

Proposed Year wise Structure of UG Program in Zoology

Year	Semester	Course Codes	Paper Title	Credits	Teaching Hours
1 Certificate Course in parasitic infections and Public Health	I	B050101T	Diversity of Non-Chordates and Economic Zoology	06	90
	II	B050201T	Cytology, Genetics and Infectious Diseases	04	60
		B050202P	Lab on Non-Chordates and Cytogenetics	02	60
2 Diploma in Biochemistry and physiology	III	B050301T	Diversity of Chordates and Comparative anatomy	06	90
	IV	B050401T	Biochemistry and Physiology	04	60
		B050402P	Lab on Chordata and Physiology and Biochemistry	02	60
3 Degree in Bachelor of Science	V	B050501T	Evolutionary and Developmental Biology	05	75
		B050502T	Ecology, Ethology and Wildlife	05	75
	VI	B050601T	Molecular Biology, Bioinstrumentation and Biotechniques	04	60
		B050602T	Gene Technology, Immunology and Computational Biology	04	60
		B050602P	Lab on Ecology, Embryology, Biotechniques and Computational Biology	02	60

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Subject prerequisite

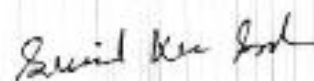
To study Zoology in undergraduate, a student must have studied Biology, Biotechnology or Life Science in Class 12.

Programme Objectives (POs)

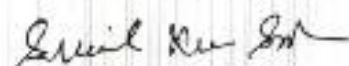
1. The programme has been designed in such a way so that the students get the flavour of both classical and modern aspects of Zoology/Animal Sciences. It aims to enable the students to study animal diversity in Indian subcontinent, environmental science and behavioural ecology.
2. The modern areas including cell biology and genetics, biochemistry, physiology followed by biostatistics, Evolutionary biology, bioinformatics and genetic engineering have been included to make the study of animals more interesting and relevant to human studies which is the requirement in recent times.
3. The lab courses have been designed in such a way that students will be trained to join public or private labs.

Certificate Course in Parasitic Infections & Public Health**B. Sc. I Programme Specific Outcomes (PSOs)**

PSO1	This programme aims to introduce students to animal diversity specially of invertebrates. The students will be taught about invertebrates using observational strategies, museum specimens and field reports. Students will also learn about economically important invertebrates especially parasitic protozoans, and helminths which cause various infectious diseases in man.
PSO 2	The students will learn the basic principles of genetics and how to prepare karyotypes to study the chromosomes.
PSO 3	How chromosomal aberrations are inherited in humans by pedigree analysis in families.
PSO 4	The students will have hands-on training in the techniques like microscopy, preparation of slides which will help them in getting employment in pathology labs and contribute to health care system.
PSO 5	The Certificate courses will enable students to apply for technical positions in government and private labs/institutes.



Diploma in Biochemistry and Physiology	
B.Sc. II Programme Specific Outcomes (PSOs)	
PSO1	This programme aims to introduce students to animal diversity especially of vertebrates. The students will be taught about vertebrates using observational strategies, museum specimens and field reports. The students will develop understanding of chordate body plan and also variation the on anatomical theme in various classes of chordates.
PSO 2	The students will be able to understand and apply the principles and techniques of biochemistry, molecular biology which prepares students for further career in molecular biology. Independently execute a laboratory experiment using the standard methods and techniques.
PSO 3	The students will learn the structure and functioning of human body in biochemical terms. They will develop basic concepts about assessing human health on the basis of levels of various molecules in blood and other body fluids. An understanding of body metabolism will enable students to appreciate the complexity, diversity and interactions in biomolecules necessary for normal functioning of body.
PSO 4	The students will get basic understanding of structural organization and functioning of organ systems like digestive system, respiratory system, circulatory system, excretory system, nervous system, muscular and reproductive system of chordates. Students will be familiarized with different apparatuses and techniques used for various diagnostic purposes.
PSO 5	The Diploma courses will ensure employability in Hospitals/Diagnostics and Pathology labs with good hands-on training. It will also enable students to take up higher studies and Research as their career and work in renowned labs in the country and abroad.

Degree in Bachelor of Science	
B.Sc. III Programme Specific Outcomes (PSOs)	
PSO1	This programme aims to introduce students to animal diversity of invertebrates and vertebrates. The students will be taught about economically important animals and also about their evolution and development
PSO 2	Comparative anatomy, physiology and biochemistry will enable students to learn chordate body plan and develop an understanding of its functioning.
PSO 3	Inclusion of ecology will enrich students with understanding of our world which is crucial for human well-being and prosperity. This section will provide new knowledge of the interdependence between people and nature that is vital for food production, maintaining clean air and water, and sustaining biodiversity in a changing climate.
PSO 4	An understanding of gene technology and computational biology will open new horizon for students and give them idea of potential of these disciplines in solving global challenges like food scarcity, medicine/vaccine availability, pollution and climate change.
PSO 5	The basic concepts of biosystematics, evolutionary biology and biodiversity will enable students to solve the biological problems related to environment.
PSO 6	At the end of the course the students will be capable enough to comprehend the reason behind such a huge diversity of animals and reason out why two animals are grouped together or remain separate due to similarities and differences which exist at many levels along with ecological, environmental and cellular inputs.
PSO 7	The Degree courses will enable students to go for higher studies like Masters and Ph.D. in Zoology and Allied subjects.

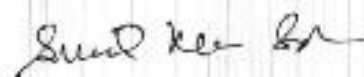


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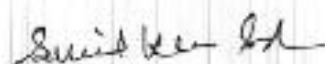
Programme/Class: Certificate	Year: First	Semester: First
Subject: ZOOLOGY		
Course Code: B050101T	Course Title: Diversity of Non-Chordates and Economic Zoology	
Course outcomes: The student at the completion of the course will be able to: The student at the completion of the course will be able to: • demonstrate comprehensive identification abilities of non-chordate diversity • explain structural and functional diversity of non-chordate • explain evolutionary relationship amongst non-chordate groups • Get employment in different applied sectors • Students can start their own business i.e. self-employments. • Enable students to take up research in Biological Science		
Credits: 6	Core: Compulsory	
Max. Marks: 25+75	Min. Passing Marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0		
Unit	Topic	Total No. of Lectures (90)
I	Protozoa to Coelenterate • Protozoa – <i>Paramecium</i> (Morphology and Reproduction) • Porifera – <i>Sycon</i> (Canal System) • Coelenterata – <i>Obelia</i> (Morphology and Reproduction)	10
II	Ctenophora to Nemathelminthes • Ctenophora - Salient features • Platyhelminthes - <i>Taenia</i> (Tape worm) (Morphology and Reproduction) • Nemathelminthes – <i>Ascaris lumbricoides</i> (Morphology and Reproduction)	10
III	Annelida • Annelida – <i>Hirudinaria</i> (Leech) (Morphology and Reproduction)	10
IV	Arthropoda • Arthropoda – <i>Palaemon</i> (Prawn) (Morphology, Appendages, Nervous System and Reproduction)	10
V	Mollusca to Echinodermata • Mollusca – <i>Pila</i> (Morphology, Shell, Respiration, Nervous System and Reproduction) • Echinodermata – <i>Pentaceros</i> (Morphology and Water Vascular System)	10



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VI	Economic Zoology-1 Vectors and pests Life cycle and control of following pests: Gundhi bug, Sugarcane leafhopper, Pink boll worm, Termites and Mosquitoes and rodents.	20
VII	Economic Zoology-2 Culture of beneficial animals: Sericulture, Apiculture, Lac-culture, Vermiculture	20
Suggested Readings: 1. Barnes et al (2009). The Invertebrates: A synthesis. Wiley Backwell 17 2. Kotpal R L: A text book of Invertebrates, Rastogi Publication, Meerut 3. Marshall: Parker & Haswell Text Book of Zoology, Vol. I (7th ed 1972, Macmillan) 4. Moore: An Introduction to the Invertebrates (2001, Cambridge University Press) 5. Brusca and Brusca (2016) Invertebrates. Sinauer 6. Jan Pechenik (2014) Biology of the invertebrates. McGraw Hill 7. Neilsen (2012). Animal Evolution: Interrelationships amongst living Phyla. Oxford 8. Parasitology- Chatterjee 9. Parasitology- Chakraborty 10. Thomas C. Chung. General Parasitology. Harcourt Brace and Co. Ltd. Asia, New Delhi. 11. Gerard D. Schmidt and Larry S Roberts. Foundations of Parasitology. McGraw/Hill. 12. Bisht. U S., Apiculture, ICAR Publication. 13. Singh S., Beekeeping in India, Indian council of Agricultural Research, New Delhi. 14. Pedigo, L.P. (2002). Entomology and Pest Management, Prentice Hall. 15. Lee, Earthworm Ecology 16. Stevenson, Biology of Earthworms 17. Destructive and Useful Insects by C. I. Metcalf 18. Sericulture for Rural Development : Hanumappa (1978), Himalaya Publication, 19. Sriculture in India Sarkar, D.C. (1988), CSB, Bangalore. Course Books published in Hindi may be prescribed by the Universities and Colleges		
This course can be opted as an elective by the students of following subjects: The eligibility for this paper is 10+2 with Biology as one of the subject		
Suggested Continuous Evaluation Methods: House Examination/Test: 10 Marks Written Assignment/Presentation/Project / Term Papers/Seminar: 10 Marks Class performance/Participation: 5 Marks		
Further Suggestions: None		

Programme/Class: Certificate		Year: First	Semester: Second
Subject: ZOOLOGY			
Course Code: B050201T		Course Title: Cytology, Genetics and Infectious Diseases	
Course outcomes: The student at the completion of the course will be able to: • Understand the structure and function of all the cell organelles. • Know about the chromatin structure and its location. • To be familiar with the basic principle of life, how a cell divides leading to the growth of an organism and also reproduces to form new organisms. • How one cell communicates with its neighboring cells? • Understand the basic principles of genetics and how genes (earlier called factors) are inherited from one generation to another. • Understand the Mendel's laws and the deviations from conventional patterns of inheritance. • Comprehend how environment plays an important role by interacting with genetic factors. • How to detect chromosomal aberrations in humans and study the pattern of inheritance by pedigree analysis in families.			
Credits: 4		Core: Compulsory	
Max. Marks: 25+75		Min. Passing Marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:4-0-0			
Unit	Topics	Total No. of Lectures (60)	
I	Structure and Function of Cell Organelles I • Plasma membrane: chemical structure— lipids and proteins • Cell-cell interaction: cell adhesion molecules, cellular junctions • Endomembrane system: protein targeting and sorting, endocytosis, exocytosis Introduction to all national and international Biologists (Zoologists) who have contributed/contributing to Zoological and Life Sciences as a mark of tribute to ancient and modern biology will be included as part of the Continuous Internal Evaluation (CIE)	6	
II	Structure and Function of Cell Organelles II • Cytoskeleton: microtubules, microfilaments, intermediate filaments • Mitochondria: Structure, oxidative phosphorylation • Peroxisome and ribosome: structure and function	6	
III	Nucleus and Chromatin Structure • Structure and function of nucleus in eukaryotes • Chemical structure and base composition of DNA and RNA • DNA supercoiling, chromatin organization, structure of chromosomes • Types of DNA and RNA	8	

IV	Cell cycle and Cell Division • Cell division: mitosis and meiosis • Cell cycle and its regulation, • Apoptosis	8
V	Mendelism and Sex Determination • Basic principles of heredity: Mendel's laws, monohybrid and dihybrid crosses • Complete and Incomplete Dominance • Genic Sex-Determining Systems, Environmental Sex Determination, Sex Determination in <i>Drosophila</i>, Sex Determination in Humans • Sex-linked characteristics and Dosage compensation	8
VI	Extensions of Mendelism, Genes and Environment • Extensions of Mendelism: Multiple Alleles, Gene Interaction • The Interaction Between Sex and Heredity: Sex-Influenced and Sex-Limited Characteristics • Cytoplasmic Inheritance, Genetic Maternal Effects • Interaction Between Genes and Environment: Environmental Effects on Gene Expression, Inheritance of Continuous Characteristics	8
VII	Human Chromosomes and Patterns of Inheritance • Human karyotype • Chromosomal anomalies: Structural and numerical aberrations with examples • Pedigree analysis • Patterns of inheritance: autosomal dominant, autosomal recessive, X-linked recessive, X-linked dominant	8
VIII	Infectious Diseases • Introduction to pathogenic organisms: viruses, bacteria, fungi, protozoa, and worms • Structure, life cycle, pathogenicity, including diseases, causes, symptoms and control of common parasites: <i>Trypanosoma</i>, <i>Giardia</i> and <i>Wuchereria</i>	8

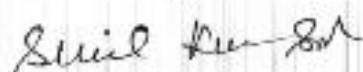
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Suggested Readings: 1. Lodish et al: Molecular Cell Biology: Freeman & Co, USA (2004). 2. Alberts et al: Molecular Biology of the Cell: Garland (2002). 3. Cooper: Cell: A Molecular Approach: ASM Press (2000). 4. Karp: Cell and Molecular Biology: Wiley (2002). Pierce B. Genetics. Freeman (2004). 5. Lewin B. Genes VIII. Pearson (2004). 6. Watson et al. Molecular Biology of the Gene. Pearson (2004). 7. Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, Janis KubyKuby Immunology. W H Freeman (2007). 8. Delves Peter J., Martin Seamus J., Burton Dennis R., Roitt Ivan M. Roitt's Essential Immunology, 13th Edition. Wiley Blackwell (2017). 9. Shetty Nandini Immunology Introductory Textbook. New Age International. (2005)
Course Books published in Hindi may be prescribed by the Universities and Colleges
Course prerequisites: To study this course, a student must have had the subject biology in class/12th
Suggested Continuous Evaluation Methods: Total Marks: 25 House Examination/Test: 10 Marks Written Assignment/Presentation/Project / Term Papers/Seminar: 10 Marks Class performance/Participation: 5 Marks
Further Suggestions: None

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Programme/Class: Certificate		Year: First	Semester: Second
Subject: ZOOLOGY			
Course Code: B050202P		Course Title: Lab on Non-Chordates & Cytogenetics	
Course outcomes: At the completion of the course students will learn Hands-on: 1. To study invertebrate diversity through museum and specimen and permanent slides. 2. To use simple and compound microscopes. 3. To prepare slides and stain them to see the cell organelles. 4. The chromosomal aberrations by preparing karyotypes. 5. To learn how chromosomal aberrations are inherited in humans by pedigree analysis in families. 6.			
Credits: 2		Core: Compulsory	
Max. Marks: 25+75		Min. Passing Marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:0-0-4			
Unit	Topics		Total No. of Practical Hours (60)
I	1.Study of representative museum/ specimens of various non-chordate phyla. Sycon, Euplectella, Hayalonema, Spongilla, Hydra, Aurelia, Sea Anemone, Planaria, Taenia, Fasciola, Ascaris, Nereis, Pheretima, Leech, Peripatus, Palaemon, Crab, Limulus, Scolopendra, Termite, Cicada, Grasshopper, Cockroach, Chiton, Pila, Unio, Octopus, Pearl oyster, Star fish, Holothuria, Echinus 2. Study of permanent slides of whole mounts of invertebrates. Euglena, Paramecium, Entamoeba, Giardia, Leishmania, Trypanosoma, Plasmodium, Fasciola, Taenia (scolex and proglottids), Schistosoma, Echinococcus, Enterobius, Ancylostoma, Cimex (bed bug) and Pediculus (Louse). 3. Permanent mount of wings, mouth parts and developmental stages of mosquito and house fly, Larval stages of helminths and crustaceans. Permanent preparation of ticks/ mites, abdominal gills of aquatic insects viz. Chironomus larva, dragonfly and mayfly nymphs, and antenna of housefly. 4. Study of Life cycles of Silk moth, Honey bee, and lac insects.		20
II	1. To prepare permanent slide of sponge gemmule, Obelia colony, Obelia medusa, and statocyst of Palaemon 2. To dissect out nerve ring and septal nephridia of earthworm 3. To dissect out nervous system of Cockroach/Grasshopper /Palaemon 4. To dissect out nervous system of Pila 5. Study of external appendages of and Palaemon 6. Study of segmentation in Leech and Earthworm		15

III	1. To study different cell types such as buccal epithelial cells, neurons, striated muscle cells using Methylene blue. 2. To study the different stages of Mitosis in root tip of onion. 3. To study the different stages of Meiosis in grasshopper testis. 4. To prepare molecular models of nucleotides, amino acids, dipeptides using bead and stick method.	10
V	1. Study of mutant phenotypes of <i>Drosophila</i>. 2. Preparation of polytene chromosomes. 3. Study of sex chromatin (Barr bodies) in buccal smear and hair bud cells (Human). 4. Preparation of human karyotype and study the chromosomal aberrations with respect to number, translocation, deletion etc. from the pictures provided. 5. To prepare family pedigrees.	10
VI	Virtual Labs (Suggestive sites) https://www.vlab.co.in https://zoologysan.blogspot.com www.vlab.iitb.ac.in/vlab www.onlinelabs.in www.powershow.com https://vlab.amrita.edu https://sites.dartmouth.edu	5

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Suggested Readings:

1. Lodish et al: Molecular Cell Biology: Freeman & Co, USA (2004).
2. Alberts et al: Molecular Biology of the Cell: Garland (2002).
3. Cooper: Cell: A Molecular Approach: ASM Press (2000).
4. Karp: Cell and Molecular Biology: Wiley (2002). Pierce B. Genetics. Freeman (2004).
5. Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, Janis Kuby: Immunology. W H Freeman (2007).
6. Kesar, Saroj and Vashishta N. (2007). Experimental Physiology: Comprehensive Manual. Heritage Publishers, New Delhi

Course Books published in Hindi may be prescribed by the Universities and Colleges

Course prerequisites: To study this course, a student must have had the subject biology in class/12th
The eligibility for this paper is 10+2 from Arts/ Commerce/ Science

Suggested Continuous Evaluation Methods:

Total Marks: 25

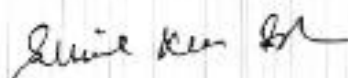
House Examination/Test: 10 Marks

Written Assignment/Presentation/Project / Term Papers/Seminar: 10 Marks

Class performance/Participation: 5 Marks

Further Suggestions: None

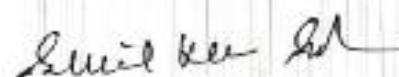
At the End of the whole syllabus any remarks/suggestions: University must ensure incorporation of all 06 units including virtual labs in practical evaluation.



Programme/Class: Diploma		Year: Second	Semester: Third
Subject: ZOOLOGY			
Course Code: B050301T		Course Title: Diversity of Chordates and Comparative Anatomy	
Course outcomes: The student at the completion of the course will be able to: • Demonstrate comprehensive identification abilities of chordate diversity • Explain structural and functional diversity of chordates • Explain evolutionary relationship amongst chordates • Take up research in biological sciences.			
Credits: 6		Core Compulsory/Elective	
Max. Marks: 25+75		Min. Passing Marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0			
Unit	Topic		Total No. of Lectures (90)
I	Origin of Chordates & Hemichordata • Origin of Chordates. Classification of Phylum Chordata upto the class. • Hemichordata: General characteristics, classification and detailed study of <i>Balanoglossus</i> (Habit and Habitat, Morphology, Anatomy, Physiology and Development).		6
II	Cephalochordata and Urochordata • Cephalochordata : General characteristics, classification and detailed study of <i>Branchiostoma</i> (<i>Amphioxus</i>) (Habit and Habitat, Morphology, Anatomy, Physiology). • Urochordata : General characteristics, classification and detailed study of <i>Herdmania</i>(Habit and Habitat, Morphology, Anatomy, Physiology and Post Embryonic Development).		12
III	Classification and General Characteristics of Vertebrates • General characters and Classification of different classes of vertebrates (Pisces, Amphibia, Reptilia, Aves, Mammalia) up to the order with examples. • Poisonous and Non Poisonous Snakes and biting mechanism. • Neoteny and Paedogenesis • Migration in birds • Dentition in Mammals		12
IV	Comparative Anatomy and Physiology of Vertebrates Integumentary System Structure, functions and derivatives of Integument Skeletal System Overview of axial and appendicular skeleton, Jaw suspensorium, Visceral arches		12
V	Digestive System Alimentary canal and associated glands and dentition		

		12
VI	Respiratory System Skin, gills, lungs and air sacs; Accessory respiratory organs	12
VII	Circulatory System General plan of circulation, evolution of heart and aortic arches Urinogenital System Succession of kidney, Evolution of urinogenital ducts, Types of mammalian uteri	12
VIII	Nervous System Comparative account of vertebrate brain; Autonomic nervous system, Spinal cord, Cranial nerves in mammals Sense Organs Classification of receptors Brief account of visual and auditory receptors in man	12
Suggested Readings: 1. Harvey et al: The Vertebrate Life (2006) 2. Kotpal R L: A Text book of Vertebrates, Rastogi Publications, Meerut 3. Hildebrand: Analysis of Vertebrate Structure (4th ed 1995, John Wiley) 4. Kenneth V. Kardong (2015) Vertebrates: Comparative Anatomy, Function, Evolution McGraw Hill 5. McFarland et al: Vertebrate Life (1979, Macmillan Publishing) 6. Parker and Haswell: TextBook of Zoology, Vol. II (1978, ELBS) 7. Romer and Parsons: The Vertebrate Body (6th ed 1986, CBS Publishing Japan) 8. Young: The Life of vertebrates (3rd ed 2006, ELBS/Oxford) 9. Weichert C.K and William Presch (1970). Elements of Chordate Anatomy, Tata McGraw Hills Course Books published in Hindi may be prescribed by the Universities and Colleges		
This course can be opted as an elective by the students of following subjects: The eligibility for this paper is 10+2 with Biology as one of the subject		
Suggested Continuous Evaluation Methods: House Examination/Test: 10 Marks Written Assignment/Presentation/Project / Term Papers/Seminar: 10 Marks Class performance/Participation: 5 Marks		
Further Suggestions: None		

At the end of the whole syllabus any remarks/suggestions:

Programme/Class: Diploma		Year: Second	Semester: Fourth
Subject: ZOOLOGY			
Course Code: B050401T		Course Title: Biochemistry and Physiology	
Course outcomes:			
The student at the completion of the course will learn:			
• To develop a deep understanding of structure of biomolecules like proteins, lipids and carbohydrates • To understand the thermodynamics of enzyme catalyzed reactions. • To understand systems biology and various functional components of an organism. • To explore the complex network of these functional components. • To comprehend the regulatory mechanisms for maintenance of function in the body.			
Credits: 4		Core: Compulsory	
Max. Marks: 25+75		Min. Passing Marks: as per rules	
Unit	Topics		Total No. of Lectures (60)
I	Structure and Function of Biomolecules • Structure and Biological importance of carbohydrates (Monosaccharides, Disaccharides, Polysaccharides and Glycoconjugates) • Lipids (saturated and unsaturated fatty acids, Tri-acylglycerols, Phospholipids, Glycolipids, Steroids) • Structure, Classification and General properties of α-amino acids; Essential and non-essential α-amino acids, Levels of organization in proteins; Simple and conjugate proteins. • Nucleic Acids: Basic structure of DNA and RNA		12
II	Enzyme Action and Regulation • Nomenclature and classification of enzymes; Cofactors; Specificity of enzyme action • Isozymes; Mechanism of enzyme action, Activation Energy • Factors affecting rate of enzyme-catalyzed reactions; Enzyme inhibition; • Allosteric enzymes; Regulation of enzyme action		10
III	Metabolism of Carbohydrates, Lipids and Proteins • Metabolism of Carbohydrates: glycolysis, citric acid cycle, gluconeogenesis, Glycogenolysis and Glycogenesis • Lipids — Biosynthesis of palmitic acid; Ketogenesis,		8

	• β-oxidation and omega-oxidation of saturated fatty acids • Metabolism of Amino acids- Transamination, Deamination and Urea cycle • Vitamins	
V	Digestion and Respiration • Structural organization and functions of gastrointestinal tract and associated glands • Mechanical and chemical digestion of food; Absorptions of carbohydrates, lipids, proteins, water, minerals and vitamins • Mechanism of respiration, Pulmonary ventilation; Respiratory volumes and capacities; Transport of oxygen and carbon dioxide in blood, Respiratory pigments, Dissociation curves and the factors influencing it; Control of respiration	7
VI	Circulation and Excretion • Components of blood and their functions • Hemostasis: Blood clotting system, Blood groups: Rh factor, ABO and MN • Structure of mammalian heart • Cardiac cycle; Cardiac output and its regulation, Electrocardiogram, Blood pressure and its regulation • Structure of kidney and its functional unit; Mechanism of urine formation	8
VII	Nervous System and Endocrinology • Structure of neuron, resting membrane potential • Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibers • Types of Synapse • Endocrine glands and their hormones - pineal, pituitary, thyroid, parathyroid, pancreas, adrenal • Classification of hormones, Mechanism of Hormone action	8
VIII	Muscular System Histology of different types of muscle; Ultra structure of skeletal muscle; Molecular and chemical basis of muscle contraction; Characteristics of muscle twitch; Motor unit, summation and tetanus	7
Suggested Readings: 1. Nelson & Cox: Lehninger's Principles of Biochemistry: McMillan (2000) 2. Zubay et al: Principles of Biochemistry: WCB (1995) 3. Jain J.L: Fundamentals of Biochemistry, S. Chand Publication, new Delhi 4. Murray et al: Harper's Illustrated Biochemistry: McGraw Hill (2003) Elliott and Elliott: Biochemistry and Molecular Biology: Oxford University Press		



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5. Guyton, A.C. & Hall, J.E. Textbook of Medical Physiology. XI Edition, Harcourt Asia PTE Ltd. /W.B. Saunders Company. (2006).
6. Tortora, G.J. & Grabowski, S. Principles of Anatomy & Physiology. XI Edition John Wiley & sons (2006).
7. Christopher D. Moyes, Patricia M. Schulte. Principles of Animal Physiology. 3rd Edition, Pearson Education (2016).
8. Hill, Richard W., et al. Animal physiology. Vol. 2. Sunderland, MA: Sinauer Associates, (2004).
9. Chatterjee C C Human Physiology Volume 1 & 2. 11th edition, CBS Publishers(2016).

Course Books published in Hindi may be prescribed by the Universities and Colleges

Course prerequisites: To study this course, a student must have had the subject biology in class/12th

Suggested Continuous Evaluation Methods:

Total Marks: 25

House Examination/Test: 10 Marks

Written Assignment/Presentation/Project / Term Papers/Seminar: 10 Marks

Class performance/Participation: 5 Marks

Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

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Programme/Class: Diploma		Year: Second	Semester: Fourth
Subject: ZOOLOGY			
Course Code: B050402P		Course Title: Lab on Chordates, Biochemistry and Physiology	
Course outcomes: The student at the completion of the course will be able to: • Understand and appreciate chordate diversity • Understand the structure of biomolecules like proteins, lipids and carbohydrates • Perform basic hematological laboratory testing, • Distinguish normal and abnormal hematological laboratory findings to predict the diagnosis of hematological disorders and diseases.			
Credits: 2		Core: Compulsory	
Max. Marks: 25+75		Min. Passing Marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:0-0-4			
Unit	Topics		Total No. of Practical Hours (60)
I	Study of Representative specimens/models of various classes of vertebrates- Petromyzon, Myxine, Scoliodon, Labeo, Wallago, Mystus, Channa, Exocoetes, Frog, Toad, Ichthyophis, Rhacophorus, Alytes, Turtle, Hemidactylus, Varanus, Naja, Bungarus, Viper, Models of Crocodylus, Gavialis, Alligator, Archaeopteryx, Brontosaurus. stuffed bird specimens- Eudynamis, Passer domesticus, duck, Owl, kite, vulture, Parrot, Peacock, Bulbul; Models of Echidna, Platypus, Macropus, Opposum, Hystrix, Rabbit and mole.		15
II	1. To prepare stained/unstained slide of placoid, cycloid and ctenoid scales. 2. Comparative study of bones of amphibians and mammals. 3. Comparative study of histological slides of different tissues of vertebrates. 4. Study of common edible fishes of Uttar Pradesh. 5. Dissection and tag labeling of afferent and efferent branchial vessels and cranial nerves in Wallago/ Labeo		10
III	1. Estimation of haemoglobin using Sahli's haemoglobinometer 2. Preparation of haemin and haemochromogen crystals 3. To study different mammalian blood cell types using Leishman stain. 4. Recording of blood pressure using a sphygmomanometer 5. Recording of blood glucose level by using glucometer		10
IV	1. Study of permanent slides of Mammalian skin, Cartilage, Bone, Spinal cord, Nerve cell, Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid 2. Recording of simple muscle twitch with electrical stimulation (or Virtual) 3. Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee jerk reflex)		10

V	1. Ninhydrin test for α-amino acids. 2. Benedict's test for reducing sugar and Iodine test for starch. 3. Test for sugar and acetone in urine. 4. Qualitative tests of functional groups in carbohydrates, proteins and lipids. 5. Action of salivary amylase under optimum conditions.	10
VI	Virtual Labs (Suggestive sites) 1. https://www.vlab.co.in 2. https://zoologysan.blogspot.com 3. www.vlab.iitb.ac.in/vlab 4. www.onlinelabs.in 5. www.powershow.com 6. https://vlab.amrita.edu 7. https://sites.dartmouth.edu	5

Suggested Readings: 1. Cox, M.M and Nelson, D.L. (2008). Lehninger's Principles of Biochemistry, V Edition, W.H. Freeman and Co., New York. 2. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2007). Biochemistry, VI Edition, W.H. Freeman and Co., New York. 3. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hecourt Asia PTE Ltd. /W.B. Saunders Company. 4. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons 5. Victor P. Eroschenko. (2008). diFiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott W. & Wilkins. 6. Arey, L.B. (1974). Human Histology. IV Edition. W.B. Saunders. 7. Kesar, Saroj and Vashishta N. (2007). Experimental Physiology: Comprehensive Manual. Heritage Publishers, New Delhi	
Course Books published in Hindi may be prescribed by the Universities and Colleges	
Course prerequisites: To study this course, a student must have had the subject biology in class/12th The eligibility for this paper is 10+2 from Arts/ Commerce/ Science	
Suggested Continuous Evaluation Methods:	
Total Marks: 25	
House Examination/Test: 10 Marks	
Written Assignment/Presentation/Project / Term Papers/Seminar: 10 Marks	
Class performance/Participation: 5 Marks	
Further Suggestions: None	

At the End of the whole syllabus any remarks/ suggestions: University must ensure incorporation of all 06 units including virtual labs in practical evaluation.

Raj

Sunil Kumar

Proramme/Class: Degree		Year: Third	Semester: Fifth
Subject: ZOOLOGY			
Course Code: B050501T		Course Title: Evolutionary and Developmental Biology	
Course outcomes: The student at the completion of the course 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.			
Credits: 5		Core: Compulsory	
Max. Marks: 25+75		Min. Passing Marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0			
Unit	Topic	Total No. of Lectures [75]	
I	Theories of Evolution • Origin of Life • Historical review of evolutionary concept: Lamarckism, Darwinism (Natural, Sexual and Artificial selection) • Modern synthetic theory of evolution • Patterns of evolution (Divergence, Convergence, Parallel, Coevolution)	15	
II	Population Genetics • Microevolution and Macroevolution: allele frequencies, genotype frequencies, Hardy-Weinberg equilibrium and conditions for its maintenance • Forces of evolution: mutation, selection, genetic drift	8	
III	Direct Evidences of Evolution Types of fossils, Incompleteness of fossil record, Dating of fossils, Phylogeny of horse	8	

IV	Species Concept and Extinction • Biological species concept (Advantages and Limitations); Modes of speciation (Allopatric, Sympatric)	7
	• Mass extinction (Causes, Names of five major extinctions)	
V	Gametes, Fertilization and Early Development • Gametogenesis • Fertilization • Cleavage • Gastrulation, • Fate maps • Developmental mechanics of cell specification	15
VI	Developmental Genes • Genes and development • Differential gene expression • Environmental regulation of development	7
VII	Early Vertebrate Development • Fish • Birds • mammals	7
VIII	Late Developmental Processes • Development of eye, limb in vertebrate • Metamorphosis: the hormonal reactivation of development in amphibians, insects • Regeneration: salamander limbs, mammalian liver, Hydras • Aging: the biology of senescence	8

Rul

Shail Kaur Sh

Suggested Readings:

1. Ridley, M. (2004). *Evolution*. III Edition. Blackwell Publishing
2. Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). *Evolution*. Cold Spring, Harbour Laboratory Press.
3. Hall, B. K. and Hallgrímsson, B. (2008). *Evolution*. IV Edition. Jones and Bartlett Publishers
4. Campbell, N. A. and Reece J. B. (2011). *Biology*. IX Edition, Pearson, Benjamin, Cummings.
5. Douglas, J. Futuyma (1997). *Evolutionary Biology*. Sinauer Associates.
6. Developmental Biology: T. Subramaniam, (Reprint), Narosa Publishing House Pvt. Ltd., New Delhi (2013).
7. Essential Developmental Biology: Jonathan M. W. Slack, (3rd ed.), Wiley-Blackwell. (2012).
8. Developmental Biology: From a Cell to an Organism (Genetics & Evolution) eBook: Russ Hodge, Infobase Publishing. (2009).
9. Current Topics In Developmental Biology: Roger A. Pedersen, Gerald P. Schatten, Elsevier. (1998).
10. Developmental biology: Werner A. Müller, Springer Science & Business Media. (2012).
11. Human Embryology and Developmental Biology E-Book: Bruce M. Carlson, Elsevier Health Sciences. (2018).
12. Developmental Biology: Michael J. F. Barresi, Scott F. Gilbert, Oxford University Press. (2019).
13. Balinski A I: Embryology

Course Books published in Hindi may be prescribed by the Universities and Colleges

This course can be opted as an elective by the students of following subjects: The eligibility for this paper is 10+2 with Biology as one of the subject

Suggested Continuous Evaluation Methods:

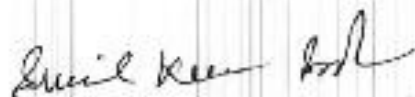
House Examination/Test: 10 Marks

Written Assignment/Presentation/Project / Term Papers/Seminar: 10 Marks

Class performance/Participation: 5 Marks

Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None



Programme/Class: Degree	Year: Third	Semester: Fifth
Subject: ZOOLOGY		
Course Code: B050502T	Course Title: Ecology, Ethology and Wildlife	
Course outcomes: The student at the completion of the course will learn: • Complexities and interconnectedness of various environmental levels and their functioning. • Global environmental issues, their causes, consequences and amelioration. • To understand and identify behaviours in a variety of taxa. • The proximate and ultimate causes of various behaviours. • About the molecules, cells, and systems of biological timing systems. • Conceptualizing how species profitably inhabit in the temporal environment and space out their activities at different times of the day and seasons. • To interpret the cause and effect of lifestyle disorders contributing to public understanding of biological timing. • To understand the importance of wildlife conservation.		
Credits: 5		Core: Compulsory
Max. Marks: 25+75		Min. Passing Marks: as per rules
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0		
Unit	Topic	Total No. of Lectures (75)
I	Introduction to Ecology • History of ecology, Autecology and synecology, Levels of organization, Laws of limiting factors, Study of physical factors	7
II	Concept of Ecosystem • Structure and function of ecosystem, Types of ecosystems with one example, Food chain: Detritus and grazing food chains, Food web; Energy flow through the ecosystem • Ecological pyramids and Ecological efficiencies, Nutrient and biogeochemical cycle with one example of Carbon cycle	12
III	Population and Community Ecology • Population characteristics: Density, natality, mortality, life tables, fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion	15

	• Exponential and logistic growth, • Community characteristics: species richness, dominance, diversity, abundance, Ecological succession with one example	
IV	Environmental Hazards • Sources of Environmental hazards • Climate changes • Greenhouse gases and global warming • Acid rain, Ozone layer destruction	7
V	Effects of Climate Change • Effect of climate change on public health • Sources of waste, types and characteristics, Sewage disposal and its management, Solid waste disposal, Biomedical waste handling and disposal, • Nuclear waste handling and disposal, Waste from thermal power plants, • Case histories on Bhopal gas tragedy, Chernobyl disaster, Seveso disaster and Three Mile Island accident and their aftermath.	7
VI	Behavioural Ecology and Chronobiology • Origin and history of Ethology, • Instinct vs. Learnt Behaviour • Associative learning, classical and operant conditioning, Habituation, Imprinting, • Circadian rhythms; Tidal rhythms and Lunar rhythms • Chronomedicine	10
VII	Introduction to Wild Life • Values of wild life - positive and negative; Conservation ethics; Importance of conservation; Causes of depletion; World conservation strategies. • Prominent wildlife of India: Birds and Mammals	10
VIII	Protected areas • National parks & sanctuaries, Community reserve; Important features of protected areas in India; Tiger conservation - Tiger reserves in India; Management challenges in Tiger reserve	7



Sumit K. Singh

Suggested Readings:

1. Ecology: Theories & Applications. Peter D. Stiling, 2001, Prentice Hall.
2. Ecological Modeling. 2008. Grant, W.E. and Swannack, T.M., Blackwell.
3. Ecology: The Experimental Analysis of Distribution and Abundance. Charles J. Krebs, 2016, Pearson Education Inc.
4. Elements of Ecology. T.M. Smith and R.L. Smith, 2014, Pearson Education Inc.
5. Environmental Chemistry. 2010. Stanley and Manahan, E. CRC, Taylor & Francis. London.
6. Environment. Raven, Berg, Johnson, 1993, Saunders College Publishing.
7. Essentials of Ecology. G.T. Miller, Jr. & Scott. E. Spoolman, 2014, Brooks/Cole, Cengage Learning.
8. Freshwater Ecology: A Scientific Introduction. 2004. Closs, G., Downes, B. and Boulton, A. Wiley-Blackwell publisher, Oxford.
9. Fundamental Processes in Ecology: An Earth system Approach. 2007. Wilkinson, D.M. Oxford

University Press, UK.

10. Fundamentals of Ecology. E.P. Odum & Gray. W. Barrett, 1971, Saunders
11. Caughley, G., and Sinclair, A.R.E. (1994). Wildlife Ecology and Management. Blackwell Science.
12. Woodroffe R., Thirgood, S. and Rabinowitz, A. (2005). People and Wildlife, Conflict or Co-existence? Cambridge University.
13. Bookhout, T.A. (1996). Research and Management Techniques for Wildlife and Habitats, 5 th edition. The Wildlife Society, Allen Press.
14. Sutherland, W.J. (2000). The Conservation Handbook: Research, Management and Policy. Blackwell Sciences
15. Hunter M.L., Gibbs, J.B. and Sterling, E.J. (2008). Problem-Solving in Conservation Biology and Wildlife Management: Exercises for Class, Field, and Laboratory. Blackwell Publishing.

Course Books published in Hindi may be prescribed by the Universities and Colleges

This course can be opted as an elective by the students of following subjects:

The eligibility for this paper is 10+2 with Biology as one of the subject

Suggested Continuous Evaluation Methods:

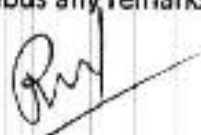
House Examination/Test: 10 Marks

Written Assignment/Presentation/Project / Term Papers/Seminar: 10 Marks

Class Performance/Participation: 5 Marks

Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None



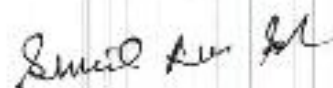
Programme/Class: Degree		Year: Third	Semester: Sixth
Subject: ZOOLOGY			
Course Code: B050601T		Course Title: Molecular biology, Bioinstrumentation & Biotechniques	
Course outcomes: The student at the completion of the course will be able to have: • A detailed and conceptual understanding of molecular processes viz. DNA to trait. • A clear understanding of the processes of central dogma viz. transcription, translation etc. underlying survival and propagation of life at molecular level. • Understanding of how genes are ultimately expressed as proteins which are responsible for the structure and function of all organisms. • Learn how four sequences (3 letter codons) generate the transcripts of life and determine the phenotypes of organisms. • How genes are regulated differently at different time and place in prokaryotes and eukaryotes.			
Credits: 4		Core: Compulsory	
Max. Marks: 25+75		Min. Passing Marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:4-0-0			
Unit	Topic		Total No. of Lectures (60)
I	Process of Transcription • Fine structure of gene • RNA polymerases • Transcription factors and machinery • Formation of initiation complex • Initiation, elongation and termination of transcription in prokaryotes and eukaryotes		7
II	Process of Translation • The Genetic code • Ribosome • Factors involved in translation • Aminoacylation of tRNA, tRNA-Identity, aminoacyl tRNA synthetase • Initiation, elongation and termination of translation in prokaryotes and eukaryotes		7
III	Regulation of Gene Expression I • Regulation of gene expression in prokaryotes: <i>lac</i> and <i>Trp</i> operons in <i>E. coli</i> • Regulation of gene expression in eukaryotes: Role of chromatin in gene expression • Regulation at transcriptional level and Post-transcriptional		8

	- modifications: Capping, Splicing, Polyadenylation • RNA editing.	
IV	Regulation of Gene Expression II • Regulation of gene expression in eukaryotes: • Regulation at translational level, Post- translational modifications: protein folding etc. • Intracellular protein degradation • Gene silencing, RNA interference (RNAi)	8
V	Principle and Types of Microscopes • Principle of Microscopy and Applications • Types of Microscopes: light microscopy, dark field microscopy, phase-contrast microscopy, • Fluorescence microscopy, confocal microscopy, electron microscopy	6
VI	Centrifugation and Chromatography • Principle of Centrifugation • Types of Centrifuges: high speed and ultracentrifuge • Types of rotors: Vertical, Swing-out, Fixed-angle etc. • Principle and Types of Chromatography: paper, ion-exchange, gel filtration, HPLC, affinity	8
VII	Spectrophotometry and Biochemical Techniques • Biochemical techniques: Measurement of pH, Preparation of buffers and solutions • Principle of Colorimetry/Spectrophotometry: Beer-Lambert law • Measurement, applications and safety measures of radio-tracer techniques	8
VIII	Molecular Techniques • Detection of nucleic acid by gel electrophoresis • DNA sequencing, DNA fingerprinting, RFLP • Polymerase Chain Reaction (PCR) • Detection of proteins, PAGE, ELISA, Western blotting	8
Suggested Readings: 1. Lodish et al: Molecular Cell Biology: Freeman & Co, USA (2004). 2. Alberts et al: Molecular Biology of the Cell: Garland (2002). 3. Cooper: Cell: A Molecular Approach: ASM Press (2000). 4. Karp: Cell and Molecular Biology: Wiley (2002). 5. Watson et al. Molecular Biology of the Gene. Pearson (2004). 6. Lewin. Genes VIII. Pearson (2004). 7. Pierce B. Genetics. Freeman (2004). 8. Sambrook et al. Molecular Cloning Vols I, II, III. CSHL (2001). 9. Primrose. Molecular Biotechnology. Panima (2001). 10. Clark & Switzer. Experimental Biochemistry. Freeman (2000) Course Books published in Hindi may be prescribed by the Universities and Colleges		

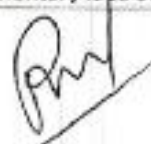
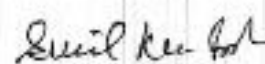
Sumit Ranjan

This course can be opted as an elective by the students of following subjects: The eligibility for this paper is 10+2 with Biology as one of the subject
Suggested Continuous Evaluation Methods: House Examination/Test: 10 Marks Written Assignment/Presentation/Project / Term Papers/Seminar: 10 Marks Class performance/Participation: 5 Marks
Further Suggestions: None

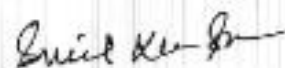
At the End of the whole syllabus any remarks/ suggestions: None

Programme/Class: Degree		Year: Third	Semester: Sixth
Subject: ZOOLOGY			
Course Code: B050602T		Course Title: Gene Technology, Immunology and Computational Biology	
Course outcomes: The student at the completion of the course will be able to:			
• Understand the principles of genetic engineering, how genes can be cloned in bacteria and the various technologies involved in it. • Know the applications of biotechnology in various fields like agriculture, industry and human health. • To have an in depth understanding about Immune System & its mechanisms. • Get introduced to DNA testing and utility of genetic engineering in forensic sciences. • Get introduced to computers and use of bioinformatics tools. • Enable students to get employment in pathology/Hospital. • Take up research in biological sciences.			
Credits: 4		Core: Compulsory	
Max. Marks: 25+75		Min. Passing Marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0			
Unit	Topic		Total No. of Lectures (60)
I	Principles of Gene Manipulation • Recombinant DNA Technology • Selection and identification of recombinant cells • Restriction Enzymes, DNA modifying enzymes, Cloning Vectors, Ligation • Gene transfer techniques, Gene therapy		12
II	Applications of Genetic Engineering • Single cell proteins • Biosensors, Biochips • Crop and livestock improvement, development of transgenics • Development of DNA drugs and vaccines		10
III	Immune System and its Components • Historical perspective of Immunology, Innate and Adaptive Immunity, clonal selection, complement system • Structure and functions of different classes of immunoglobulins, Hypersensitivity • Humoral immunity and cell mediated immunity		10
IV	Biostatistics I • Calculations of mean, median, mode, variance, standard deviation • Concepts of coefficient of variation, Skewness, Kurtosis • Elementary idea of probability and application		7

V	Biostatistics II - Data summarizing: frequency distribution, graphical presentation pie diagram, histogram - Tests of significance: one and two tailed tests, t-test and Chi-square test	7
VI	Basics of Computers - Basics (CPU, I/O units) and operating systems - Concept of homepages and websites, World Wide Web, URLs, using search engines	6
VII	Bioinformatics - Databases: nucleic acids, genomes, protein sequences and structures, Bibliography - Sequence analysis (homology): pairwise and multiple sequence alignments-BLAST, CLUSTALW - Phylogenetic analysis	8
Suggested Readings: 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. Zar, Pearson Education Inc., Delhi. 10. Statistical Methods (Eighth Edition) by G. W. Snedecor and W. G. Cochran, Willey 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). Course Books published in Hindi may be prescribed by the Universities and Colleges		
This course can be opted as an elective by the students of following subjects: The eligibility for this paper is 10+2 with Biology as one of the subject.		
Suggested Continuous Evaluation Methods: House Examination/Test: 10 Marks Written Assignment/Presentation/Project / Term Papers/Seminar: 10 Marks Class performance/Participation: 5 Marks		
Further Suggestions: None		

Programme/Class: Degree		Year: Third	Semester: Sixth
Subject: ZOOLOGY			
Course Code: B050602P		Course Title: Lab on Ecology, Embryology, Biotechniques and Computational Biology	
Course outcomes: The student at the completion of the course will be able to: • Understand the basic concepts, importance, status and interaction between organisms and environment and appreciate the value of wildlife in the ecosystem. • Develop knowledge about animal development. • Get knowledge about techniques used in modern research etc. • Enable students to use principles of biostatistics and bioinformatics for analysis of data.			
Credits: 2		Core: Compulsory	
Max. Marks: 25+75		Min. Passing Marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4			
Unit	Topic	Total No. of Practical Hours (60)	
I	Study of an aquatic ecosystem, its biotic components and food chain. • Estimation of Dissolved oxygen and carbon dioxide in given water sample. • Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided. • Study of population dynamics through numerical problems. • Study of circadian functions in humans (daily eating, sleep and temperature patterns).	15	
II	1. To study working principle of simple and compound microscope. 2. To study working principles of lab equipments- pH meter, Centrifuge, Spectrophotometer and PCR. 3. To identify amino acids using Paper chromatography 4. Determination of ABO blood group 5. Demonstration of DNA extraction from blood or tissue sample 6. Demonstration of agarose gel electrophoresis for detection of DNA, and PAGE for detection of Proteins 7. To study Restriction enzyme digestion using teaching kits. 8. To detect genetic mutations by Polymerase Chain Reaction (PCR) using teaching kits.	15	

III	To measure the pre and post clitellar lengths of earthworm and to calculate Mean, Median, mode and standard deviation. To learn presentation of data in the form of frequency table and graph. To learn sequence analysis using BLAST To learn multiple sequence alignment using CLUSTALW To learn about phylogenetic analysis using the programme Phylip	15
IV	Study of common insect pests of stored grain and crop Study of mouth parts of cockroach Study of embryonic stages of frog and chick through permanent slides Report on a visit to National Park/Biodiversity Park/Wild life sanctuary	10
IV	Virtual Labs (Suggestive sites) 1. Gel Documentation System- https://youtu.be/WPptJ-FanNE 2. Colorimeter- https://youtu.be/y4aK6G0bGul 3. PCR Part 1- https://youtu.be/CpGX1UPSI4A 4. PCR Part 2- https://youtu.be/6lcHAYPTAEw 5. DNA isolation Part 1- https://youtu.be/QE7U0InY9A 6. DNA isolation part 2- https://youtu.be/-efr_HFaHxM 7. DNA curve- https://youtu.be/ubL8QxTouG4 8. Spectrophotometer- https://youtu.be/ubL8QxTouG4 9. Agarose Part 1- https://youtu.be/7gyHPFww-g 10. Agarose part 2- https://youtu.be/j_bOZCHN4Sg 11. Use softwares like Primer3, NEB cutter NCBI, BLAST, CLUSTAL W, PHYLIP 12. https://www.vlab.co.in 13.	5

[Signature]

Swati K. S.

	13. https://zoologysan.blogspot.com	
	14. www.vlab.itp.ac.in/vlab	

Suggested Readings:

1. Ecology: The Experimental Analysis of Distribution and Abundance. Charles J. Krebs, 2016, Pearson Education Inc.
2. Fundamentals of Ecology. E.P. Odum & Gray. W. Barrett, 1971, Saunders.
3. Robert Leo Smith Ecology and field biology Harper and Row publisher
4. Bookhout, T.A. (1996). Research and Management Techniques for Wildlife and Habitats, 5th edition. The Wildlife Society, Allen Press.
5. Methods and Practice in biodiversity Conservation by David Hawks worth, Springer publication.

Course Books published in Hindi may be prescribed by the Universities and Colleges

This course can be opted as an elective by the students of following subjects:

The eligibility for this paper is 10+2 from Arts/Commerce/Science

Suggested Continuous Evaluation Methods:

House Examination/Test: 10 Marks

Written Assignment/Presentation/Project / Term Papers/Seminar: 10 Marks

Class performance/Participation: 5 Marks

Further Suggestions: None

At the end of the whole syllabus any remarks/ suggestions: University must ensure incorporation of all 04 units including virtual labs in practical evaluation.