

DEPARTMENT OF ZOOLOGY

COMPILED SYLLABUS OF NEP 2021 ONWARDS, FROM I TO VI SEMESTER

DEPARTMENT OF ZOOLOGY
Syllabus of I and II sem (NEP) highlighting skills, employability and entrepreneurship

Course Title/Code: **Cytology, Genetics and Infectious Diseases**

Course Code: **DSCC5Z00T1**

Total Contact Hours: **56**

Course outcome : 2023-24

1st B.Sc Zoology NEP Syllabus

I SEMESTER

Course Title: Cytology, Genetics and Infectious Diseases (Theory)

CO1: Students will gain knowledge about the basic concepts of cell and its signalling, apoptosis, heredity pattern and parasitology.

CO2: Understand the structure and function of cell organelles, chromosome, mechanism of inheritance and human pathogenic organisms.

CO3: Concept of heredity, cytology and human pathogens makes student acquit with knowledge of analysis of chromosome abbreviations, cell cycle regulation and infectious diseases.

CO4: Applying the knowledge of cytology, inheritance pattern, parasitology for analysing the basic architecture and physiology of human body.

CO5: Evaluate the complexities of prokaryotes and eukaryotes, cell cycle, cell division, mendelian inheritance, host parasitic relationship.

SEMESTER I- ZOOLOGY CORE Course I Content:

Content	Hours
Unit I	14
Chapter 1. Structure and Function of Cell Organelles I in Animal Cell <ul style="list-style-type: none"> • Plasma membrane: Chemical composition—Fluid mosaic model, • Endomembrane system: protein targeting and sorting, transport, endocytosis and exocytosis and types of cell junctions. 	
Chapter 2. Structure and Function of Cell Organelles II in Animal Cell <ul style="list-style-type: none"> • Cytoskeleton: microtubules, microfilaments, intermediate filaments • Mitochondria: structure, Oxidative phosphorylation; electron transport system. • Endoplasmic reticulum, Lysosomes, Peroxisome and Ribosome: Structure and Function, 	
Unit II	14
Chapter 3. Nucleus and Chromatin Structure <ul style="list-style-type: none"> • Structure and function of nucleus in eukaryotes & prokaryotes • Chemical structure and base composition of DNA and RNA • Ultra structure of eukaryotic chromosome, Chromatin Organization-Nucleosome model • Types of DNA and RNA. 	
Chapter 4. Cell cycle, Cell Division and Cell Signaling: <ul style="list-style-type: none"> • Cell division: mitosis and meiosis • Introduction to Cell cycle and its regulation, apoptosis • Signal transduction: intracellular signaling and cell surface receptors, via G- protein linked receptors. • Cell-cell interaction: -Autocrine, Paracrine and Endocrine types. 	

Unit III	14
<p>Chapter 5. Mendelism and Sex Determination</p> <ul style="list-style-type: none"> • Basic principles of heredity: • Mendel 's laws- Monohybrid cross and Dihybrid cross • Incomplete Dominance • Genetic Sex-Determining Systems, Environmental Sex Determination, • Chromosomal Sex Determination and mechanism in <i>Drosophila melanogaster</i>. • Sex-linked characteristics in humans and dosage compensation. 	
<p>Chapter 6. Extensions of Mendelism, Genes and Environment</p> <ul style="list-style-type: none"> • Extensions of Mendelism: Multiple Alleles, Gene Interaction-inheritance of comb pattern in fowl. • The Interaction Between Sex and Heredity: Sex-Influenced and Sex-Limited Characteristics • Cytoplasmic Inheritance- Kappa particles in Paramecium, Maternal Inheritance & Maternal Effects. • Interaction between Genes and Environment, Phenocopy • Inheritance of Continuous Characteristics. 	
Unit IV	14
<p>Chapter 7. Human Chromosomes and Patterns of Inheritance</p> <ul style="list-style-type: none"> • Human karyotyping and Pedigree analysis. • Patterns of inheritance: autosomal dominance, autosomal recessive, X-linked recessive, X-linked dominant. • Chromosomal anomalies: Introduction, Structural and Numerical Aberrations with two examples (Autosomal & Allosomal) 	
<p>Chapter 8. Infectious Diseases</p> <ul style="list-style-type: none"> • Introduction to human pathogenic organisms- viruses (HPV, HIV), bacteria (<i>Staphylococcus aureus</i>, <i>Salmonella typhi</i>), fungi (<i>Candida</i>), protozoa (<i>Entamoeba histolytica</i>, <i>Leishmania donovani</i>) and helminths worms (<i>Trichinella spiralis</i>, Dwarf tapeworm) • Structure, life cycle, pathogenicity, including diseases, causes, symptoms and control of common parasites: <i>Trypanosoma</i>, <i>Giardia</i> and <i>Wuchereria</i>. 	

ZOOLOGY CORE LAB
DSCC5ZOOP1- Cell Biology & Cytogenetics Lab
COURSE CONTENT

List of practicals to be conducted

mLAC syllabus - 56 hrs.

1. Understanding usage of simple, compound and stereozoom microscopes.
2. To study different cell types such as buccal epithelial cells, striated muscle cells using Methylene blue/any suitable stain (virtual/ slide/slaughtered tissue).
3. To study the different stages of Mitosis in root tip of *Allium cepa*.
4. To study the different stages of Meiosis in grasshopper testis (virtual/ slides)
5. To check the permeability of cells using salt solution of different concentrations.
6. Study of parasites in humans (eg. Protozoans, Helminthes in compliance with examples being studied in theory) permanent micro slides.
7. To learn the procedures of preparation of temporary slides (fish scale) and permanent slides, with available mounting material (sex comb of *Drosophila*/ insect mouth parts).
8. Study of life cycles of *Drosophila* sp. (from Cultures or Photographs).
9. Preparation of polytene chromosomes (*Chironomus* larva or *Drosophila* larva).
10. Preparation of human karyotype and study the chromosomal structural and numerical aberrations from the pictures provided. (Virtual/optional).
11. <https://www.vlab.co.in>
12. <https://zoologysan.blogspot.com>
13. www.vlab.iitb.ac.in/vlab
14. www.onlinelabs.in
15. www.powershow.com

OPEN ELECTIVE COURSE CONTENT

I Semester

Course outcome : 2023-24

Course Title: Economic Zoology (OE)

CO1: Students will understand the methods used in sericulture, apiculture, Dairy and Poultry management, Aquaculture, Vermiculture and Lac culture.

CO2: Conceptual knowledge of economic zoology will assist them to analyze the environmental and economical issues.

CO3: Enable students to apply entrepreneurship abilities, planning and setting up small-scale enterprises in the field of agriculture and livestock management

Course Title: Economic Zoology Course Code: OEC5ZOOT1	Course Credits: 3
Total Contact Hours: 42	Duration of ESA: 3 Hours
Formative Assessment Marks: 40	Summative Assessment Marks: 60

Course Content

Content	Hrs.
Unit I	14
Chapter 1. Sericulture: <ul style="list-style-type: none">History and present status of sericulture in IndiaMulberry and non-mulberry species in Karnataka and IndiaMulberry cultivationMorphology and life cycle of <i>Bombyx mori</i>Silkworm rearing techniques: Processing of cocoon, reelingSilkworm diseases-pests and their control Chapter 2. Apiculture: <ul style="list-style-type: none">Introduction to apicultureSpecies of honey bees in India, life cycle of <i>Apis cerena</i>Colony and its organization, and communication Honey production and processing: <p>Bee keeping ; methods and equipments: indigenous methods, extraction appliances, extraction of honey from the comb and processing</p> <p>Honey bee products and by products : Bee pasturage, honey and bees wax and their uses.</p> <p>Honey bees pathology and their management.</p>	

Chapter 3. Live Stock Management:

Dairy: Introduction to common dairy animals and techniques of dairy management

- Types, loose housing system and conventional barn system; advantages and limitations of dairy farming
- Establishment of dairy farm and choosing suitable dairy animals-cattle
- Cattle feeds, milk and milk products
- Cattle diseases

Poultry: Types of breeds and their rearing methods

- Feed formulations for chicks
- Nutritive value of egg and meat
- Disease of poultry and control measures

Unit III**Chapter 4. Aquaculture:**

- Aquaculture in India: An overview and present status and scope of aquaculture
- Types of aquaculture: Pond culture: Construction, maintenance and management (carp , shrimp , shellfish , composite fish culture) and pearl culture.

Chapter 5. Fish culture:

- Common fishes used for culture.
- Fishing crafts and gears.
- Ornamental fish culture: Fresh water ornamental fishes- biology, breeding techniques
- Construction and maintenance of aquarium: Construction of home aquarium, materials used, setting up of freshwater aquaria, aquarium plants, ornamental objects, cleaning the aquarium, maintenance of water quality. control of snail and algal growth.
- Modern techniques of fish seed production

Chapter 6. Prawn culture:

- Culture of fresh and marine water prawns.
- Preparation of farm.
- Preservation and processing of prawn, export of prawn.

Chapter 7. Vermiculture:

- Scope of Vermiculture.
- Types of earthworms.
- Habit categories - epigeic, endogeic and anecic; indigenous and exotic species.
- Methodology of vermicomposting: containers for culturing, raw materials required, preparation of bed, environmental pre-requisites, feeding, harvesting and storage of Vermicompost.
- Advantages of vermicomposting. Diseases and pests of earthworms.

Chapter 8. Lac Culture:

- History of lac and its organization, lac production in India. Life cycle, host plants and strains of lac insect.
- Lac cultivation: Local practice, improved practice, propagation of lac insect, inoculation period, harvesting of lac.
- Lac composition, processing, products, uses and their pests

II SEMESTER BSC ZOOLOGY

CORE COURSE CONTENT II SEMESTER

Course outcome : 2023-24

Course Title: Biochemistry and Physiology (Theory)

CO1: Basic Biomolecules helps the students to understand various physiological process taking place in the living system

CO2: A sound knowledge of physiology of life process like, Digestion, respiration, circulation, nervous control enables them to understand the importance of these system for survival.

CO3: Concepts of endocrinology enables students to understand the pathophysiology and clinical manifestation of endocrine glands.

CO4: Students will able to analyze a ECG in relation to physiological events and various disease states, including conduction abnormalities, probability of tachycardia and describes clinical significance.

CO5: Understanding of molecular basis of catalysis by enzymes and the underlying basis of their specificity and clinical importance of enzyme inhibitors.

Course Title: Biochemistry and Physiology	Course Credits: 4
Course Code: DSCC5Z00T2	L-T-P per week: 4-0-0
Total Contact Hours: 56	Duration of ESA: 3 Hours
Formative Assessment Marks: 40	Summative Assessment Marks: 60
Model Syllabus Authors:	

CORE COURSE CONTENT:

mLAc syllabus	Hours
Unit I	14
Chapter 1. Structure and Function of Biomolecules: <ul style="list-style-type: none">Structure and Biological importance of carbohydrates (Monosaccharides, Disaccharides, Polysaccharides).Lipids: Biological importance and definition of saturated and unsaturated fatty acids, Tri-acyl glycerols, Phospholipids, Glycolipids and Steroids.Structure, Classification and General Properties of α-amino acids; structure of essential (Histidine and Isoleucine) and non-essential amino acids (Glycine and Proline).Levels of organization in proteins; Simple protein- definition with example and conjugate proteins - definition with example	
Chapter 2. Enzyme Action and Regulation <ul style="list-style-type: none">Nomenclature and classification of enzymes; Cofactors- definition with example.Isozymes and Clinical use of isozymes. Mechanism of enzyme action with specificity.Enzyme kinetics; Factors affecting rate of enzyme-catalyzed reactions; Regulation of enzyme action.	

<ul style="list-style-type: none"> Equation of Michaelis-Menton, Concept of Km and V max, Enzyme inhibition- definition with examples. Allosteric enzymes definition 	
Unit 2	14
Chapter 3. Metabolism of Carbohydrates and Lipids <ul style="list-style-type: none"> Metabolism of Carbohydrates: glycolysis, citric acid cycle, gluconeogenesis. Lipids- Biosynthesis of palmitic acid and Ketogenesis, β-oxidation of saturated fatty acids with even and odd number of carbon atoms 	
Chapter 4. Metabolism of Proteins and Nucleotides <ul style="list-style-type: none"> Catabolism of amino acids: Transamination, Deamination, Urea cycle illustration with explanation, Nucleotides and vitamins (Vitamin A) Peptide linkages- Definitions of di, tri and polypeptide linkage with example. 	
Unit 3	14
Chapter 5. Digestion and Respiration in humans <ul style="list-style-type: none"> Structural organization and functions of gastrointestinal tract and associated glands. Mechanical and chemical digestion of food; Absorptions of carbohydrates, lipids, proteins and water. Structure of trachea and Lung. Mechanism of respiration- Inspiration and Expiration, Pulmonary ventilation; Respiratory volumes and capacities; Transport of oxygen and carbon dioxide in blood, Respiratory pigments- haemoglobin and myoglobin, Dissociation curves and the factors influencing it (Ph, CO₂ and 2,3-diphosphoglyceride) 	
Chapter 6. Circulation and Excretion in humans <ul style="list-style-type: none"> Components of blood and their functions. Blood clotting: Blood clotting system (Best and Tylor), Blood groups: Rh-factor, ABO and MN Structure of mammalian heart Cardiac cycle; Cardiac output, Electrocardiogram, Blood pressure and its regulation Structure of kidney and its functional unit; Mechanism of urine formation 	
Unit 4	14
Chapter 7. Nervous System and Endocrinology in humans <ul style="list-style-type: none"> Structure of multipolar neuron, resting membrane potential (RMP) Origin of action potential and its propagation across the myelinated (in detail) and unmyelinated (briefly) nerve fibers. Types of synapse (Mention chemical and electrical synapses with example). Endocrine glands - pineal, pituitary, thyroid, parathyroid, pancreas and adrenal; hormones secreted by them and three functions of each. Classification of hormones based on chemical nature; Mechanism of Hormone action (only lipid soluble). 	

Chapter 8. Muscular System in humans

- Histology of different types of muscles; Ultra structure of skeletal muscle; Molecular and chemical basis of muscle contraction; Characteristics of muscle twitch; Motor unit, summation and tetanus. (minimum of three characters)

ZOOLOGY SEMESTER II CORE COURSE LAB CONTENT

Course Title/Code: Biochemistry and Physiology	Course Credits: 2
Course Code: DSCC5Z00P2	L-T-P per week: 0-0-4
Total Contact Hours: 56	Duration of ESA: 4 Hours
Formative Assessment Marks: 25	Summative Assessment Marks: 25
Model Syllabus Authors:	

COURSE CONTENT

List of practicals to be conducted	Hours
<p>Note: Models to be prepared by the students and should submit during the preparatory exam (for IA marks)</p> <p>1. Preparation of models of nitrogenous bases- nucleosides and nucleotides. 2. Preparation of models of amino acids and dipeptides. 3. Preparation of models of DNA and RNA.</p> <p>Experiments to be performed by students</p> <p>4. Qualitative analysis of Carbohydrates (Molisch's test, Iodine test, Benedict's tests Selwinoff's test), Proteins (Xanthoprotein test, Biuret test, Ninhydrin test) and Lipids (solubilty test, Sudan III test, Salkowski test). 5. Qualitative analysis of Nitrogenous wastes – Ammonia, Urea and Uric acid. 6. Separation of amino acids by paper chromatography.</p>	20
<p>7. Determination of the activity of enzyme (Urease)-Effect of [S] and determination of Km and Vmax. (Only demonstration). 8. Determination of the activity of enzyme (Urease) - Effect of temperature and time. 9. Action of salivary amylase under optimum conditions (Only demonstration). 10. Quantitative estimation of Oxygen consumption by fresh water Crab. 11. Quantitative estimation of salt gain and salt loss by fresh water crab</p>	15
<p>12. Estimation of Hemoglobin in human blood using Sahli's haemoglobino meter. 13. Counting of RBC in blood using Hemocytometer. 14. Counting of WBC in blood using Hemocytometer. 15. Differential staining of human blood corpuscles using Leishman stain. 16. Recording of blood glucose level by using glucometer (Only demonstration).</p>	15

TOPICS RECOMMENDED FOR SEMINAR/PROJECT REPORT

1. Biochemical pathways, their evolutionary background and regulation.
2. Blood groups and their importance.
3. Vital enzymes for human body.
4. *Essential and nonessential amino acids.*
5. Important body lipids.
6. Significance of animal proteins.
7. Role of carbohydrates in animal body.
8. Nature of proteins and nurture of animal body.
9. Role of lipids in structural and functional organization of body.

II SEMESTER
OPEN ELECTIVE COURSE
CONTENT

Course outcome : 2023-24

Course Title: Parasitology (OE)

CO1: They will be able to interpret various ways of parasitic infection and disease caused by them.

CO2: Illustrate the complexities of the parasite-host relationship and appraise the impact of parasitic diseases on human societies.

CO3: Analyze laboratory methods used to detect and identify parasites.

Semester: II Zoology

Course Title: Parasitology Course Code: OEC5ZOOT2	Course Credits: 3
Total Contact Hours: 42	Duration of ESA: 3 Hours
Formative Assessment Marks: 40	Summative Assessment Marks: 60
Model Syllabus Authors:	

COURSE CONTENT

Content	42Hrs
Unit – 1	
<p>Chapter 1. General Concepts</p> <ul style="list-style-type: none"> • Introduction, Parasites, parasitoids, host, zoonosis • Origin of parasites (Without any theory) • Basic concept of Parasitism, Symbiosis, Phoresy, commensalisms and mutualism (Definition with example) • Host-parasite interactions and adaptations (with reference to leech and tape worm) • Occurrence, mode of infection and prophylaxis (general account) <p>Chapter 2. Parasitic Platyhelminthes</p> <ul style="list-style-type: none"> • Study of morphology, pathogenicity, prophylaxis and control measures of • <i>Fasciolopsis buski</i> • <i>Schistosoma haematobium</i> • <i>Hymenolepis nana</i> • Study of morphology, life cycle, pathogenicity, prophylaxis and control measures of <i>Taenia solium</i> 	14

Chapter 3. Parasitic Protists

- Study of morphology, pathogenicity, prophylaxis and control measures of *Giardia intestinalis*, *Trypanosoma gambiense*, *Plasmodium vivax*
- Study of morphology, life cycle, pathogenicity, prophylaxis and control measures of *Entamoeba histolytica*

Unit – 2

14

Chapter 4. Parasitic Nematodes

- Study of morphology, pathogenicity, prophylaxis and control measures of *Ancylostoma duodenale*, *Wuchereria bancrofti*, *Trichinella spiralis*
- Study of morphology, life cycle, pathogenicity, prophylaxis and control measures of *Ascaris lumbricoides*
- *Nematode plant interaction; Gall formation*

Chapter 5. Parasitic Arthropods

- Biology, importance and control of Ticks (*Soft tick Ornithodoros*, *Hard tick Ixodes*), Mites (*Sarcoptes*), Lice (*Pediculus*), Flea (*Xenopsylla*), Bug (*Cimex*) Parasitoid (*Wasps*)

Chapter 6. Parasitic Vertebrates

- Cookcutter Shark
- Hood Mocking bird and Vampire bat and their parasitic behavior and effect on host

Unit – 3

14

Chapter 7. Molecular diagnosis & clinical parasitology

- General concept of molecular diagnosis for parasitic infection
- Advantages and disadvantages of molecular diagnosis
- Fundamental techniques used in molecular diagnosis of endoparasites
- Immunoassay or serological techniques for laboratory diagnosis of endoparasites on the basis of marker molecules like *Giardia intestinalis*, *B. coli*, *E. histolytica*, *L. donovani*, Malarial parasite using ELISA, RIA
- Counter Current Immuno electrophoresis (CCI)
- Complement Fixation Test (CFT) PCR, DNA, RNA probe

III Semester BSc Zoology: Core Course Content

Course Title/Code: Molecular Biology, Bioinstrumentation & Techniques in Biology	Course Credits: 4
Course Code: DSCC5ZOOT3	L-T-P per week: 4-0-0
Total Contact Hours: 56	Duration of ESA: 3 Hours
Formative Assessment Marks: 40	Summative Assessment Marks: 60
Model Syllabus Authors:	

Course Outcomes (COs):

At the end of the course the student should be able to understand:

1. After successful accomplishment of the course, the learners will be able to acquire better understanding and comprehensive knowledge regarding most of the essential aspects of Molecular Biology subject which in turn will provide a fantastic opportunity to develop professional skill related to the field of molecular biology.
2. The course will mainly focus on the study of principal molecular events of cell incorporating DNA Replication, Transcription and Translation in prokaryotic as well as eukaryotic organisms.
3. Acquiring knowledge on instrumentation and techniques in biology.

mLAC SYLLABUS		Hrs
Unit I		14
Chapter 1: Process of Transcription		8
<ul style="list-style-type: none"> • Fine structure of gene (Cistron, Recon, Muton) • RNA polymerases - types and functions • Transcription in prokaryotes and eukaryotes 		
Chapter 2: Process of Translation		6
<ul style="list-style-type: none"> • Genetic code and its salient features • Translation in prokaryotes and eukaryotes 		
Unit II		14
Chapter 3. Regulation of gene expression-I		10
<ul style="list-style-type: none"> • Regulation of gene expression in prokaryotes- lac operon (inducible) and trp operon (repressible) in <i>E. coli</i> • Regulation of gene expression in eukaryotes • Role of chromatin (euchromatin and heterochromatin) in gene expression. • Post-translational modifications: purpose, advantages, and significance; glycosylation, methylation, phosphorylation, and acetylation • Post-transcriptional modification: capping, splicing, polyadenylation 		
Chapter 4. Regulation of gene expression-II		4
<ul style="list-style-type: none"> • Intracellular protein degradation (lysosomal autophagy and ubiquitin proteasome pathway). • Concept of RNA editing (mRNA), gene silencing, and RNAi. 		
Unit III		14
Chapter 5: Microscopy		9
Principles and applications of Light microscopy, Dark field microscopy, Phase contrast microscopy, Fluorescence microscopy, Confocal microscopy and Electron microscopy (SEM and TEM).		
Chapter 6: Centrifugation and Chromatography		5
<ul style="list-style-type: none"> • Centrifugation: Principles, types, and applications (High speed and Ultracentrifugation) • Chromatography: Principle and applications of: TLC, HPLC and GC 		
Unit IV		14
Chapter 7: Biochemical Instrumentation		6
<ul style="list-style-type: none"> • pH meter, measurement of pH • Principle, applications and safety measures of Radio-tracer techniques - Autoradiography • Colorimetry and Spectrophotometry: Beer-Lambert's law, Absorption spectrum, UV-VI Spectrophotometer. 		
Chapter 8: Molecular Techniques		8
<ul style="list-style-type: none"> • Principle and applications of ELISA, PCR & RT-PCR, Agarose gel-electrophoresis, SDS-PAGE, Southern Blotting and Western Blotting. DNA Sequencing (Sanger's Dideoxy method), DNA Fingerprinting. 		

Zoology Semester III (Practical III)

Core Course Lab Content

Course Title: Molecular Biology, Bioinstrumentation and Techniques in Biology	Course Credits: 2
Course Code: DSCC5ZOOP3	L-T-P per week: 0-0-4
Total Contact Hours: 56	Duration of ESA: 3 Hours
Formative Assessment Marks: 25	Summative Assessment Marks: 25

Course Outcomes (COs):

At the end of the course the student should be able to:

1. At the end of the course, students will be able to understand the applications of biophysics and principle involved in bio-instruments.
2. Understand the methodology involved in bio techniques.
3. Students can Demonstrate knowledge and practical skills of using instruments in biology and medical field.
4. They can perform techniques involved in molecular biology and diagnosis of diseases.

Lab Course Content

mLAC SYLLABUS	Hrs.
List of experiments	14 units (1 unit-4hrs)
1. To study the principle and applications of simple, compound and binocular microscopes.	1
1. To study the principle and applications of various lab equipments- pH meter, Electronic balance, Vortex mixer, use of glass and micropipettes, Laminar air flow, Incubator, shaker, Water bath and centrifuge.	2
2. To prepare Buffer solutions (Phosphate, Citrate, Tris-HCl buffer)	1
2. To estimate amount of RNA by Orcinol method.	2
5. Demonstration of differential centrifugation to fractionate components in a given mixture.	1
6. Principle and applications of colorimeter and estimation of amount of protein by Lowry's method.	2
7. To identify different unknown nitrogenous bases using ascending paper chromatography.	1
8. Extraction of DNA from the given animal tissue sample.	2
9. To estimate amount of DNA by di-phenyl amine (DPA) method.	2

Visit to any research institute for detailed study & demonstration of high end equipments.

Pedagogy: Written Assignment/Presentation/Project / Term Papers/Seminar

Semester: III Zoology Open Elective

Course Title: Animal Behaviour Course Code: OEC5ZOOT4	Course Credits: 3
Total Contact Hours: 42	Duration of ESA: 3 Hours
Formative Assessment Marks: 40	Summative Assessment Marks: 60
Model Syllabus Authors:	

Course Outcomes (COs):

At the end of the course the students will be able to:

1. Examine and critically to evaluate the emergence of ideas that have shaped how we observe and collect data on animal behaviour.
2. Understand the main historical ideas that underpin animal behaviour theory
3. Critically review hypotheses to explain animal behaviour
4. Understand different methods for collecting data on animal behaviour
5. Have advanced their written and oral presentation skills.

mLAC SYLLABUS	Number of hours
Unit I	14
Chapter 1.: Introduction to Animal Behaviour <ul style="list-style-type: none"> • Brief contributions of Karl Von Frish, Ivan Pavlov, Konrad Lorenz, NikoTinbergen. • Proximate and ultimate causes of behaviour. 	
Chapter 2. Patterns of Behaviour <ul style="list-style-type: none"> • Stereotyped Behaviors - Orientation and Reflex. • Individual Behavioural patterns: Instinct and Learned Behaviour Associative learning, classical and operant conditioning, Habituation, Imprinting 	
Unit II	14
Chapter 3. Social Behaviour: <ul style="list-style-type: none"> • Social organization in termites and honey bees. • Social behaviour: Altruism. • Conflict behaviour. 	
Chapter 4. Sexual Behaviour <ul style="list-style-type: none"> • Sexual dimorphism, Mate choice in peacock. • Intra-sexual selection (male rivalry in red deer). • Kinship theory: Relatedness & inclusive fitness. • Parental care in fishes (Nest Building & cost benefit 	
Unit III	14
Chapter 5. Chronobiology <ul style="list-style-type: none"> • Brief historical developments in chronobiology. • Adaptive significance of biological clocks. • Biological Rhythms • Sleep – wake cycle, jetlag and shiftwork. 	
Chapter 6: Communications in animals <ul style="list-style-type: none"> • Bioluminescence in deep sea fishes and insects • Territoriality in Monkeys and Dogs • Role of pheromones in animal communication- Insects and Vertebrates, • Communication in Honey bees (Waggle Dance) 	

Suggested Readings:

1. Animal Behaviour by Drickamar.
2. John Alcock, Animal Behaviour, Sinauer Associate Inc., USA.
3. Paul W. Sherman and John Alcock, Exploring Animal Behaviour, Sinauer Associate Inc., Massachusetts, USA.
4. Chronobiology Biological Timekeeping: Jay. C. Dunlap, Jennifer. J. Loros, Patricia J. DeCoursey(ed). 2004, Sinauer Associates, Inc. Publishers, Sunderland, MA, USA
5. Insect Clocks D.S. Saunders, C.G.H. Steel, X., Afopoulou (ed.) R.D. Lewis. (3rdEd) 2002 Barendsand Noble Inc. New York, USA
6. Biological Rhythms: Vinod Kumar (2002) Narosa Publishing House, Delhi/ Springer-Verlag, Germany.

Pedagogy: Chalk and Talk, PPT, Group discussion, Seminar, Interaction, virtual lab, Lab visit

SEMESTER: IV SEMESTER, B. SC., (HONS) ZOOLOGY

Course Title: Core Course Content: Gene Technology Immunology and Computational Biology	Course Code: DSCC5ZOOT4
Course Type: Discipline Core Theory, L-T-P: 4-0-0	Course Credits: 4
Total Contact Hours: 56	Duration of ESA: 3 Hrs.
Formative Assessment Marks: 40	Summative Assessment Marks: 60

Course Outcomes (COs)

At the end of the course the student should be able to:

1. Acquaint knowledge on versatile tools and techniques employed in genetic engineering and recombinant DNA technology.
2. An understanding on application of genetic engineering techniques in basic and applied experimental biology.
3. To acquire a fundamental working knowledge of the basic principles of immunology.
4. To understand how these principles, apply to the process of immune function.
5. Use, and interpret results of, the principal methods of statistical inference and design; helps to communicate the results of statistical analyses accurately and effectively; helps in usage of appropriate tool of statistical software.

Topics Suggested for Assignment/ Formative Assessment:

mLAC SYLLABUS		Hrs
Unit I		14
Chapter 1: Principles of Gene Manipulation <ul style="list-style-type: none"> ● Recombinant DNA Technology: Introduction, steps involved. ● Restriction Enzymes and Ligases and Nucleic acid modifying enzyme. ● Gene cloning Vector: Concept of plasmids-pBR322, Lambda phage vectors, cosmids ● Gene transfer techniques (Direct and indirect). ● Screening and selection of recombinant colonies 		7
Chapter 2: Applications of Genetic Engineering <ul style="list-style-type: none"> ● Transgenic animals (Transgenic cow, Transgenic Fish); Transgenic plants(cry protein); ● Production of Human Recombinant insulin and ● Hybridoma technology: Synthesis and applications of Monoclonal antibodies ● Gene Therapy (SCID) ● Biosensors and its applications 		7
Unit II		14
Chapter 3: Introduction to the Immune System <ul style="list-style-type: none"> ● Defense against diseases: Introduction, First and second line of defense, Innate and acquired immunity; Antigen presenting cells (APC's), Role of Band T-lymphocytes (Humoral immunity and cell mediated immunity), primary and secondary immune response. ● Functional aspects of organs of the Immune system - Thymus and bone marrow, spleen, Lymph Node, Small intestine and Liver (Peyer's patchesand Von Kupffer cells). 		7
Chapter 4: Antigens and Antibodies <ul style="list-style-type: none"> ● Antigens and haptens: Properties (foreignness, molecular size,heterogeneity). ● B and T cell epitopes. ● Structure of IgG and functions of different classes of immunoglobulins. ● Major histocompatibility complex - Structure of MHC I & II. 		7
Unit III		14
Chapter 5: Clinical Immunology <ul style="list-style-type: none"> ● Immunity against diseases of viral, bacterial and protozoan infections. ● Vaccines: Types and Uses - Immunization schedule for children. ● Transplantation immunology: Transplantation of organ- Types, graftrejection and Immuno-suppressors 		7
Chapter 6: Bioinformatics <ul style="list-style-type: none"> ● Databases: Sequence and structural ● Sequence analysis (homology): Pairwise and Multiple Sequence alignment- ● BLAST, CLUSTALW, Sequence alignment- FASTA. ● Scope and applications of Bioinformatics. 		7
Unit IV		14
Chapter 7: Biostatistics I <ul style="list-style-type: none"> ● Measures of central tendency: Mean, Median, Mode. ● Data summarizing: Frequency distribution, Graphical presentation - bardigram, pie diagram, histogram. ● Elementary idea of probability and its applications. 		7
Chapter 8: Biostatistics II <ul style="list-style-type: none"> ● Measures of dispersion: Range, Standard Deviation, Variance. ● Correlation and Regression. ● Tests of significance: t-test- Paired and unpaired, Chi square test, ANOVA. 		7

1. Q/A, Short Question, Quiz, MCQ, Assignment etc.

Recommended Books:

1. Primrose & Twyman. Principles of Genome Analysis and Genomics. Blackwell (2003).
2. Hartl & Jones. Genetics: principles & Analysis of Genes & Genomes. Jones & Bartlett (1998).
3. Sambrook *et al.* Molecular Cloning Vols I, II, III. CSHL (2001).
4. Primrose. Molecular Biotechnology. Panima (2001).
5. Clark & Switzer. Experimental Biochemistry. Freeman (2000)
6. Sudbery. Human Molecular Genetics. Prentice-Hall (2002).
7. Wilson. Clinical Genetics-A Short Course, Wiley (2000).
8. Pasternak. An Introduction to Molecular Human Genetics. Fitzgerald (2000).
9. Biostatistical Analysis (Fourth Edition) by Jerrold H. Zarr, Pearson Education Inc., Delhi.
10. Statistical Methods (Eighth Edition) by G. W. Snecdecor and W. G. Cochran, Wiley Blackwell
11. Biostatistics (Tenth Edition) by W.W. Daniel and C. L. Cross, Wiley
12. Introductory Biological Statistics (Fourth Edition) by John E. Havel, Raymond E. Hampton and Scott J. Meiners
13. Westhead *et al* Bioinformatics: Instant Notes. Viva Books (2003)
14. Genetic engineering: Sandhya Mitra BITS, Pilani
15. Principles of Biostatistics Khan and Khanam
16. Transgenic animals: Ranga

Web Sources:

Pedagogy: Lectures, Presentations, videos, Assignments and Weekly Formative Assessment Tests.

Zoology Core Course Lab Content - Semester IV (Practical IV)

Course Title: Gene Technology, Immunology and Computational Biology	Course Credits: 02
Course Type: Minor Discipline Core Practical, L-T-P: 0-0-4	Course Code: DSCC5ZOO4
Total Contact Hours: 56	Duration of ESA: 3 Hours
Formative Assessment Marks: 25	Summative Assessment Marks: 25
Model Syllabus Authors:	

Course Outcomes (COs):

At the end of the course the student should be able to:

1. Accurately, safely and appropriately use all the equipment regularly used in Molecular Biology(DNA manipulation, including balances, pipettes, electrophoresis and centrifuges).
2. Prepare chemical solution and reagents to the precision appropriate to the task.
3. Demonstrate knowledge of the biochemical basis underpinning the molecular biologytechniques.

Lab Course Content

mLAC SYLLABUS	Hrs
List of experiments	
<ol style="list-style-type: none"> 1. Calculate the mean, median, mode and standard deviation (Measurement of pre and post clitellar lengths (with suitable examples). 2. Measure the height and weight of all students in the class and apply statistical measures. 3. Determination of ABO Blood group and Rh factor. 4. To study Restriction enzyme digestion using teaching kits (Demonstration only). 5. To detect genetic mutations by Polymerase Chain Reaction (PCR) using teaching kits (Demonstration only). 6. Demonstration of agarose gel electrophoresis for detection of DNA. 7. Demonstration of Polyacrylamide Gel Electrophoresis (PAGE) for detection of proteins. 8. To calculate molecular weight of unknown DNA and protein fragments from gel pictures. (https://www.youtube.com/watch?v=mCiCiO0cfbg&ab_channel=Bio-Resource) 9. To learn nucleotide sequence database. 10. To learn sequence alignment: Pairwise alignment (Protein/ DNA). 	

Pedagogy: Lectures, Presentations, videos, Labs, Assignments, Tests, Individual or group Field oriented Project Report.

V semester Zoology Core Course Content

Program Name	B. Sc	Semester	V
Course Title	Non-Chordates and Economic Zoology (Theory)		
Course Code	ZOO C-9-T	No. of Credits	4
Contact hours	60 hours (4hrs/week)	Duration of SEA/Exam	2 ¹ / ₂ hrs
Formative Assessment Marks	40	Summative Assessment Marks	60

Course Outcomes (COs):

After the successful completion of the course, the student will be able to:

- CO1.** Group animals on the basis of their morphological characteristics/ structures.
- CO2.** Demonstrate comprehensive identification abilities of Non-Chordate diversity.
- CO3.** Explain structural and functional diversity of Non-Chordates
- CO4.** Develop understanding on the diversity of life with regard to protists, non-chordates and chordates.
- CO 5.** Examine the diversity and evolutionary history of a taxon through the construction of a basic phylogenetic/ cladistics tree.

Semester V Zoology-Paper- V
Non-Chordates and Economic Zoology

mLAC Syllabus	Hr
Unit I	18
Chapter 1: Introduction to Animal Architecture <ul style="list-style-type: none"> • Body symmetry: Definition and types with examples – spherical, radial, biradial and bilateral symmetry • Body organization: Hierarchical organization of animal complexity – Definition and types with examples -protoplasmic, cellular level, tissue level, organ level and organ system level of organization. • Germ layers: Definition, types with examples - diploblastic condition and triploblastic condition. • Body coelom: Definition, origin and types with examples – acoelom, pseudocoelom, eucoelom - enterocoelom and schizocoelom. • Metamerism: Definition and types with examples – pseudometamerism, true metamerism homonomous and heteronomous. 	5
Chapter 2: Protozoa to Coelenterate: <ul style="list-style-type: none"> • Protozoa- General characters of the phylum up to classes with examples • <i>Paramecium</i> (Morphology and Reproduction-Conjugation in <i>Paramoecium caudatum</i>, significance of conjugation) 	2
<ul style="list-style-type: none"> • Porifera-General characters of the phylum up to classes with examples • <i>Sycon</i> (Canal System-Asconoid, syconoid, leuconoid and rhagonoid types) 	3
<ul style="list-style-type: none"> • Coelenterata – General characters of the phylum Coelenterata up to classes with examples. • <i>Obelia</i> (Morphology-polyp and medusa and Reproduction-asexual and sexual) 	3
Chapter 3: Ctenophora to Nematelminthes: <ul style="list-style-type: none"> • Ctenophora – : Salient feature • Platyhelminthes- General characters of the phylum Platyhelminthes up to classes with examples. • <i>Taenia</i> (Tape worm) (Morphology and Reproduction) • Nematelminthes- General characters of the phylum Nematoda with examples • <i>Ascaris lumbricoides</i> (Morphology and Reproduction) 	5
Unit II	15
Chapter 4: Annelida: <ul style="list-style-type: none"> • Annelida – General characters of the phylum up to classes with examples • <i>Hirudinaria</i> (Leech) (Morphology Reproduction, and Parasitic adaptation (Morphological and physiological) 	5
Chapter 5: Arthropoda <ul style="list-style-type: none"> • Arthropoda – General characters of the phylum and classification upto classes with suitable examples • <i>Palaemon</i> (Prawn) Morphology, Appendages- structure of a typical appendage, structure and function of appendages, concept of serial homology 	10

<ul style="list-style-type: none"> • Nervous System and Reproduction) • Unique features of <i>Peripatus</i> • Larval forms of Arthropoda (one larval stage from each class) 	
Unit III	12
Chapter 6. Mollusca and Echinodermata:	
<ul style="list-style-type: none"> • Mollusca – General characters of the phylum and classification upto classes with suitable examples 	1
<ul style="list-style-type: none"> • <i>Pila</i> (Morphology, Shell-structure of shell (sectional view), Respiration, Nervous System and Reproduction and life cycle. 	5
<ul style="list-style-type: none"> • Echinodermata – General characters of the phylum and classification upto classes with suitable examples. 	1
<ul style="list-style-type: none"> • <i>Asterias</i> (starfish)-(Morphology-oral and aboral view and Water Vascular System), Pedicellaria,Regenaration in Echinodermata. 	5
Unit IV	15
Economic Zoology	
Chapter 7. Vectors and Pests:	
<ul style="list-style-type: none"> • Definition with examples 	1
<ul style="list-style-type: none"> • Life cycle, disease caused and the control of following vector and pests: Gundhi Bug (rice bug). Sugarcane leafhopper, Termites and Mosquitoes (anopheles) and their control. 	3
<ul style="list-style-type: none"> • Rodents (rat) – as vector and pest 	1
Chapter-8 Economic Zoology	
<ul style="list-style-type: none"> • Lac-culture: Methods of Cultivation and products. 	1
<ul style="list-style-type: none"> • Pearl Culture (Introduction, Steps involved, Composition) 	1
<ul style="list-style-type: none"> • Vermiculture and Vermicomposting- Introduction, Types of earthworm based on habit, steps involved in vermiculture, Vermicompost preparation, merits of vermicomposting and safety measures. Multiplying of earthworms 	4
<ul style="list-style-type: none"> • Poultry-Definition, Breeds of Fowls – Indigenous and Exotic breeds (birds of American, English and Mediterranean class with example), 	4
<ul style="list-style-type: none"> • Diseases of poultry birds (causative agent, symptoms and controlmeasure): Ranikhet, Fowl Pox, Fowl Cholera and Fowl Typhoid. Poultry products and bi-products 	

V Semester Zoology Core Course Lab Content

Course Title	Non-Chordates and Economic Zoology (Practical)	Practical Credits	2
Course Code	ZOO C10-P	Contact Hours	4 hrs/week
Formative Assessment	25 Marks	Summative Assessment	25 Marks

Course Outcomes (COs):

At the end of the course the student should be able to:

1. Understand basics of classification of non-chordates.
2. Learn the diversity of habit and habitat of these species.
3. Develop the skills to identify different classes and species of animals.
4. Know uniqueness of a particular animal and its importance
5. Enhancement of basic laboratory skill like keen observation and drawing.

Practical Content:

mLAC Syllabus
<ol style="list-style-type: none"> 1. Preparation and observation of <i>Paramecium</i> culture. 2. Protozoa: Slides of <i>Amoeba</i>, <i>Euglena</i>, <i>Noctiluca</i>, <i>Paramecium</i> and <i>Vorticella</i> 3. Porifera: Systematics of <i>Sycon</i>, <i>Euplectella</i>, <i>Hyalonema</i>, <i>Spongilla</i> and <i>Euspongia</i> (Specimens). Study of permanent slides of T.S of <i>Sycon</i>, spicules and gemmules. 4. Cnidaria: Systematics of <i>Aurelia</i> and <i>Hydra</i> (Specimens). Slides of <i>Hydra</i> (T.S of <i>Hydra</i>), <i>Obelia</i>-polyp and medusa, and <i>Ephyra</i> larva, 5. Study of Corals-<i>Astraea</i>, <i>Fungia</i>, <i>Meandrina</i>, <i>Corallium</i>, <i>Gorgonia</i> and <i>Pennatula</i>. 6. Helminthes: Systematics of <i>Planaria</i>, <i>Fasciola hepatica</i> and <i>Taenia solium</i>, <i>Ascaris</i>- Male and female (Specimens). Slides of T.S. of <i>Planaria</i>, T.S of male and female <i>Ascaris</i>. 7. Annelida: Systematics of <i>Nereis</i>, <i>Heteronereis</i>, <i>Sabella</i>, <i>Aphrodite</i> (Specimens). Slide of T.S. of Earthworm through typhlosole. 8. Arthropoda: Systematics of <i>Panaeus</i>, <i>Palaemon</i>, <i>Astracus</i>, Scorpion, Spider, <i>Limulus</i>, <i>Peripatus</i>, <i>Millipede</i>, <i>Centipede</i>, Praying mantis, Termite Queen, Moth, Butterfly, Dung beetle/Rhinoceros beetle (Any six specimens). Slide of Larvae- Nauplius, Zoea, Mysis. 9. Mollusca: Systematics of <i>Chiton</i>, <i>Mytilus</i>, <i>Aplysia</i>, <i>Pila</i>, <i>Octopus</i>, <i>Sepia</i> (Specimens) and

Glochidium larva (Slide).

10. **Shell Pattern**-*Unio, Ostrea, Cypria, Murex, Nautilus, Patella, Dentalium*, Cuttle bone.
11. **Echinodermata**: Systematics of Sea star, Brittle star, Sea Urchin, Sea cucumber, Sea lilly (Specimens). Slides of Bipinnaria larva, Echinopluteus larva and Pedicellaria.
12. **Harmful Non-Chordates**: Soil Nematodes. Agricultural, veterinary and human pests of Arachnida and Arthropoda ().
13. **Beneficial Non-Chordates**:
 - a. **Sericulture**: Life cycle of *Bombyx mori*. Uzi fly-(Pest), Cocoon, Raw silk.
 - b. **Apiculture**: Any 2 Species of honey bee and bee wax.
 - c. **Pearl Culture**: Pearl Oyster and Natural Pearls.
14. **Virtual Dissection/ Cultured specimens**: Earthworm –Nervous system,
15. **Virtual Dissection/ Cultured specimens**:
 - Prawn - Nervous system.
 - Cockroach- Salivary Apparatus, Digestive and nervous system,.

V Semester Zoology Core Course Content

Program Name	B.Sc	Semester	V
Course Title	Chordates and Comparative Anatomy (Theory)		
Course Code	ZOO C-11-T	No. of Credits	4
Contact hours	60 hours (4hrs/week)	Duration of SEA/Exam	2 ^{1/2} hrs
Formative Assessment Marks	40	Summative Assessment Marks	60

Course Outcomes (COs):

After the successful completion of the course, the student will be able to:

CO1. To demonstrate comprehensive identification abilities of chordate diversity

CO2. Able to explain structural and functional diversity of chordate diversity

CO3. To understand evolutionary relationship amongst chordates

CO4. To take up research in biological sciences.

CO5. To realize that very similar physiological mechanisms are used in very diverse organisms.

CO6. To Get a flavor of research by working on project besides improving their writing skills. It will further enable the students to think and interpret individually.

Semester V Zoology- Paper- VI

Chordates and Comparative Anatomy

mLAC Syllabus	Hr
Unit I	15
Chapter 1: Chordates:	1
<ul style="list-style-type: none"> • Origin of Chordates. (Hemichordate and annelid Theory) • General characters of chordates and classification upto classes with examples. 	1
Chapter 2: Hemichordata:	1
<ul style="list-style-type: none"> • General Characters, Affinities and systematic position of Hemichordata. • Type Study of <i>Balanoglossus</i> – Habit and Habitat, Morphology, Coelom. • Tornaria larva and its affinities between non-chordates and Chordata. 	2 1
Chapter 3:Urochordata :	1
<ul style="list-style-type: none"> • Type Study of <i>Herdmania</i>-Habit and Habitat, Morphology • Ascidian tadpole- structure and its retrogressive metamorphosis. 	2
Chapter 4: Cephalochordata:	3
<ul style="list-style-type: none"> • Type Study of <i>Branchiostoma (Amphioxus)</i>-Habit and Habitat, Morphology, Feeding mechanism (filter feeding), excretory and circulatory system. 	
Chapter 5: Agnatha	1
<ul style="list-style-type: none"> • General characters of Agnatha and classification upto classes. • Salient features of Cyclostomata and Ostracodermi with orders and examples. • Ammocoete larva and its significance. 	1 1 1
Unit II	15
Chapter 6: Vertebrates:	1+5
<ul style="list-style-type: none"> • General characters and Classification of different classes of vertebrates (Pisces, Amphibia, Reptilia, Aves, Mammalia) with examples. • General characters of Chondrichthyes and Osteichthyes. • Interesting features and evolutionary significance of Dipnoi. • Salient features of Placodermi with examples. • Interesting features of <i>Sphenodon</i> and <i>Archaeopteryx</i> (Connecting Link). • Salient features of Ratitae and Carinatae with examples. • Interesting features of mammalian orders (Insectivora, Carnivora, Chiroptera, Cetacea, Proboscidea, • Ungulata–Perissodactyla and Artiodactyla • Primates–Platyrrhiniand Catarhini) with examples. 	1 1 1 1 1 1 2 1 1
Unit III	15
Chapter 7. General account of Chordates:	1
<ul style="list-style-type: none"> • Types of caudal fins, scales and swim bladder in fishes. • Origin of Amphibia. • Neoteny and Paedogenesis. • Parental care in Pisces and Amphibians. • Adaptive radiation in extinct reptiles with suitable examples. • Temporal fossae in reptiles. • Poison apparatus and biting mechanism in snakes. 	1 1 2 1 1 1 2

<ul style="list-style-type: none"> • Flight adaptations in birds. • Dentition in mammals. • Evolution of molar tooth. • Migration in Pisces (catadromous-Eel, anadromous-Salmon, potamodromous-Carp), Birds (Latitudinal, Longitudinal, seasonal and Diurnal with example) 	1 2 2
Unit IV	15
Comparative Anatomy of Vertebrates: Chapter 8. Integumentary System: <ul style="list-style-type: none"> • Structure of skin and its derivatives in Pisces (Scoliodon), Amphibia (frog), Aves (Pigeon) and Mammals (Man). 	3
Chapter-10 Respiratory system <ul style="list-style-type: none"> • Comparative account of respiratory system in vertebrates: Pisces (Scolidon), Amphibian (Frog), Aves (Pigeon) and Mammals (Man). 	3
Chapter-11 Circulatory System <ul style="list-style-type: none"> • Comparative account of heart and aortic arches in vertebrates: Pisces (Scoliodon), Amphibian (Frog), Aves (Pigeon) and Mammals (Man). 	3
Chapter-12 Excretory System <ul style="list-style-type: none"> • Succession of kidney in vertebrates. 	2
Chapter-13 Nervous system <ul style="list-style-type: none"> • Comparative account of brain in vertebrates: Pisces (Scoliodon), Amphibian (Frog), Aves (Pigeon) and Mammals (Man). 	4

V Semester Zoology Core Course Lab Content

Course Title	Chordates and Comparative Anatomy Zoology	Practical Credits	2
Course Code	ZOO C12-P	Contact Hours	4 hrs/week
Formative Assessment	25 Marks	Summative Assessment	25 Marks

Practical Content:

mLAC Syllabus

1. Protochordata:

- Balanoglossus and its T. S through proboscis
- Ascidian/ *Herdmania* and *Amphioxus*, T.S. of *Amphioxus* through pharynx and intestine.

2. Cyclostomata: *Petromyzon*, Ammocoete larva and *Myxine*.

3. Pisces:

- Cartilaginous Fishes – *Narcine*, *Trygon*, *Pristis*, *Mylobaties*
- Bony Fishes – Zebra fish, Hippocampus, Muraena, Ostracion, Tetradon, Pleuronectus, Diodon, Echeneis. (Any four).

4. Ornamental fishes:

- Siamese, Koi, Oscar, Betta Sp., Neon tetra, Guppies, Gold fish, Angle fish, Rainbow fish, Mollies (Any four).

5. Accessory respiratory organs : *Saccobranthus*, *Clarias* and *Anabas*.

6. Amphibia: *Rana*, *Bufo*, *Ambystoma*, *Axolotl* larva, *Necturus* and *Ichthyophis*.

7. Reptilia:

- Turtle, Tortoise, *Mabuya*, *Calotes*, Chameleon, *Varanus*.
- Snakes: Rat snake, Cobra, Krait, Russell's viper and Hydrophis;

8. Aves: Beak modifications in the following examples: Duck, Crow, Pigeon, Parrot

9. Mammalia: Mongoose, Squirrel, Pangolin, Hedge Hog, Rat.

10. Virtual Dissection/ Cultured specimens:

Shark/Bony fish: Afferent and efferent branchial systems,

11. Virtual Dissection/ Cultured specimens:

- Rat: Dissection (only demonstration) – Circulatory system (arterial and venous), Urinogenital system.

12. Comparative account of Skeletal System in Frog, Bird and man: Vertebrae and girdles

13. Comparative account of skin in shark, frog, pigeon and Mammal.

14. Comparative account of heart in shark, frog, pigeon and Mammal.

15. Comparative account of brain in Shark frog, pigeon and Mammal.

VI Semester Zoology Core Course Content

Program Name	B.Sc	Semester	VI
Course Title	Evolutionary & Developmental Biology (Theory)		
Course Code	ZOO C-15-T	No. of Credits	4
Contact hours	60 hours (4hrs/week)	Duration of SEA/Exam	2 ^{1/2} hrs
Formative Assessment Marks	40	Summative Assessment Marks	60

Course Outcomes (COs):

After the successful completion of the course, the student will be able to:

- Understand that by biological evolution we mean that many of the organisms that inhabit the earth today are different from those that inhabited it in the past.
- Understand that natural selection is one of several processes that can bring about evolution, although it can also promote stability rather than change.
- Understand how the single cell formed at fertilization forms an embryo and then a full adult organism.
- Integrate genetics, molecular biology, biochemistry, cell biology, anatomy and physiology during embryonic development.
- Understand a variety of interacting processes, which generate an organism's heterogeneous shapes, size, and structural features.
- Understand how a cell behaves in response to an autonomous determinant or an external signal, and the scientific reasoning exhibited in experimental life science.

Semester VI Zoology-Paper-VII Evolutionary & Developmental Biology (Theory)

mLAC Syllabus	Hr
Unit I	16
Chapter 1: Theories of Evolution:	
• Origin of Life- Special creation, Pangenesis, Abiogenesis, Biogenesis, Biochemical origin of Life	2
• Historical review of evolutionary concept: Preformation Theory, Theory of Epigenesis, Biogenetic Law, Germplasm Theory, Theory of Catastrophism, Theory of Orthogenesis, Lamarckism, Darwinism (Natural, Sexual and Artificial selection).	2
• Modern synthetic theory of evolution- Neutral Theory of Evolution.	1
• Adaptive radiations: Cursorial, Arboreal, Volant, aquatic and fossorial forms.	1
• Patterns of evolution Divergence, Convergence, Parallel, Co-evolution	2
Chapter 2: Population Genetics:	
• Microevolution and Macroevolution: allele frequencies, Gene frequencies.	2

<ul style="list-style-type: none"> • Hardy- Weinberg equilibrium- Definition and significance 	2
<ul style="list-style-type: none"> • Forces of evolution: mutation 	2
<ul style="list-style-type: none"> • Natural selection-Introduction, Stabilization, Directional, Disruptive selection. 	2
<ul style="list-style-type: none"> • Genetic drift- Founder's Effect and Bottle Neck Effect. 	
Unit II	14
Chapter 3 Direct Evidences of Evolution:	
<ul style="list-style-type: none"> • Types of fossils-Actual remains, Petrified fossils, Moulds, Casts, Tracks and Trials. 	2
<ul style="list-style-type: none"> • Incompleteness of fossil record 	1
<ul style="list-style-type: none"> • Dating of fossils-Stratigraphy, Biostratigraphy, Radiometry-Lead method, Carbon method, Potassium-Argon method, Fission track method. 	2
<ul style="list-style-type: none"> • Phylogenetics Introduction, Phylogenetic tree, Phylogeny of horse and Human 	5
Chapter 4 Species Concept and Extinction:	
<ul style="list-style-type: none"> • Biological species concept (Advantages and Limitations) 	1
<ul style="list-style-type: none"> • Modes of speciation (Allopatric, Sympatric). 	1
<ul style="list-style-type: none"> • Mass extinction (Causes, Names of five major extinctions) 	2
Unit III	14
Chapter 5. Gamete Fertilization and Early Development:	
<ul style="list-style-type: none"> • Gametogenesis- Spermatogenesis- formation of spermatids, spermiogenesis, sertoli cells and their role in spermatogenesis. Structure of a typical mammalian sperm, Oogenesis. 	3
<ul style="list-style-type: none"> • Fertilization- Types, Mechanism of fertilization, monospermic and polyspermic fertilization with examples. 	2
<ul style="list-style-type: none"> • Cleavage pattern-Radial, Biradial ,Spiral ,Bilateral, Determinate and Indeterminate with examples. 	1
<ul style="list-style-type: none"> • Gastrulation, fate maps and Morphogenesis in Frog. 	2
Chapter 6 Developmental Genes:	
<ul style="list-style-type: none"> • General concepts of organogenesis 	1
<ul style="list-style-type: none"> • Introduction to genetic basis of embryonic development and Developmental control genes (Homeobox genes). 	5
Unit IV	16
Chapter 7. Early Vertebrate Development:	
<ul style="list-style-type: none"> • Early development of mammals including placentation- Types - Yolk sac and Chorionic-allantoic placenta; Deciduate and non-deciduate placenta; morphological and histological placenta types with suitable examples. 	3
<ul style="list-style-type: none"> • Metamorphosis (Early and Late, Role of hormones in metamorphosis) in frog, 	2
<ul style="list-style-type: none"> • Regeneration- Regeneration in Sponges, Hydroid coelenterates, Earthworms, Star fishes, 	2
<ul style="list-style-type: none"> • Environmental regulation of development. 	1
Chapter 8 Late Developmental Processes:	
<ul style="list-style-type: none"> • Development of eye, kidney, limb in amphibian. 	3
<ul style="list-style-type: none"> • Mammalian female reproductive cycles- estrous menstrual cycle. 	3
<ul style="list-style-type: none"> • Aging- physiology of aging and oxidative stress 	1
<ul style="list-style-type: none"> • The biology of senescence 	1

VI Semester Zoology Core Course Lab Content

Course Title	Evolutionary & Developmental Biology	Practical Credits	2
Course Code	ZOO C16-P	Contact Hours	4 hrs/week
Formative Assessment	25 Marks	Summative Assessment	25 Marks

Practical Content

mLAC Syllabus
1. Study of fossils from models/pictures.
2. Study of a) Homologous organ- Fore limb of Frog, Bird and Mammal; Mouth parts of cockroach, house fly, butterfly and mosquito. b) Analogous organ- Vertebrate eye, Cephalopod eye; Insect, Bird wing
3. Study and verification of Hardy-Weinberg Law by chi square analysis. (problems on Hardy-Weinberg Law)
4. Types of eggs based on quantity and distribution of yolk: Sea urchin, insect, frog, Chick.
5. Graphical representation and interpretation of data of height/ weight of a sample of 100 humans in relation to their age and sex.
6. Early development of frog: Cleavage, Blastula, Gastrula with Yolk plug stage and Neurula
7. Placenta: histological types
8. Study of different stages of chick development through Windowpane technique (Demonstration only)
9. Study of development of chick embryo through incubated chick eggs up to 96h (18, 24, 36, 48, 72)
10. Study of adaptive radiations in feet of birds- Parrot, Crow, Duck, Pigeon and mouth parts of insects- Butterfly, Housefly, Mosquito, Cockroach.

VI Semester Zoology Core Course Content

Program Name	B. Sc	Semester	VI
Course Title	Environmental Biology, Wildlife Management & Conservation (Theory)		
Course Code	ZOO C-17-T	No. of Credits	4
Contact hours	60 hours (4hrs/week)	Duration of SEA/Exam	2 ¹ / ₂ hrs
Formative Assessment Marks	40	Summative Assessment Marks	60

Course Outcomes (COs):

After the successful completion of the course, the student will be able to:

- CO1. Develop an understanding of how animals interact with each other and their natural environment.
- CO2. Develop the ability to use the fundamental principles of wildlife ecology to solve local, regional and national conservation and management issues.
- CO3. Develop the ability to work collaborative team-based projects.
- CO4. Gain an appreciation for the modern scope of scientific inquiry in the field of wildlife conservation management.
- CO5. Develop an ability to analyze, present and interpret wildlife conservation management in formation.

Semester VI Zoology – Paper-VIII
Environmental Biology, Wildlife Management & Conservations (Theory)

mLAC Syllabus	Hr
Unit I	15
Chapter 1: Ecology: <ul style="list-style-type: none"> • Introduction to ecology, Definition, Sub-divisions and Scope of Ecology. • Concept of habitat: Micro- habitat and macro-habitat. • Concept of Ecological Niche: niche width and overlap; fundamental and realized niche 	2
Chapter 2: Environment: <ul style="list-style-type: none"> • Definition, types of environment- terrestrial, aquatic, desert, grassland and aerial environment. 	3
Chapter 3: Ecosystem : <ul style="list-style-type: none"> • Structure and function-abiotic and biotic components, food chain, food web, trophic pyramids-types, energy flow and mineral cycling, primary production and decomposition • Structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water-lentic,lotic, marine, eustarine). • Ecological succession 	6
Chapter 4: Environmental Biology: <ul style="list-style-type: none"> • Adaptive features of plants and animals to different environment. Ecological factors:- • Limiting factors: Liebig’s law of minimum and Shelford’s law of tolerance • Ecotone and edge effect, weather, climate. 	4
Unit II	15
Chapter 5: Pollution: Definition and Types of pollutants:	1
<ul style="list-style-type: none"> • Air- Natural and anthropogenic sources of pollution, primary and secondary pollutants, transport and diffusion of pollutants, methods of monitoring and control of air pollution), 	2
<ul style="list-style-type: none"> • Soil- Industrial waste effluents, heavy metals and their interactions with soil components, chemical and bacteriological sampling as analysis of soil quality, soil pollution control. 	2
<ul style="list-style-type: none"> • Water- Sources and consequences of water pollution, physico-chemical and bacteriological sampling, Analysis of water quality and standard, sewage and wastewater treatment and recycling. 	2
<ul style="list-style-type: none"> • Thermal pollution: Sources, Methods to mitigate 	1
<ul style="list-style-type: none"> • Ozone layer depletion, biomagnification, bioaccumulation and bioremediation (metal contaminated soils, spilled oil, grease deposits and synthetic pesticides) 	3
<ul style="list-style-type: none"> • Greenhouse effect and Global warming, climate change 	1
<ul style="list-style-type: none"> • Effects of pollution on plants and animals 	2
<ul style="list-style-type: none"> • Biosensors to detect environmental pollutants 	1
Unit III	15
Chapter 6. Wildlife Conservation: <ul style="list-style-type: none"> • Community forest eco-restoration, eco-sensitive zones, biodiversity hotspots in India. 	3
<ul style="list-style-type: none"> • Ex-situ conservation (captive breeding programs, population reintroduction and translocations, botanical gardens, zoological gardens, gene banks, gene pool, 	5

<p>cryopreservation, pollen storage, seed banks, Bio bank, Seedling, tissue culture and DNA banks, artificial seed technology, Reproduction Technologies)</p> <ul style="list-style-type: none"> • In-situ conservation (Wild life sanctuaries, National parks and Biosphere reserves) • Coastal and marine biodiversity, conservation in relation to climate change • Citizen Science (Social responsibilities of Citizen in Conservation) 	<p>3 3 1</p>
Unit IV	15
<p>Chapter 7. Wildlife Management:</p> <ul style="list-style-type: none"> • Importance of Biodiversity and various ecosystem services • Project Lion, Project Tiger, Project Elephant. Wildlife Protection Act 1972, amended 2002., Forest conservation act 1980, Environment protection act 1986, • Causes and depletion of wildlife, inventory and classification of wetlands and their biotic components, general strategies and issues, concept of home range and territory, animal census, tracing movement • Remote sensing and GIS-Definition, components and applications. Remote sensing application in Forestry, Ecology and environment (spatial mapping and modeling) • IUCN conservation categories- Endangered, Threatened, Vulnerable, Red Data Books, National conservation authorities (National Biodiversity Authority and National Tiger Conservation Authority) and International conventions namely RAMSAR convention, convention on biological diversity. 	<p>2 6 3 4</p>

VI Semester Zoology Core Course Lab Content

Course Title	Environmental Biology, Wildlife Management & Conservation (Practicals)	Practical Credits	2
Course Code	ZOO C18-P	Contact Hours	4 hrs/week
Formative Assessment	25 Marks	Summative Assessment	25 Marks

Practical Content

mLAC Syllabus	
1. Water quality parameters assessment:	Collection of water sample, Dissolved Oxygen (O ₂), Carbon dioxide (CO ₂), Chlorides and Salinity estimation in water.
2. Analysis of physico-chemical parameters of soil:	pH, moisture, temperature and organic matter.
3. Analysis of air pollution:	Air monitoring for particulate matter
4. Visit of pond and lakes:	Collection and identification of flora and fauna of selected ecosystems. Collection, preservation and estimation of zooplanktons..
5. Demonstration of field equipments used in wildlife census:	Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System, Various types of cameras and lenses.

6. Identification of wild animals: Wild animal's- pugmarks, hoof marks scats, pellet groups, nest, antlers. Demonstration of field techniques for wild flora and fauna.

7. Estimation of density and relative abundance of species using quadrants and plotless methods