

As per the NEP 2020
Bachelor of Science
Zoology

(Effective from Academic Year 2024-2025 onwards)



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Dy. Registrar
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Semester – I**Learning Objectives**

- To make students aware about the diversity of Animals present on the planet and how are they possibly related to each other in light of evolution.

Learning outcomes

By studying this course students will gain basic knowledge on

- The diversity of animals
- Their general characteristics
- Various groups of animals and their evolutionary relationships
- Basic principles and concepts of evolution that contribute to animal diversity

Course Title:	Biology of Non-Chordates		Course Code: 24BZO5101T
Total Lecture hour 45			Hours
Unit I	Elementry Idea of Animal Taxonomy: General principles of taxonomy, Five-kingdom concept, Origin of Metazoa, Basis of classification of non-chordata: Level of Organization, Symmetry, coelom, segmentation and embryogeny. Salient features and classification of Protozoa and Porifera, Coelenterata, Ctenophora, Platyhelminthes, Aschelminthes, Annelida, Arthropoda, Mollusca, Echinodermata and Hemichordata upto classes level.		12
Unit II	Lower Non-Chordates Locomotion, Osmoregulation and Reproduction in Protozoa, Canal System in Porifera, Polymorphism in Hydrozoa, Coral reefs, Life history of Obelia & Taenia solium, Larval forms of Coelenterates & Platyhelminthes, Life history of Ascaris lumbricoides and parasitic adaptations in helminthes.		13
Unit III	Higher Non-Chordates-I Locomotion, Digestion, Respiration, Blood Circulation, Reproduction in Neries. Metamerism in Annelida, Vermicomposting, Apiculture, Sericulture, Lac Culture. Metamorphosis in Insects, Larval form of Crustacea.		10
Unit IV	Higher Non-Chordates-1 Torsion in Gastropods, Locomotion, Digestion,Respiration, Blood Circulation, Reproduction in Pila, Pearl Culture. Water-vascular system in Asteroidea, Larval forms of Mollusca, Echinodermata and Hemichordata		10
Reference Books:			
1	Barnes,R.S.K.,Calow,P.,Olive,P.J.W.,Golding,D.W.andSpicer,J.I.(2002).TheInvertebrates: A New Synthesis, III Edition, Blackwell Science		
2	Barrington,E.J.W.(1979).Invertebrate Structure and Functions.II Edition,E.L.B.S.and Nelson		
3	Richard C Brusca,Gonzalo Giribet, Wendy Moore Invertebrates 4th Edition Oxford University Press		
4	Richard Fox , Robert D. Barnes, Edward E. Ruppert, Invertebrate Zoology: A Functional Evolutionary Approach, Brooks/Cole; 7th edition edition2003		
5	Hyman, L.H. Invertebrate Series (Recent edition)		
6	Parker JJ and WA Haswel Textbook of Zoology. Vol I and II		
7	Kotpal, R.L.2022 Modern text book of Zoology: Invertebrates. Rastogi Publication, Meerut.		


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 Shiksha
 Siksha Vigyan

Course Title:		Non-Chordate Laboratory	Course Code: 24BZO5101P
1	Microscopic Technique : 1. Organization and working of optical microscopes: dissecting and compound microscope. 2. General methods of microscopical permanent preparations: Narcotization: fixing and preservation: washing: staining: destaining: dehydration: clearing and dealcoholization: mounting. General idea of composition preparation and use of: i. Fixatives : Formalin. Bouin's fluid. ii. Stains: Borax carmine. aceto-carmine, aceto-orcein, haematoxylin, eosin. iii. Common reagents: Normal saline, Ringer's solution, acid water. acid alcohol and Mayer's albumin. 3. Collection and Culture Methods. i. Collection of animals from their natural habitat during field trips. e.g.. Amoeba, Paramecium, Euglena, Planaria, Earthworm. Daphnia, Cyclops. etc. ii. Culture of Paramecium in the laboratory and study of its structure. life processes and behaviour in the living state.		
2	Anatomy : Earthworm: External features, general viscera and alimentary canal. reproductive system. nervous system. Cockroach: External features, appendages (wing and leg), mouth parts. alimentary canal. reproductive and nervous systems and salivary gland. Pila: Alimentary Canal, Nervous system, Gill Lamella, Osphradium Prawn: Appendages, Alimentary Canal, Nervous system, Statocyst, Hastate Plate		
3	Study of Specimen: Spongilla, Leucosolenia, Sycon, Euspongia, Euplectella, Hyalonema, Physalia, Porpita, Sea anemone (Metridium), Alcyonium, Gorgonia, Pennetula, Renilla, Jelly Fish Beroe Cestum Ctenoplanea Dugesia/Planaria Taenia solium Ascaris, Male& Female Ascaris, Aphrodite Arenicola Chaetopterus Sabella Polynoe Eunice Neries Heteroneries Acanthobdella Pantobdella Polygordius, Bonellia, Lingula Apus Balanus Crab Cray Fish Astacus Eupagurus Sacculina with Host Desert Locust Squilla Silk Moth with Development Stage Lac Insect with Development Stage Millipede Peripatus Aplysia Dentalium Chiton Doris, Limex Argonauta Nautilus Neopilana Solen Mantis White Grub Pearl Oyester Cypraea, Pentaceros Echinus Ophiothrix Antedon Cucumaria, Star Fish, Balanoglossus		
4	Study of Permanent Slide: Radiolarian and Foraminifera ooze, Euglena, and Paramecium, Binary fission and Conjugation in Paramecium, Monocystis, Nyctotherus Gemmule Sponge spicules, V.S. Sycon, T.S. Sycon, Obelia medusa, Miracidium, Redia and Cercaria larvae of Fasciola, Scolex of Taenia, Mature and gravid proglottids of Taenia solium, Dracanculus Enterobius Wucheria T.S. of Leech through crop pockets, Trochophore larva Daphnia Cyclopous Nauplius, Zoea and Megalopa , Veliger and Glochidium larva of Mollusca, T.S. of arm of star fish, Bipinnaria and Auricularia larva, T.S. Balanoglossus through collar and proboscis, Tornaria larva (Charts and Photographs can be used)		
5	Permanent Preparation and Study of the following Paramecium, Euglena, forminiferous shells, sponge spicules, sponge fibres, gemmul . Hydra, Obelia colony and medusa. Parapodium of Nereis and heteronereis, ovary, nephridia, nerve ring and setae of earthworm salivary glands and trachea of Cockroach, Cyclops and Daphnia (Any other as per the availability)		
6	Visit to local area and study of observed non-chordates,		
Reference Books:			
1	Verma P. S. A Manual of Practical Zoology: Invertebrates. S Chand Publication		
2	Kotpal,R.L.2022 Series From Phylum-Protozoa to Echinodermata, RastogiPublication,Meerut		

Semester – II**Learning Objectives**

- To impart in-depth knowledge about the structural patterns and a comparative account of the different organ systems of vertebrates.
- To understand the account of the functional and comparative morphology provides a deep understanding of animal diversity and the adaptive changes the vertebrates have gone through during evolution from common ancestors
- To help students identify the body plan types of complex chordates and their systematic organization based on evolutionary relationships, structural and functional affinities.
- To provide an in-depth knowledge on the embryonic and post embryonic developmental processes.
- To apprise the students of the fascinating aspect of the development of a single fertilized egg to mature into a fully developed complex organism.
- To explain the basic principles and concepts the developmental processes from a single cell system to a multi-cellular system.
- To provide the undergraduate students an in-depth knowledge on the embryonic and post embryonic developmental processes.
- By understanding the developmental processes, the students can relate to errors occurring during development leading to congenital disorders and human diseases.
- To familiarize the students with the technique of IVF and pre-diagnostic methods to identify any abnormality arising during development.
- To make the students aware of the areas of great interest including stem cell therapy, tissue engineering and regenerative medicine.

Learning outcomes

Upon completion of the course, students should be able to:

- Have a better understanding of the evolutionary significance of comparative anatomy.
- Understand the importance of morphology and anatomy of organisms in relation to evolution.
- Appreciate the comparative anatomy among vertebrates that provides evolutionary evidences.
- Enhance collaborative learning and communication skills through practical sessions, teamwork, group discussions, assignments, and projects.
- Appreciate the events that lead to the formation of a multicellular organism from a single fertilized egg.
- Better understand the general patterns and sequential developmental stages during embryogenesis.
- Gain knowledge of the general mechanisms involved in morphogenesis.
- Comprehend the processes of ageing to improve the overall health and quality of life in aged people. Acquire basic knowledge and importance of latest techniques like stem cell therapy, in vitro fertilization and amniocentesis etc.

Course Title:		Comparative Anatomy and Development Biology of Vertebrates	Course Code: 24BZO5201T
Total Lecture hour 45			Hours
Unit I	Elementary Idea of Chordates: Classification and Salient feature of phylum Chordata up to orders (up to subclass in mammals), Salient Feature of Herdmania, Branchiostoma and Petromyzon (Sea Lamprey). Ascidian Tadpole Larva and its retrogressive Metamorphosis. Ammocete larva, Pisces.		12

Unit II	swim bladder and accessory respiratory organs, parental care in Pisces and Amphibia Comparative anatomy of Vertebrates:	
Unit III	Structure of Integuments, Brief account of Alimentary canal, Evolution of Aortic Arches and Heart, Evolution of kidney and Urinogenital ducts, Difference between venomous and non venomous snakes, flight adaptation in birds, Adaptive radiation in mammals. Historical perspectives and basic concepts of Developmental Biology, Gametogenesis: Oogenesis, Spermatogenesis, Types of egg, Egg envelops, Mechanism of Fertilization, Blocks to polyspermy; Cleavage; Types of Blastula; Fate maps; Gastrulation in frog and chick, Embryonic induction and organizers. Fate of Germ Layers.	10
Unit IV	Metamorphosis and its hormonal regulation in Amphibians, Regeneration: Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each); Ageing: concepts and theories. Teratogenesis: Teratogenic agents and their effects on embryonic development; IVF, Embryonic stem cell (ESC), Amniocentesis. Stem cell technology. Extra-embryonic membranes in birds; Structure, types, and functions of placenta.	13
Reference Books:		
1	Kotpal RL(2022) Modern Textbook of Zoology –Vertebrates; Rastogi Publications - Meerut; 2022	
2	Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford University Press.	
3	Tiwari SK (2006) Fundamentals of World Zoogeography, Sarup & Sons SUGGESTED	
4	Lewis Wolpert (2010). Principles of Development. II Edition, Oxford University Press.	
5	Verma PS. and Agarwal V.K (2014) Chordate Embryology, S Chand Publication.	

Course Title:	Comparative Anatomy and Development Biology of Vertebrates Laboratory	Course Code: 24BZO5201P
Anatomy		
General viscera, afferent and efferent branchial blood \ vessels, eye.muscles and their innervation, brain, cranial nerves, and internal ear of any edible Fish.		
Blood vascular, Urinogenital and Nervous system (brain, cranial nerves, spinal nerves) of rat or any suitable mammal		
Permanent preparations and study of the following:(With the help of Chart and Model)		
Spicules and pharyngeal wall of Herdmania: Scales of Fish, Stripped muscle fibres.		
Osteology: A Comparative study of articulated and disarticulated bones of Frog, Varanus, Fowl and Rabbit (or any other mammal).		
Study of Microscopic slides:		
Whole mounts of oral hood velum and pharyngeal wall of Amphioxus, T.S. of Amphioxus through various regions; tadpole larva of Ascidia; whole mounts of Pyrosoma, Salpa, Doliolum and Oikopleura; VS. of skin of fish; T.S. of body of fish through various regions, V.S. of Skin of frog; T.S. of cartilage, bone, testis and ovary of frog; V.S. of skin of bird; V.S. of mammalian skin, TS of Mammalian Bone.		
Study of museum specimens		
Ascidia, Ciona, Botryllus, Ammocoete, Petromyzon, Myxine, Zygeana (Sphyrna), Torpedo, Chimaera, Acipenser, Amia or Lepidosteus, Labeo, Clarias, Anguilla, Hippocampus, Exocoetus, Echenes, any flat-fish, Protopterus, Ichthyophis or any blind-worm. Proteus, Ambystoma, Axolotl, Siren, Alytes, Hyla, Tastudo, Chelone, and fresh water tortoise, Sphenodon, Hemidactylus, Phrynosoma, Draco, Chameleon, Eryx, Hydrophis, Naja, Viper; Bungarus.		

Crocodile, Alligator, Archaeopteryx, Running bird, *Pavo cristatus* (peacock), Chorioitis (Great Indian bustard), Ornithorhynchus, Tachyglossus, Didelphys, Macropus, Bat, Loris, Scaly Ant Eater.

Study of development of frog/toad with the help of:

- Preserved materials available: Eggs, cleavage, blastula, gastrula, Nerula. tail-bud hatching mature tadpole larvae, metamorphic stages toad/frog. g.
- Histological slides: Cleavage, blastula, gastrula, Ncurula and tail-bud stage.

Study of development of chick with help of whole mounts:

- 18 hrs. 21 hrs. 24 hrs. 36 hrs. 48 hrs 56 hrs 72 hrs and 96 hours of incubation.
- Primitive streak stage in living embryo (if possible) after removal of the blastoderm of the egg.
- Study of the embryo at various stages of incubation in vivo by making a window opening in egg.
- Study of various foetal envelopes in a 12 day old chick embryo.

Reference Books:

1	S. Lal, Practical Zoology Vertebrate , Rastogi Publications.
2	O.P. Jangir, Developmental Biology: A Manual, CBC publishers and distributors pvt ltd, 2002

Semester – III

Learning Objectives

The objective of the course is to help the students to learn and develop an understanding of a cell as a basic unit of life. This course is designed to enable them to understand the functions of cellular organelles and how a cell carries out and regulates cellular functions.

Learning outcomes

Upon completion of the course, students should be able to:

- Understand the fundamental principles of cell biology.
- Explain the structure and functions of cell organelles involved in diverse cellular processes.
- Appreciate how cells grow, divide, survive, die, and regulate these important processes.
- Comprehend the process of cell signaling and its role in cellular functions.
- Have an insight into how defects in the functioning of cell organelles and regulation of cellular processes can develop into diseases. Learn the advances made in the field of cell biology and their applications.

Course Title:	Cell and Molecular Biology	Course Code: 24BZO6301T
Total Lecture hour 45		Hours
Unit I	Overview of Cells , Plasma membrane and Endomembrane System Microscopic techniques: Phase contrast and Electron microscope (TEM and SEM) Membrane Biology', Transport across membranes: active and passive transport, facilitated transport; Cell-cell junctions: Tight junctions, adherens junctions, gap junctions. GERL System: Endoplasmic Reticulum (ER), Golgi apparatus, Signal hypothesis, Vesicular transport from ER to Golgi apparatus, Protein sorting and transport from Golgi apparatus, Coated Vesicles, Lysosomes, Peroxisomes. Structure and function of Mitochondria: Respiratory chain, Chemiosmotic hypothesis, ATP synthesis	15

Course Title:	Cell and Molecular Biology Laboratory	Course Code: 24BZO6301P
1. Microscopy: • Compound microscope: principle, components, and handling • Phase contrast microscope • Electron microscope • Differential Interference Contrast (DIC) Microscope 2. Principle and types of cell fixation and staining; Cell fractionation. 3. To study prokaryotic cells by Gram staining and eukaryotic cell (cheek cells) by hematoxylin/methylene blue. 4. To study the effect of hypotonic, isotonic, and hypertonic solutions on cell permeability. 5. Preparation of a temporary slide of squashed and stained onion root tip to study various stages of mitosis. 6. Study of Meiosis in testis of Grasshopper or Cockroach. 7. Study of Polytene chromosomes from Chironomous/Drosophila larva. 8. Study of various stages of meiosis through permanent slides. 9. Preparation of stained mount to show the presence of Barr body in human female blood cells/cheek cells. 10. Isolation of DNA from suitable sample. 11. Cytochemical demonstration of:		

- DNA by Feulgen reaction
- Mucopolysaccharides by PAS reaction
- Proteins by Mercuric Bromophenol Blue/Acid Fast Green

Reference Books:

1	Gupta, R., Makhija, S. and Toteja, R. (2018). Cell Biology Practical Manual, Prestige Publishers, New Delhi 110003.
2	Sharma, V. K. (1991). Techniques in Microscopy and Cell Biology, Tata McGraw Hill Publishing Company Limited, New Delhi.

Semester – IV**Learning Objectives**

Students will learn about the chemical properties of molecules, determine the ways in which they interact and react with each other and understand how body works at system level.

Learning outcomes

At completion of the course the student will be able to:

- Explain human anatomy and physiology: describe cellular levels of organization, and the basics of biochemistry and cell biology.
- Discuss system physiology and their control and regulation mechanisms.
- Explain and examine histological samples and basic laboratory practice in cell culture
- Discover the interaction between body systems and the outside environment for the exchange of materials, the capture of energy, the release of waste, and the overall maintenance of the internal systems that regulate the exchange.
- Will be able to undertake investigations and perform analyses that provide information about biochemistry and solve related problems.

Course Title:	Mammalian Physiology and Biochemistry		Course Code: 24BZO6401T
Total Lecture hour 45			Hours
Unit I	Role of enzymes in Digestion, Water and Fat soluble Vitamines Respiration: Mechanism of gas exchange in lungs, Transportation of Carbon dioxide and oxygen via blood and control of breathing. Blood Composition, Mechanism of Blood Clotting Heart: Conduction and regulation of heart beat; nervous and chemical regulation of heart rate, Cardiac cycle and ECG.		12
Unit II	Structure of Nephron, Physiology of urine formation, osmoregulators and osmoconformers. Muscle: Types of muscles, ultrastructure of skeletal muscle, Types of Muscles, Chemical and Physiological basis of skeletal muscle contraction, Sliding filament theory of muscle contraction.		10
Unit III	Types of Neurons, structure of Neuron , Conduction of nerve impulse, Action Potential, Ultrastructure of striated muscle, Mechanism of Hormone action, Structure ,function and disorders of different Endocrine gland (Hypothalamus, Pineal gland,Pituitary gland, Thyroid gland, Parathyroid, Adrenal, and Pancreas) Functions and Regulation of Ovary and Testis		11
Unit IV	Enzyme Kinetics : Derivation of Michaelis-Menten equation, Concept of Km and Vmax,		12

	Lineweaver-Burk plot, Enzyme inhibition; Allosteric enzymes and their kinetics Carbohydrate Metabolism: Sequence of reactions and regulation of glycolysis, Citric acid cycle, Pentose Phosphate pathway, Gluconeogenesis, Glycogenolysis and Glycogenesis. Lipid Metabolism : β-oxidation of saturated fatty acids ,Biosynthesis of Fatty acid and triglycerides Protein Metabolism : Catabolism of amino acids: Transamination, Deamination, and Decarboxylation, Urea cycle; Fate of C-skeleton of, Glucogenic and Ketogenic amino acids.
Reference Books:	
1	Marieb E.N. and Hoehn K.N. (2009) Human Physiology. Pearson Education Publication , 9th edition
2	Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons.
3	Guyton & Hall, (2016) Textbook of Medical Physiology. Elsevier, 12 th edition.
4	Botham, K.M., Kennelly, P.J., Rodwell, V.W. and Well,P.A. (2022). Harper's Illustrated Biochemistry, 32 nd Edition, International Edition, The McGraw-Hill Companies Inc.
5	Hames, B.D. and Hooper, N.M. (2000). Instant Notes in Biochemistry, II Edition, BIOS Scientific Publishers Ltd., U.K.

Course Title:	Mammalian Physiology and Biochemistry Laboratory	Course Code: 24BZO6401P
1.	Determination of ABO Blood group, study of blood smear	
2.	Enumeration of red blood cells and white blood cells using haemocytometer	
3.	Estimation of haemoglobin using Sahli's haemoglobinometer	
4.	Preparation of haemin and haemochromogen crystals	
5.	Recording of blood pressure using a sphygmomanometer	
6.	Examination of sections of mammalian slides: Oesophagus, Stomach, Duodenum,Ileum,Rectum, Liver, trachea, lung, kidney, Pineal gland, Pituitary gland, Thyroid gland, Parathyroid, Adrenal, Pancreas, Testis and Ovary).	
7.	Estimation of total protein in given solutions	
8.	Detection of SGOT and SGPT or GST and GSH in serum/ tissue	
9.	To study the enzymatic activity of Trypsin/ Lipase.	
10.	To perform the Acid and Alkaline phosphatase assay from serum/ tissue.	
11.	Test for Reducing and Non-reducing Sugar(Carbohydrates), Protein and Lipid	
12.	Seperation of Amino Acids by TLC / Paper chromatography method.	
Reference Books:		
1	Victor P. Eroschenko. (2008). diFiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott W. & Wilkins.	
2	S.P. Singh (2018) Practical Manual of Biochemistry 8th Edition, CBS Publishers	

Microbiology, Immunology and Biotechnology**Course Objectives:**

1. To introduce key concepts in microbiology, immunology, and biotechnology.
2. To study microbial structure, function, and disease-causing mechanisms.
3. To understand immunity, antigen-antibody interactions, and immune responses.
4. To explore microbial applications in food, health, and the environment.
5. To learn basic techniques in cloning, cell culture, and genetic engineering.

Course outcomes:

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

1. Understand the fundamentals of microbiology and immunology.
2. Identify microbes and explain disease mechanisms and treatments.
3. Apply microbiological and immunological techniques.
4. Recognise the role of microbes in industry and the environment.
5. Demonstrate knowledge of biotechnological tools and their applications.

Course Title:	Microbiology, Immunology and Biotechnology	Course Code: 24BZO7501T
Total Lecture hours: 60		Hours
Unit I	History of Microbiology: Contributions of Anton van Leeuwenhoek, Louis Pasteur, Edward Jenner and Robert Koch. Basic structural and functional characteristics of bacteria, fungi, cyanobacteria, rickettsiae, chlamydiae, mycoplasmas and viruses. Structural organisation of bacterial flagella, capsule, cell wall, cell membrane, cytoplasm, chromosome, and growth phases. Techniques in Microbiology: Pure culture technique, growth conditions (temperature, pH, nutrients), Gram's staining, fungal staining. Bacterial diseases: causative agent, brief pathology, treatment and prevention of diphtheria, meningitis, tuberculosis, botulism, tetanus, leprosy. Viral diseases: causative agent, brief pathology, treatment, prevention of influenza, herpes, measles, chicken pox, small pox, rabies, polio, AIDS, COVID-19.	15
Unit II	Components of the Immune System: different types of cells and organs involved. Antigens: Essential features of an antigen, antigenic determinants, Immunological valence, adjuvants, haptens. Antibodies: Nature and Primary structure of immunoglobulins; Types of immunoglobulins: IgG, IgM, IgA, IgD and IgE and their structure and functions. Antigen-antibody reactions: Precipitation and Agglutination. Types of immunity: Active and passive immunity, cell-mediated immunity, humoral immunity, and autoimmunity. Basic idea of interferon, the Complement system and MHC. Techniques in Immunology: ELISA and RIA	15
Unit III	Application of Microbes: Use of microbes in fermented foods, dairy and beverages: wine, beer, cheese, curd and vinegar. Use of microbes in wastewater treatment, bioremediation (brief idea). Types of vaccines: Live attenuated, inactivated vaccine, DNA and recombinant. Monoclonal antibodies production and application, Abzymes.	15
Unit IV	Concept and Scope of Animal Biotechnology: Cloning methods (Cell, Animal and Gene cloning). Vectors- Plasmids, Cosmids, Lambda bacteriophages and Yeast artificial chromosomes (YAC). Animal cell culture: Equipment and materials for animal cell culture; applications of cell culture techniques; Recombinant DNA technology and its applications. Transgenesis: Methods of Transgenesis, Production of transgenic animals and their application in Biotechnology; Stem cells: Types and their applications. Dairy biotechnology: Food, drink and dairy biotechnology (outline idea only). Fermented food production: dairy products, wine, beer, vinegar and food preservation	15
Reference and Reading Books:		


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1. Darnell, J. Molecular Cell Biology, Freeman, 7th edition, 2013.
2. Cross A.E. and Nagle R.B. (2006). Cell Adhesion and Cytoskeletal Molecules in Metastasis. Vol. XII, Springer Publication.
3. Karp G. John. (2013). Cell and Molecular Biology. Concepts and Experiments. 7th Edition, Wiley & Sons Inc., New York.
4. Fundamentals of microbiology by Edward Alcamo. Benjamin/Cummings Publishing Company, Inc.
5. Prescott's Microbiology by Joanne. M. Willey, Linda Sherwood, Christopher J. Woolverton, 2017. McGraw-Hill Education
6. Kindt, T. J., Goldsby, R. A., Osborne, B. A., & Kuby, J. (2007). Kuby Immunology (6th ed.). New York: W.H. Freeman and Company.
7. Owen, J. A., Punt, J., Stranford, S. A., & Jones, P. P. (2018). Kuby Immunology (8th ed.). New York: W.H. Freeman and Company.
9. Abbas, A.K. & Lichtman, A.H. (2001). Basic Immunology: Functions and Disorders of Immune System. US: W.B. Saunders.
10. Pagano, M., & Gauvreau, K. (2018). Principles of Biostatistics (2nd ed.). CRC Press.
11. Rosner, B. (2015). Fundamentals of Biostatistics (8th ed.). Cengage Learning.
12. Delves, P.J., Martin, S.J., Burton, D.R., & Roitt, I.M. (2011). Roitt's Essential Immunology (12th.). New Jersey, USA: John Wiley & Sons Ltd.

Course Title:	Zoology Laboratory	Course Code: 24BZO7501P
1.	Microbiology 1. Preparation and use of culture media for microbes (NA and PDA). 2. Culture of microbes (bacteria and fungi) from food (curd/ spoiled food). 3. Gram's staining for bacteria. 4. Simple staining of bacteria. 5. Slide preparation and identification of any two fungi.	
2.	Immunology 1. Tests of blood grouping. 2. Widal test to identify any pathogen in the blood. 3. Differential leucocyte count (DLC) in the blood sample. 4. ELISA Test	
3.	Study of Lab instruments: 1. Centrifuge, Autoclave, pH meter. 2. Isolation of DNA from cheek cells and Blood. 3. Separation of DNA by Agarose gel electrophoresis. 4. Chromatography: Paper/TLC chromatography for separation of dyes/Amino acids.	

➤ It should be ensured that animals used in the practical exercises are not covered under the Wildlife Act 1972 and amendments made subsequently.

Scheme of Practical Examination and Distribution of Marks

S. No.	Permanent Exercise	Marks
1	Exercise based on Microbiology	08
2	Exercise based on Biotechnology	08
3	Exercise based on Immunology	08
4	Spotting (1 to 8)	16
5	Record	05
6	Viva-voce	05
	Grand Total	50

Dr. R. Reddy
Registrar
Sri Sakshi University
(Warangal)

Ecology and Animal Behaviour**Course Objectives**

To provide students with fundamental knowledge of ecological principles and animal behaviour, emphasising organism-environment interactions, biodiversity, and behavioural adaptations in nature.

Course outcomes:

Students will be able to:

1. Understand key ecological concepts.
2. Analyse population and community interactions.
3. Identify major biomes and ecosystems.
4. Explain essential animal behaviours.
5. Recognise the importance of biodiversity and conservation.

Course Title:	Ecology and Animal Behaviour	Course Code: 24BZO7601T
Total Lecture hours: 60		Hours
Unit I	Introduction to Ecology: Definition, History, Subdivision, and Scope of Ecology. Environmental factors: Physical factors - Soil, water, air and temperature. Biotic factors- Interspecific and Intraspecific relations, neutralism, mutualism, commensalism, antibiosis, parasitism, predation, competition. Concept of limiting factors, Liebig's law of minimum, Shelford's law of tolerance, combined concept of limiting factors.	15
Unit II	Population and Community Ecology: Measurement of Population Density. Factors affecting population growth, growth factors, dispersal, characteristics of the community, concept of ecosystem and niches. Food chain, food web, Ecological pyramid, Energy flow in an ecosystem, biogeochemical cycles of CO ₂ , N ₂ , O ₂ , S and P. Prospects and strategies of sustainable development.	15
Unit III	Brief introduction to the major ecosystems of the world: ecological succession, conservation of natural resources, Desert ecosystem; characteristics of desert environment, desert fauna and their adaptations, with special reference to Rajasthan. Brief account of environmental pollution, global warming and its impact upon the Human race.	15
Unit IV	History and concept of ethology: Methods of studying animal behaviour, Role of hormones and pheromones in behaviour, and biological rhythms. Social behaviour and Social Organisation among mammals eg, Rhesus and Black buck. Learning and Memory – Conditioning, Habituation, Insight learning, Association learning, Reasoning and Communication; Wildlife of Rajasthan and its conservation.	15
Reference and Reading Books:		
1. The Atmosphere. Lutgens, F.K. and Tarbuek, J.E. 1992. Prentice Hall, New Jersey 2. Ecology, Individuals, Populations and Communities. Begon. M., J.I., Harper and C. R. Townsend. Science. Oxford. 3. Ecological Concepts. Cherrett, J. M. Blackwell Sci. Publications. Oxford, U.K. 4. Population Biology. Elseth. B. D. and K. M. Baumgartner. Van Nostrand Co., New York. 5. Fundamentals of ecological modelling. Jorgensen, S. E., &Bendoricchio, G. (Vol. 21). Elsevier. 6. Ecological Census Techniques-A Handbook (2nd Edition). William J. Sutherland. Edited by William J. Sutherland. 7. Ecological Methods. IVth Edition, Southwood, T. R. E., Dr. Peter A. Henderson. Wiley-Blackwell. 8. Ecological Methodology. IInd Edition Charles J. Krebs. 9. Edward J. Concepts of Ecology. (4 Ed.). Kormondy. 10. Animal Behavior: An Evolutionary Approach, Alcock J., 2013, Sinauer Associates. 11. Animal Societies and Evolution: Reading from Scientific American, 1981, Tophoff H.R., W.H. Freedman and Co Ltd. 12. Animal Behavior, Breed M.D. and Moore J., 2015, Academic Press. 13. Animal Behavior, Mathur R, 2010, Rastogi Publications. 14. The Ecology & Evolution of Animal Behavior, Werlace R.A., 1979, Good Year Publishing Co., Inc. 15. Biological Rhythms, Kumar V., 2002, Narosa Publishing House, Delhi/ Springer-Verlag		

Course Title:	Zoology Laboratory	Course Code: 24BZO7601P
1.	Examination of physical characteristics of soil/water sample: Temperature, Relative humidity, Texture.	
2.	Examination of physical and chemical characteristics of soil/water sample: pH, turbidity, salinity, chloride content, dissolved O ₂ , alkalinity, and Free CO ₂ .	
3.	Study of local habitat (Pond and Terrestrial Ecosystem): Collection and examination of microscopic fauna (Zooplanktons/ Phytoplanktons/ Benthos).	
4.	Paramecium culture and study of behaviour of Paramecium to different stimuli: Contact, chemicals and light.	
5.	To study the food preference and response to light in any of the stored insect pests.	
6.	To study the antennal grooming behaviour in the cockroach.	
7.	Project report based upon study of local fauna.	

➤ It should be ensured that animals used in the practical exercises are not covered under the Wildlife Act 1972 and amendments made subsequently.

Scheme of Practical Examination and Distribution of Marks for 24BZO7601P

S. No.	Permanent Exercise	Marks
1	Exercise based on Ecology	10
2	Exercise based on Ethology	09
3	Tour Report	05
4	Spotting (1 to 8)	16
5	Record	05
6	Viva-voce	05
	Grand Total	50


 Dy. Registrar
 Pandit Deendayal Upadhyaya
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