolation of Protein
2. Preparation of Karyotype from Brain cells of Drosophila
3. Preparation of G band chromosomes
4. Preparation of polytene for study of Gene amplification
5. Estimation of Protein
6. Separation of amino acids by Paper chromatography
7. Separation of Lipids by Thin Layer Chromatography
8. Separation of DNA by Agarose Gel Elctrophoresis

3. Adaptation / plankton :-

> Collection identification of aquatic plants , weeds & plankton

2) List of Practicals

Taxonomy description & identification of following order:

Orthoptera, Dictyoptera, Hemiptera, Hymenoptera, Diptera, Coleoptera & Lepidoptera.

Study of permanent slides of body parts.

.Embryological study through Drosphila culture.
Study of adaptive features in some order of insects.
Minor dissection: Temporary mounting of special type of mouth parts, wings, legs, ovpositer,
Study of the external morphology of an insect, wings, haltere, elytra
Study of the adaptive feature of terrestrial and aquatic insects
Study of the mouthparts of the representative of the order: Orthoptera, Dictyoptera, Hemiptera, Lepidoptera and Hymenoptera.
Study of respiratory structure of terrestrial, semi-aquatic and aquatic insects.
Study of the life cycles of Termites, Honeybee, Mosquitoes.

1. SOIL ANALYSIS :-

- Estimation of OMC / Total carbon of soil sample .
- Estimation of CaCo3in a soil sample **.**
- Estimation of soil respiration rate in a sample .

2. BIOTIC ANALYSIS :-

- Qualitative , Quantitative assessment and working of indices of diversity and dominance of :-
- Benthos .
- Soil fauna.

3.BIOSTATISTICAL ANALYSIS :-

- Analysis of standard devation and standed error in a set of data .
- Species area curve for sampling of population by quadrate method.

4. ECOLOGICAL ADAPTATION STUDY :-

- Fresh water fish [hill stream fish]
- Marine fish .
- Ecological Equipments(use of pH meter, water bath , centrifuge , colorimeter, thermometer) **.**
- Ecological significances of plants .
- Identification of Bio indicator Species .