

**Syllabus for B.Sc. Zoology (NEP)**  
**Credit Based System**  
**B.Sc. Semester - V**  
**DSC - V**  
**Developmental Biology**

**Course Objectives**

1. To impart knowledge about fundamental developmental processes such as fertilization, cleavage, and organogenesis.
2. To enable students to analyze the role of genetic and environmental factors in development.
3. To train students in experimental techniques and research methodologies related to developmental biology.

**Course Outcomes (COs)**

Upon successful completion of this course, students will be able to:

- CO1:** Demonstrate an in-depth understanding of key developmental processes such as fertilization, cleavage, gastrulation, and organogenesis by illustrating their cellular and molecular mechanisms. *(L3)*
- CO2:** Investigate the influence of genetic, environmental, and epigenetic factors on development by analysing experimental data and generating hypotheses. *(L4)*
- CO3:** Construct models depicting major developmental pathways, integrating concepts from morphogenesis, differentiation, and pattern formation. *(L4)*
- CO4:** Evaluate the role of developmental genes and signalling pathways using comparative analysis in model organisms like *Drosophila*, *Xenopus*, and *Zebrafish*. *(L4)*
- CO5:** Design and conduct experiments related to developmental biology techniques such as embryo dissection, in situ hybridization, and immunostaining to demonstrate practical understanding. *(L4)*
- CO6:** Assess the mechanisms of aging and regeneration by examining cellular processes and identifying potential therapeutic interventions. *(L4)*

## **Paper V:- Developmental biology**

### **UNIT – I:-**

**(12Periods)**

#### **Gametes to fertilization in Frog**

- 1.1 Spermatogenesis:-Process of hormonal control, structure of sperm.
- 1.2 Oogenesis : Mechanism and hormonal control, egg structure
- 1.3 Sperm egg recognition and fusion : Chemotaxis , acrosome reaction and fusion.
- 1.4 Post fertilization events (prevention of polyspermy, fast block slow block rearrangement of egg cytoplasm)

### **UNIT – II:-**

**(12Periods)**

#### **Early embryonic development in frog:**

- 2.1 Embryonic Cleavage : Cleavage properties, Types of egg based on yolk content, factor affecting cleavage, Type of cleavage.
- 2.2 Blastula of frog : Formation and structure
- 2.3 Gastrulation of frog : Cell movement in gastrulation, Process of formation of gastrula.
- 2.4 Germ layer formation : Cell specification, commitment and differentiation

### **UNIT – III:-**

**(12Periods)**

#### **Axis specification in embryo:**

- 3.1 Embryonic organizer in frog: Concept of induction, Spemann-Mangold experiment, primary organizer.
- 3.2 Cell cell communication : concept of cell signalling, types of signalling, basic concept of cell receptors.
- 3.3 Concept of morphogen gradient:
- 3.4 Basics of axis specification in *Drosophila*.

### **UNIT – IV:-**

**(12Periods)**

#### **Gene and development:**

- 4.1 Sex determination in bird and human
- 4.2 Dosage compensation : heterochromatinization, mechanism and significance
- 4.3 Cloning by nuclear transfer in mammals.
- 4.4 Teratogens : Effect on development of embryo, alcohol and retinoic acid as teratogen.

**UNIT – V:-****(12Periods)****Techniques in developmental biology:**

- 5.1 Multiple ovulation.
- 5.2 IVF,ICSI.
- 5.3 *In situ hybridization*: Principle, types and application.
- 5.4 Cryopreservation : Principles mechanism and application (gametes & embryos).

**UNIT – VI:-****(12Periods)****Developmental biology in human welfare:**

- 6.1 Model organisms with examples *Drosophila & C.elegans*
- 6.2 Transgenic animals with examples
- 6.3 Sources & Basics of stem cells culturing with examples of application.
- 6.4 Induced Pluripotency Basics and genes involved.

**Practical based on Developmental Biology–**

1. Study of permanent slides of Frog embryology : T.S. Blastula, T.S.Gastrula, T.S. Neurula, T.S. tadpole passing through internal and external gill stage.
2. Study of permanent slides of chick embryology W.M.: 18hrs,24hrs, 36 Hrs, 72hrs. 96 hrs.
3. Semen analysis : Motility and Sperm count (Source of semen : Government artificial insemination centre).
4. Sperm vitality study using suitable stains (Source of semen : Government artificial Insemination centre).
5. Study of any model organism –Lifecycle stages.
6. Study of Egg Structure (Avian Egg)
7. Study of teratogenic effects of various chemicals/teratogens on *Drosophila*/chick development
8. Histology of male and female reproductive organs (Testis, Ovary, Uterus, Fallopian tube and accessory reproductive glands) With the help of already available permanent slides/ ICT tools/ charts/ photographs etc.
9. Demonstration of Barr body
10. Submission of Field report / Diary on Congenital disorders / Birth defects / Life Cycles of Animals in your surroundings

	<b>Distribution of Marks-</b>	<b>Total Marks</b>	<b>30</b>
1.	Identification and Comment on spots (2 Slides on Frog embryology, 2 Slides on chick Embryology, 1 Slides on Reproductive Histology)		10
2.	Experiment on Sperm Count/Hypo-osmotic test for Fertility		04
3.	Experiment on Sperm Vitality/Preparation of Slides of Barr Body		04
4.	Submission of Field diary		04
5.	Submission of certified practical record		04
6.	Viva voce		04

### **References Books:-**

1. Leon W. Browwer – Developmental Biology. 2<sup>nd</sup> Edition. Saunders College publishing.
2. R. A. Pedersen and G.P. Schatten – Current Topics in Developmental Biology eds.
3. S.C. Goel-Principles of animal developmental biology, Himalaya Publishing House.
4. S.F.Gilbert- Developmental Biology, 4<sup>th</sup> Edn. Sinauer Associates Inc.Publishers.
5. D.A. Ede – An Introduction to Developmental Biology.
6. Paul Weiss- Principles of developmental: edited by Hafner publishing company  
New York.
7. John Philip Trinkaused. Tom Aloisi – Cells into organs. 2<sup>nd</sup> Edition. The forces that  
shape the Embryo.
8. Lewis Wolpertetal.- Principles of development, Oxford University Press.
9. B.M. Patten & B.M. Carlson – Foundations of Embryology. Tata Mc Graw Hill  
Publishing Company Ltd., New Delhi.
10. Balinsky(1981) 5<sup>th</sup>Ed- An Introduction to Embryology,(CBS College Publishing).
11. Austin and Short – Embryonic and foetal development. Cambridge University Press by,  
1982, 1994 2<sup>nd</sup> Ed.
12. Marshall's Physiology of Reproduction Longmont, Green and Co.LondonVol.1&2.  
Lamming 1984, 2000.

**Syllabus for B.Sc. Zoology (NEP)**  
**Credit Based System**  
**B.Sc. Semester – V**  
**DSC – VI - Biological Chemistry**

**Course Objectives**

- CO 1: To introduce students to the fundamental concepts and scope of biological chemistry.
- CO 2: To provide an understanding of the properties of water and its role in biological systems.
- CO 3: To explore the structure, classification, and functions of biomolecules, including carbohydrates, proteins, lipids, and nucleic acids.
- CO 4: To explain the principles of bioenergetics, thermodynamics, and metabolism in living organisms.
- CO 5: To describe the role of ATP in energy transfer and enzyme functions in biochemical reactions.

**Course Outcome**

1. Define fundamental concepts of biological chemistry, including the properties of water, acids, bases, and buffers.
2. Identify the classification, structure, and functions of carbohydrates, proteins, lipids, and nucleic acids.
3. Explain the properties and classification of amino acids and their role in protein structure.
4. Describe the principles of bioenergetics, thermodynamics, and metabolism in living systems.
5. Illustrate the structure and significance of ATP in energy transfer.
6. Explain enzyme properties, classification, and the mechanism of enzyme action.
7. Apply basic biochemical concepts to understand metabolic reactions and enzyme activities.

## **Unit 1**

- 1.1 Introduction to Biological Chemistry: Definition, Scope and History
- 1.2 Physical Properties of Water, Water as a Polar molecule, Hydrophobic substances and hydrophilic substances
- 1.3 Chemical Properties of water: Ionization of water, pH
- 1.4 Acid, Bases and Buffers

## **Unit 2**

- 2.1 Carbohydrates: Definition and Function of Carbohydrates
- 2.2 Classification of carbohydrates:
- 2.3 Monosaccharides and Disaccharides: examples, structures, properties and uses
- 2.4 Oligosaccharides and Polysaccharides: examples, structures and functions.

## **Unit 3**

- 3.1 Proteins: Definition and functions
- 3.2 Amino acids: Nomenclature, Physical and Chemical properties of amino acids.
- 3.3 Classification of amino acids
- 3.4 Structure of Proteins: Primary, Secondary, Tertiary and Quaternary structure.

## **Unit 4**

- 4.1 Lipids: Definition, Properties and functions
- 4.2 Classification of lipids
- 4.3 Nucleic acids: Definition and functions
- 4.4 Structure and components of nucleic acids

## **Unit 5**

- 5.1 Bioenergetics: Concept and definition
- 5.2 Thermodynamics: First and Second law of thermodynamics
- 5.3 Metabolism: Catabolic and Anabolic reactions with examples
- 5.4 Adenosine triphosphate (ATP): structure and uses of ATP

## **Unit 6**

- 6.1 Enzymes: Definition, History and functions
- 6.2 Nomenclature, classification and properties of enzymes
- 6.3 Mechanism of enzyme action: Enzyme-substrate complex theory, Lock and Key Theory, Induced Fit Model
- 6.4 Factors affecting enzyme activity

**Practical :**

1. Preparation of normal and molar solutions
2. Preparation of Buffers: Phosphate and Acetate buffers
3. Qualitative tests of functional groups in carbohydrates
4. Qualitative tests of functional groups in proteins
5. Qualitative tests of functional groups in lipids.
6. Quantitative Estimation of sugars
7. Quantitative estimation of proteins
8. Paper chromatography of amino acids.
9. Action of salivary amylase under optimum conditions.
10. Effect of pH, temperature and inhibitors on the action of salivary amylase.

**Suggested Readings:**

1. Nelson & Cox: Lehninger's Principles of Biochemistry: McMillan (2000)
2. Zubay et al: Principles of Biochemistry: WCB (1995)
3. Voet&Voet: Biochemistry Vols 1 & 2: Wiley (2004)
4. Murray et al: Harper's Illustrated Biochemistry: McGraw Hill (2003) Elliott and Elliott: Biochemistry and Molecular Biology: Oxford University Press
5. Hames, B.D. and Hooper, N.M. (2000). Instant Notes in Biochemistry, II Edition, BIOS Scientific Publishers Ltd.,U.K.
6. Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R. (2008). Molecular Biology of the Gene, VI Edition, Cold Spring Harbor Lab. Press, PearsonPub.

**Syllabus for B.Sc. Zoology (NEP)**  
**Credit Based System**  
**B.Sc. Semester – V**  
**DSE - I :Paper I - Applied and Economic Zoology**

**Course Objectives :**

- Students acquires the knowledge and skills related to applied zoological fields
- Students acquires comprehensive understanding of varied applied and economic zoology fields
- To encourage the students to set up their own small scale establishment
- Students can train other job seekers by providing training thus recalling and spreading the knowledge they have acquired

**Course Outcome :**

- CO 1 Remember, Recall and Communicate the knowledge of Beekeeping and Honeybees
- CO 2 Identify, Analyze and Apply the knowledge of Apiculture for Human Welfare
- CO 3 Understand, Analyze and Apply the knowledge of Vermiculture in Agriculture
- CO 4 Describe and Apply the knowledge of Prawn culture and set up establishment
- CO 5 Memorize, describe and demonstrate the knowledge of Pearl culture and set up establishment
- CO 6 Understand, describe and demonstrate the knowledge of Sericulture

## **Unit I :Apiculture**

- 1.1 History of Beekeeping in India, Father of Modern bee science, Langstroth Bee Hive
- 1.2 Honey Bee – Life cycle of Indian bee, Common domesticated honey bee species
- 1.3 Honey Bee – Bee hive organisation, Castes and duties, Royal Marriage
- 1.4 Honey Bee– Pests, parasites, Diseases and their management

## **Unit II :Apiculture Industry**

- 2.1 Honey – Formation, Types, Physical and Chemical Properties, Uses
- 2.2 Honey – Harvesting, & Processing Equipments
- 2.2 Honey Bee – Products and their importance to Mankind
- 2.4 Honey Industry – Scope, Methods of Beekeeping

## **Unit III : Vermicomposting**

- 3.1 Earthworm – Life cycle, Prominent species
- 3.2 Vermicomposting –Types, Processing, Benefits and uses
- 3.3 Vermicompost Industry – Scope and Future, Small and Large scale Culture
- 3.4 Earthworm - Pests and Diseases

## **Unit IV : Prawn Culture Industry**

- 4.1 Introduction – Prawn farming in India
- 4.2 Prawn – Life cycle, Culture of Fresh Water Prawn
- 4.3 Indian Prawn Industry – Production, Economic Importance
- 4.4 Prawn Culture – Diseases and health management

## **Unit V : Pearl Culture Industry**

- 5.1 Introduction and History of Pearl Culture, distribution
- 5.2 Indian Pearl Oyster – Life Cycle of *Pinctada vulgaris*, Pearl farming
- 5.3 Pearl formation, Physical/Chemical properties of Pearl, Pearl quality improvement methods
- 5.4 Indian Pearl Industry – Scope, Products and Economic Importance

## **Unit VI: Sericulture**

- 5.1 Introduction and History of Sericulture, Seri products for Value addition
- 5.2 Silkworm *Bombyxmori*, Life Cycle and Biology, Structure of Silk gland
- 5.3 Silk – Nature, Properties, Processing and Management, Central Silk Board
- 5.4 Diseases of Silkworm and their Management

### **Suggested Reference Books :**

1. Economic Zoology – Sagarika Chaudhari, NCBA, New Delhi/Kolkata
2. Economic Zoology - Gaurav Tyagi, Sonali Publications, New Delhi
3. Economic Zoology - Shukla and Upadhyay, Rastogi Publications, Meerut
4. Economic Zoology - Sarkar, Kundu and Chaki, NCBA, Kolkata

**Syllabus for B.Sc. Zoology (NEP)**  
**Credit Based System**  
**B.Sc. Semester - V**  
**DSE - I - Paper II - Parasitology**

**Course Objective:**

1. To provide a comprehensive understanding of the fundamentals of parasitology, including definitions, historical context, and the significance of parasitic diseases.
2. To explore the life cycles, pathogenesis, and treatment options for major protozoan and helminthic parasites affecting human health.
3. To examine the epidemiology and control measures for ectoparasites and vector-borne diseases, highlighting their impact on public health.

**Course Outcome**

- C01: acquire knowledge of parasitology, Define key terms, history, scope, and importance. Understand host-parasite relationships, parasite types, and the epidemiology, transmission, and prevention of parasitic infections.
- C02: comprehensively understand and classify the causative agents, life cycles, pathogenesis, clinical features, diagnosis, treatment, and prevention of amoebiasis and malaria.
- C03: describe parasite life cycles with diagrams. Apply knowledge of epidemiology to propose control and prevention strategies for parasitic infections. The causative agents, life cycles, diagnosis, and treatment of giardiasis and leishmaniasis.
- C04: describe the life cycles, pathogenesis, symptoms, and treatment of *Ascaris lumbricoides*, *Enterobius vermicularis*, and hookworms.
- C05: describe the life cycles, pathogenesis, and treatment of *Taenia solium* and flukes, including *Fasciola hepatica*.
- C06: differentiate the life cycles, symptoms, and control measures for lice, bed bugs, and mosquito-borne diseases, as well as the transmission and prevention of plague.

## **Unit I - Fundamentals of Parasitology**

- 1.1 Introduction to parasitology- Definition, History, Scope and Importance
- 1.2 Host-Parasite Relationships- Types of hosts, Host specificity and parasitic life cycles,
- 1.3 Types of Parasites- Endoparasite and Ectoparasite
- 1.4 Difference between parasitism and parasitoidism

## **Unit II- Protozoan Parasites - I**

- 2.1 Amoebiasis- Causative agent of *Entamoeba histolytica* and life cycle
- 2.2 Pathogenesis, clinical manifestation, diagnosis and treatment of amoebiasis.
- 2.3 Malaria- Causative Agents: *Plasmodium* spp. And Life Cycle (Human and Mosquito Stages)
- 2.4 Clinical Features and Complications, Control and Prevention of Malaria.

## **Unit III- Protozoan Parasites - II**

- 3.1 Giardiasis- Causative Agent: *Giardia lamblia*, and Life cycle
- 3.2 Transmission, Symptoms, Diagnosis and Treatment of Giardiasis
- 3.2 Leishmaniasis- Causative Agents: *Leishmania* spp., Types (Cutaneous, Mucocutaneous, Visceral)
- 3.4 Life Cycle, Pathogenesis, Diagnosis and Treatment

## **Unit IV- Helminthic Parasites - I**

- 4.1 Nematodes (Roundworms)-*Ascaris lumbricoides* and its Life Cycle,
- 4.2 Pathogenesis, Diagnosis and Treatment of *Ascaris lumbricoides*
- 4.3 *Enterobius vermicularis* (Pinworm): Life Cycle, Symptoms, Management
- 4.4 Hookworms: Types, Life Cycle, Clinical Features, Treatment

## **Unit V - Helminthic Parasites - II**

- 5.1 *Taenia solium*: Life Cycle,
- 5.2 Pathogenesis, Treatment of *Taenia solium*
- 5.3 Flukes- *Fasciola hepatica* morphology and life cycle
- 5.4 Clinical manifestation, diagnosis and treatment

## **Unit VI- Ectoparasites and Vector-Borne Diseases**

- 6.1 Lice: Types (Head, Body, Pubic), Life Cycle, Symptoms, Control
- 6.2 Mosquito-Borne Diseases: Dengue, Zika, Chikungunya - Vectors, Transmission, Clinical Features, Prevention
- 6.3 Bed Bugs (*Cimex* spp.): Life Cycle, Pathogenesis, Control Measures
- 6.4 Plague (*Yersinia pestis*): Transmission, Clinical Forms, Prevention

## **List of Books for reference**

### **Parasitology**

1. Brock Biology of Microorganisms (Ed. IX) M. T. Madigan J. M. Martinko and J.Parker. Prentice Hall International Publication.
2. The Nematode Parasite in Vertebrate, W. Youle and Maplestone.
3. General Parasitology, V. A. Dogiel.
4. Helminthology, E. C. Fausy.
5. Platyhelminthes and Parasitism, D.R.Birt.
6. Animal Parasite- O.W. Aisen
7. Parasitic Protozoa, J.P. Kreier and J.R. Baker. Allen and Unwin Press.
8. Medical and Veterinary Protozoology M. G. Kathering , A. James paul and V. Zaman. Churchill Livingstone

# VOCATIONAL SKILL ENHANCEMENT COURSE (VSEC)

Offered by Department of Zoology (Vocational Skill Course)

B.Sc. Semester V

Syllabus under Autonomy

Name of the course: VSEC – VSC III Techniques of Applied Zoology

## Practical

[4 hrs/week 15 weeks\* 4 pract = 60 P] [Credits 2]

### Course Objective:

1. To impart practical knowledge and hands-on skills in applied branches of zoology, specifically focusing on Apiculture and Sericulture.
2. The objective is to enable learners to understand the life cycles, rearing techniques, and economic importance of these organisms.
3. Through practical sessions, including field visits and demonstrations, students will gain competence in setting up and managing apiculture and sericulture units, thus preparing them for entrepreneurship or employment in these agro-based industries.

### Course Outcomes:

Upon successful completion of this course, students will be able to:

- CO 1. Demonstrate knowledge of Apiculture and sericulture.
- CO 2. Analyze the quality and types of bee products such as honey, beeswax, royal jelly, and propolis.
- CO 3. Evaluate the practical and commercial aspects of apiculture and sericulture through field visits and interaction with industry practices.
- CO 4. Apply practical skills to establish and manage small-scale apiary and sericulture units, fostering entrepreneurship and job readiness in applied zoology.

### PART A . Apiculture

1. Life cycle of honey bee
2. Castes of honey bees
3. Bee keeping equipments
4. Assembly of bee hive
5. Extraction of honey from honeycomb
6. Quality testing of honey
7. Other beehive products
8. Visit to established apiary centre

### PART B. Sericulture

1. Mulberry and non-mulberry Sericulture
2. Study of Life cycle of *Bombyxmori*.
3. Establishment of mulberry garden.
4. Silkworm *Bombyxmori* rearing technology
5. Visit to various sericulture centres.

**Mode of Evaluation :** Continuous internal evaluation (no end semester examination) / Poster presentation / Project / Presentation / Assignment / Quiz Total Marks :- 100

**Syllabus for B.Sc. Zoology (NEP)**  
**Credit Based System**  
**B.Sc. Semester – VI**  
**DSC VII**  
**Mammalian Physiology**

**Theory – 100 =70 exam + 30 internal**

**Course objectives ---**

- Able to recall the physiological processes of mammal.
- Analyze Physiological Processes and Adaptations: Assess how different physiological systems interact to maintain homeostasis
- Apply Knowledge to Clinical and Practical Situations: Apply knowledge of physiological mechanisms to develop and recommend appropriate interventions for managing health conditions, including respiratory disorders, blood disorders, and hormonal imbalances.

**Course outcome**

- Recall the structure of the respiratory organs and list the mechanisms involved in breathing.
- Explain the functions of blood, the process of blood coagulation, and the significance of different blood groups and the Rh-factor. Describe the structure of the human heart, its pacemaker, and the cardiac cycle.
- Apply the sliding filament theory to analyze how changes in muscle structure affect muscle contraction. Use knowledge of neuron structure to assess the impact of myelination on nerve conduction.
- Able to describe overall process of digestion and excretion.
- Identify and describe the structure and functions of major endocrine glands.
- Explain how hormonal regulation affects reproduction and lactation.

## **UNIT I : Respiratory Physiology**

- 1.1 Respiration: Structure of respiratory organs: Lungs , mechanism of breathing
- 1.2 Respiratory volume and capacities
- 1.3 Transport of gases: O<sub>2</sub> and CO<sub>2</sub> Transport, Haemoglobin
- 1.4 Neurophysiologic control of respiration

## **UNIT II: physiology of circulation**

- 2.1 Circulation: Blood : Definition and its constituents, functions of blood.
- 2.2 Blood coagulation factors, extrinsic, intrinsic pathways, blood groups ABO system and Rh-factor.
- 2.3 Heart: Structure of human heart, pace maker, Cardiac cycle.
- 2.4 Lymph : composition and functions , location of lymph nodes

## **UNIT III: Muscle and Nerve physiology**

- 3.1 Muscle Physiology: Types of Muscles: striated, non-striated and cardiac muscles
- 3.2 E.M. Structure and Chemical Composition of striated muscle. Mechanism of muscle contraction (Sliding filament theory).
- 3.3 Nerve Physiology: Neuron: E.M. Structure of neuron and Types : Myelinated and non Myelinated nerve fibres,
- 3.4 Resting potential, Action potential, saltatory nerve impulse conduction. Synapse and synaptic transmission(with acetyl choline as an example)

## **UNIT IV: Digestive and Excretory Physiology**

- 4.1 Nutrition and Digestion: Structure and functions of digestive system and associated glands;
- 4.2 Digestion and absorption of proteins, carbohydrates and lipids.
- 4.3 Excretion:Structure of excretory system, Uriniferous tubule ;
- 4.4 Mechanism of urine formation ; normal and abnormal constituent of urine; concept of dialysis

## **UNIT V : Endocrinology**

- 5.1 Endocrine system: Hormones and their classification
- 5.2 Structure & Functions of Endocrine Glands : Pineal Gland, Hypothalamus,
- 5.3 Pituitary Gland, Thyroid Gland, Parathyroid Gland,
- 5.4 Adrenal Gland, Islets of Langerhans

## **UNIT VI : Reproductive Physiology**

- 6.1 Reproductive Physiology: Estrous and menstrual cycle.
- 6.2 Hormonal control of Reproduction in males and female.
- 6.3 Structure and Physiology of Human Placenta
- 6.4 Physiology of Lactation

### **Practical :**

1. Estimation of hemoglobin percentage with the help of haemometer.
2. Preparation of Haemin crystals.
3. Blood group detection
4. R.B.C. count.
5. W.B.C. count.
6. Measurement of blood pressure.
7. Action of salivary amylase on starch.
8. Qualitative detection of nitrogenous waste products (Ammonia, urea, uric acid) in given sample.
9. Estimation of glucose.
10. Qualitative analysis of carbohydrate, lipid and protein.
11. Field Report / Diary on disorders / Diseases observe in your surrounding (Survey Report)

11. Study of histological slides of Mammal – T.S. kidney, pituitary, thyroid, adrenal, testis, ovary; uterus, placenta, medullated and non medullated nerve fiber, smooth and striated muscle

**Distribution of Marks –**

**Total Marks 50 ---15 internal (Record – 10 + internal viva -5 )+ 35 external exam**

1. Physiological Expt.	10
2. Physiological Expt.	05
3. Spotting (A To E)	05
4. Submission of Diary	05
5. Viva - voce	10

**Reference Books—**

Guyton and Hall-Textbook of Medical Physiology

Lauralee Sherwood - Human Physiology: From Cells to Systems

Chatterjee, C.C, - Human Physiology Vol-I and II

Best and Taylor - Physiological basis of Medical practice

Prosser and Brown - Comparative Animal Physiology

Hoar, W.S. - General And Comparative Physiology..

**Syllabus for B.Sc. Zoology (NEP)**  
**Credit Based System**  
**B.Sc. Semester – VI**  
**DSC – VIII**  
**Basic Immunology**

**Course Objective**

- 1 The course provides students with a comprehensive understanding of the fundamental concepts of immunology, including its historical development and key principles of the innate and adaptive immune systems.
- 2 The course introduces students to the structure, function, and interaction of the cells, organs, and molecules involved in the immune response, including antigens, antibodies, and major histocompatibility complexes.
- 3 This course equips students with practical skills in immunological assays and techniques, such as ELISA, Western blotting, and antigen-antibody interactions, enabling them to apply these methods in various practical settings for analysis.
- 4 The course enhances students' ability to analyse and interpret the role of the immune system in health and disease, including hypersensitivities, immunodeficiencies, autoimmune diseases, and the principles of vaccination and immunotherapy.

**Course Outcome**

- 1 Understanding and remembering the basic concepts and components of the immune system, including its cells, organs, and mechanisms of action.
- 2 Discrimination and identifying differences between the innate and adaptive immune systems, including primary and secondary immune responses.
- 3 Demonstrating the ability to investigate blood groups and other immunological aspects by applying techniques such as ELISA and Western blotting in practical settings.
- 5 Recognition and interpretation on implications of immune system dysfunctions, including hypersensitivities and autoimmune diseases, on human health.
- 6 Analysing the role of immunological principles, such as vaccination and immune modulation, in disease prevention and treatment.

## **UNIT I:**

- 1.1 Introduction to Immunology: Historical perspective. Definition of Immunity and Immunology. Overview of Immune System.
- 1.2 Innate immune system: Definition, Anatomical and physiological barriers to Infection.
- 1.3 Inflammation: Cardinal signs of inflammation
- 1.4 Adaptive Immunity: Definition, Characteristic Attributes, Humoral and Cell mediated Immunity

## **UNIT II:**

- 2.1 Hematopoietic stem cells and Haematopoiesis. Cells of the myeloid and Cells of the lymphoid lineage.
- 2.2 Cells of the immune system: Macrophages, Neutrophils, Eosinophil, Basophil, NK Cells, B- Lymphocytes, T- Lymphocytes, helper T(TH) cells, cytotoxic T (TC) cells.
- 2.3 Organs of the Immune system: Introduction to Primary Lymphoid Organs, Thymus and bone marrow.
- 2.4 Introduction to Secondary Lymphoid Organs, Lymph nodes.

## **UNIT III:**

- 3.1 Antigens: Properties (foreignness, molecular size, heterogeneity) and haptens.
- 3.2 Antibody: Basic structure of Antibodies, Classes of Antibodies
- 3.3 Antigen-Antibody interaction, Antigen-Antibody principle of interaction, Precipitation reaction, Agglutination reaction.
- 3.4 Major histocompatibility complex - Structure of MHC I & II.

## **UNIT IV:**

- 4.1 Antigen Processing and Presentation: Antigen presenting cells, Role of antigen presenting cells.
- 4.2 Exogenous and endogenous antigen processing and presentation pathways: Cytosolic Pathway and Endocytic Pathway.
- 4.3 Introduction to the Complement system, Functions of the complement system, components of the complement system.
- 4.4 Classical and alternative Pathway of complement activation.

## **UNIT V**

- 5.1 Cytokines: Basic properties and functions of cytokines.
- 5.2 Hypersensitivity (HS): Type I: Allergies and anaphylaxis – IgE, Mast cell degranulation, biologically active agents released in reactions, Clinical manifestations.
- 5.3 Type II: Antibody mediated HS reactions; Mechanism, Haemolytic-disease of new born (HDN).
- 5.4 Type III: Hypersensitivity: Immune complex mediated Hypersensitive reactions: Mechanism & pathogenicity of type III. Type IV: Delayed type (or) cell-mediated HS reactions.

## **UNIT VI**

- 6.1 Immune Deficiencies: basic primary and secondary deficiencies.
- 6.2 Acquired Immunodeficiency Syndrome (AIDS): HIV structure and life cycle. Preventive measures.
- 6.3 Introduction to Autoimmune Diseases, Organ-Specific Autoimmune Diseases, Type 1 diabetes mellitus.
- 6.4 Vaccines: Whole-Organism Vaccine, Purified Macromolecules as Vaccines.

## **Practical.**

1. Histological study of the Primary Lymphoid organ: Bone marrow and Thymus. through slides/photographs.
2. Histological study of the Secondary Lymphoid organ spleen, and lymph nodes through slides/photographs.
3. Preparation of stained blood film to study various types of blood cells.
4. Hemagglutination Reactions- Blood Grouping, and Rh Typing.
5. Demonstration of a). ELISA (Pregnancy detection kit)
6. Demonstration of Antigen and Antibody by Ouchterlony's double immune-diffusion method.
7. Immuno-electrophoresis demonstration.

## Reference Books

1. **Kuby Immunology**
  - Authors: Richard A. Goldsby, Thomas J. Kindt, Barbara A. Osborne
  - Publisher: W. H. Freeman
2. **Janeway's Immunobiology**
  - Authors: Kenneth Murphy, Casey Weaver
  - Publisher: Garland Science
3. **The Immune System**
  - Authors: Peter Parham
  - Publisher: Garland Science
4. **Basic Immunology: Functions and Disorders of the Immune System**
  - Authors: Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai
  - Publisher: Elsevier
5. **Roitt's Essential Immunology**
  - Authors: Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt
  - Publisher: Wiley-Blackwell
6. **Cellular and Molecular Immunology**
  - Authors: Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai
  - Publisher: Elsevier
7. **Immunology: A Short Course**
  - Authors: Richard Coico, Geoffrey Sunshine
  - Publisher: Wiley-Blackwell
8. **Clinical Immunology: Principles and Practice**
  - Editors: Robert R. Rich, Thomas A. Fleisher, William T. Shearer, Harry W. Schroeder Jr., Anthony J. Frew, Cornelia M. Weyand
  - Publisher: Elsevier
9. **Basics of Immunology:**
  - Girish L Bhoosreddy and Bharat Wadher, Himalaya Publishing house.

**Syllabus for B.Sc. Zoology (NEP)**  
**Credit Based System**  
**B.Sc. Semester – VI**  
**DSE – II- Paper – I - Ecology and Evolution**

**Course Objectives**

- CO 1: To introduce the fundamental concepts of ecology and its significance in understanding ecosystems.
- CO 2: To explain biogeochemical cycles, energy flow, and species interactions in ecological systems.
- CO 3: To provide knowledge about population dynamics, ecological succession, and environmental pollution.
- CO 4: To emphasize the importance of wildlife conservation and biodiversity, with a focus on Indian biodiversity hotspots.
- CO 5: To explore various theories related to the origin of life and experimental evidence supporting them.
- CO 6: To understand the major theories of evolution and the scientific evidence that supports evolutionary processes.

**Course Outcomes**

1. Define key ecological concepts, including ecosystems, biogeochemical cycles, and energy flow.
2. Explain species interactions, population dynamics, and ecological succession.
3. Describe environmental pollution, its sources, effects, and control measures.
4. Identify the importance of wildlife conservation, biodiversity, and biodiversity hotspots in India.
5. Summarize the historical perspectives and theories on the origin of life.
6. Explain major theories of evolution and the evidence supporting evolutionary processes.
7. Illustrate the concepts of microevolution, macroevolution, and types of isolation in evolutionary biology.

**Unit - I**

- 1.1. Ecology: Definition of ecology, historical background of ecology.
- 1.2. Significance of ecology
- 1.3. Ecosystem: Concept and types of ecosystem
- 1.4. Structure of Ecosystem: Abiotic factors and Biotic factors

## **Unit - II**

- 2.1 Biogeochemical cycles - Nitrogen, Carbon, Phosphorus and Water.
- 2.2 Food chain, food web and ecological pyramids.
- 2.3 Energy flow in the ecosystem.
- 2.4 Animal Associations - Mutualism, commensalism, parasitism, competition, predation.

## **Unit - III**

- 3.1 Concept of Species, Population dynamics and Growth curves.
- 3.2 Ecological Succession: Causes, Types and General process of Succession
- 3.3 Environmental Pollution – Sources, Effect and Control measures of Air Pollution and Water Pollution
- 3.4 Environmental Pollution – Sources, Effect and Control measures of Soil and Noise pollution

## **Unit - IV**

- 4.1 Wildlife of India: Reasons for the depletion of wildlife. Concept of threatened and endangered species.
- 4.2 Wildlife conservation –the necessity of Wildlife conservation: National parks and Sanctuaries of India
- 4.3 Biodiversity: Concept and definition
- 4.4 Biodiversity hot spots: Definition. Biodiversity hotspots of India

## **Unit - V**

- 5.1 Concept of evolution;a preview of evolution; certain misconceptions of evolutionarybiology; the significance of evolutionary biology.
- 5.2 Origin of life: Historical and theories: special creation theory, theories of spontaneous generationor abiogenesis, the decline and fall of the theory of spontaneousgeneration. Hypothesis of panspermia, theory ofchemical evolution and spontaneous origin of life.
- 5.3 Oparin's hypothesis about origin of life. Experimental proof of Oparin's hypothesis- Miller's Experiment.

5.4 Origin and evolution of RNAworld, origin and evolution of ribonucleoprotein (RNP)

## **Unit - VI**

6.2 Theories of evolution - Lamarckism and Neo-Lamarckism, Darwinism and Neo-Darwinism, Modern synthetic theory.

6.1 Evidence of Evolution: Fossil record (types of fossils, transitional forms, geological time scale)

6.3 Mechanisms of Evolution, Isolation and Speciation

6.4 Microevolution, macroevolution — Evolution of human.

### **Suggested Readings:**

- Colinvaux, P.A. (1993). Ecology. II Edition. Wiley, John and Sons, Inc.
- Krebs, C. J. (2001). Ecology. VI Edition. Benjamin Cummings.
- Odum, E.P. (2008). Fundamentals of Ecology. Indian Edition.
- Brooks/Cole Robert Leo Smith Ecology and field biology Harper and Row publisher
- Ricklefs, R.E., (2000). Ecology. V Edition. Chiron Press
- Lull, R.S. 1976. Organic Evolution. Light & Life Publisher.
- Moody: Introduction to Evolution (1978, Kalyani).
- Savage: Evolution (1963, Holt, Reinhart and Winston)
- Rastogi: Organic Evolution (1988, Kedarnath & Ramnath)
- Strickberger: Evolution (2004, Jones & Bartlett)

**Syllabus for B.Sc. Zoology (NEP)  
Credit Based System  
B.Sc. Semester VI –  
(DSE-II, Paper II) Bioinformatics**

**Course Objectives**

1. Introduce fundamental concepts of bioinformatics and its role in biological research.
2. Familiarize students with biological databases and sequence analysis.
3. Explain theoretical principles behind sequence alignment, structural bioinformatics, and genomics.
4. Highlight ethical considerations and emerging trends in bioinformatics.

**Course Outcomes (COs)**

After completing this course, students will be able to:

1. Understand the basic principles and applications of bioinformatics.
2. Describe the types and uses of biological databases.
3. Explain sequence alignment techniques and their significance.
4. Understand the theoretical aspects of protein structure and modeling.
5. Discuss genomic and proteomic approaches in biological research.
6. Recognize ethical aspects and advancements in bioinformatics.

## **Unit 1: Introduction to Bioinformatics**

- 1.1 Definition and scope of bioinformatics, importance in biological studies.
- 1.2 History, milestones, and evolution of bioinformatics.
- 1.3 Applications in healthcare, agriculture, and environmental sciences.
- 1.4 Overview of bioinformatics resources (GenBank, PDB, BLAST).

## **Unit 2: Biological Databases**

- 2.1 Types of biological databases – nucleotide and protein databases.
- 2.2 Methods for searching and retrieving biological data.
- 2.3 Sequence data formats (FASTA, GenBank) and their importance.
- 2.4 Basics of data organization, storage, and annotation.

## **Unit 3: Sequence Alignment**

- 3.1 Importance of sequence alignment in bioinformatics.
- 3.2 Pairwise sequence alignment – concepts, scoring matrices.
- 3.3 Multiple sequence alignment – overview and tools (ClustalW).
- 3.4 Phylogenetic analysis – basics and tree construction methods.

## **Unit 4: Structural Bioinformatics**

- 4.1 Basic concepts of protein structure and function.
- 4.2 Protein structure databases and visualization tools (RasMol, PyMOL).
- 4.3 Principles of molecular modelling and homology modelling.
- 4.4 Introduction to structural comparison and alignment techniques.

## **Unit 5: Genomics and Proteomics**

- 5.1 Fundamentals of genomics and genome sequencing.
- 5.2 Functional genomics – gene expression and microarrays.
- 5.3 Basics of proteomics and protein analysis techniques (2D-PAGE).
- 5.4 Applications in biotechnology and medicine.

## **Unit 6: Bioinformatics Tools and Trends**

- 6.1 Overview of common bioinformatics tools and software.
- 6.2 Basic concepts of data mining and machine learning in bioinformatics.
- 6.3 Introduction to next-generation sequencing (NGS).
- 6.4 Ethical issues and emerging trends in bioinformatics.

## Reference Books

1. "Bioinformatics: Sequence and Genome Analysis" – David W. Mount
2. "Introduction to Bioinformatics" – Arthur M. Lesk
3. "Bioinformatics: Principles and Applications" – H.J.N.M.D.B.H.L. Murthy
4. "Fundamentals of Bioinformatics" – K.J. Rao

**VOCATIONAL SKILL ENHANCEMENT COURSE (VSEC)**  
**Offered by Department of Zoology (Vocational Skill Course)**  
**B.Sc. Semester VI**  
**Syllabus under Autonomy**

**Name of the course: VSEC – VSC IV Basics of Animal Cell Culture**

**Practical**

**[4 hrs/week 15 weeks\* 4 pract = 60 P] [Credits 2]**

**Course Objectives**

1. To make student understand the concept animal tissue culture and its applications in research.
2. To make the students familiar with the cell lines and various techniques in tissue culture.

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

- CO 1. Understand the basics of an animal cell culture laboratory.
- CO 2. Implement laboratory safety protocols and aseptic techniques .
- CO 3. Comprehend the principles and operational procedures of key laboratory equipment.
- CO 4. Apply various sterilization methods, Prepare culture media for animal cell growth.
- CO 5. Isolate and culture cells and perform subculturing procedures
- CO 6. Recognize and differentiate between various established cell lines ;understanding their morphological characteristics and applications.

**Practical**

1. Layout of animal cell culture lab.
2. Laboratory safety and aseptic techniques
3. Principle and working of equipments:- Laminar flow hood, CO<sub>2</sub> incubator, autoclave, inverted microscope
4. Sterilization techniques
5. Preparation of media for animal cell culture.
6. Primary Culture Techniques-Peripheral blood lymphocyte culture ;Isolation of cells from animal tissues (e.g., chick embryo fibroblasts or liver cells).
7. Disaggregation methods: mechanical and enzymatic (trypsinization).
8. Subculturing (Passaging) of Cells-Monitoring cell confluency.
9. Subculturing (Passaging) of Cells-Trypsinization and splitting of adherent cells.
10. study of Cell Viability using trypan blue stain
11. Cell Counting using haemocytometer.
12. Observation of images of cell lines- CHO Cells / BHK / Vero / HEK.

**Mode of Evaluation :** Continuous internal evaluation (no end semester examination) / Poster presentation / Project / Presentation / Assignment / Quiz Total Marks :- 100