

# *Department of Zoology*

## **Chaudhary Charan Singh University**

### **Meerut**



**As per National Education Policy-2020**  
**Common Minimum Syllabus for all U.P. State Universities and Colleges**  
**For First Three Years of Higher Education (UG) w.e.f. 2021-2022**

Programme	Major/Minor	Year/ Semester	Attainment at Exit	Course codes	Page No.
<b>Bachelor of Science B.Sc.</b>	<b>Zoology Major</b>	I/semesters 1 & 2	Certificate Course in Medical Diagnostics & Public Health	1. B050101T- Cytology, Genetics & Infectious Diseases 2. B050201T- Biochemistry and Physiology	<a href="#">4</a>
		II/semesters 3 & 4	Diploma in Molecular Diagnostics and Genetic Counselling	1. B050301T- Molecular Biology, Bioinstrumentation & Biotechniques 2. B050401T- Gene Technology, Immunology and Computational Biology	<a href="#">10</a>
		III/semesters 5 & 6	Degree in Bachelor of Science	1. B050501T- Diversity of Non-Chordates, Parasitology and Economic Zoology 2. B050502T- Diversity of Chordates and Comparative Anatomy 3. B050601T- Evolutionary and Developmental Biology 4. B050602T- Ecology, Ethology, Environmental Science and Wildlife	<a href="#">17</a>
	Zool.Minor elective	I/II year 1/3 semester		Environment & Public Health challenges	<a href="#">28</a>
	Skill Minor elective	I year/1&2 semester		Basic Clinical Techniques- Part-I &II	<a href="#">30</a>
	Board members 2021-22			-----	<a href="#">34</a>

## BSc Zoology- Year & semester wise Structure, Paper titles, Credits & Hours

Programme/Year	Semester	Course Codes	Paper Title	Credits	Teaching Hours
<b>1 Certificate Course in Medical Diagnostics &amp; Public Health</b>	I	<b>B050101T</b>	Cytology, Genetics and Infectious Diseases	04	60
		<b>B050102P</b>	Cell Biology & Cytogenetics Lab	02	60
	II	<b>B050201T</b>	Biochemistry and Physiology	04	60
		<b>B050202P/R</b>	Physiological, Biochemical & Haematology Lab	02	60
<b>2 Diploma in Molecular Diagnostics and Genetic Counselling</b>	III	<b>B050301T</b>	Molecular Biology, Bioinstrumentation & Biotechniques	04	60
		<b>B050302P</b>	Bioinstrumentation & Molecular Biology Lab	02	60
	IV	<b>B050401T</b>	Gene Technology, Immunology and Computational Biology	04	60
		<b>B050402P/R</b>	Genetic Engineering and Counselling Lab	02	60
<b>3 Degree in Bachelor of Science</b>	V	<b>B050501T</b>	Diversity of Non-Chordates, Parasitology and Economic Zoology	04	60
		<b>B050502T</b>	Diversity of Chordates and Comparative Anatomy	04	60
		<b>B050503P</b>	Lab on Virtual Dissection, Anatomy, Economic Zoology and Parasitology	02	60
	VI	<b>B050601T</b>	Evolutionary and Developmental Biology	04	60
		<b>B050602T</b>	Ecology, Ethology, Environmental Science and Wildlife	04	60
		<b>B050603P</b>	Lab on Environmental Science, Behavioural Ecology, Developmental Biology, Wildlife, Ethology	02	60

### Subject prerequisite

To study Zoology in undergraduate, 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 flavor 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 behavioral ecology.
2. The modern areas including cell biology and genetics, molecular biology, 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.

B.Sc. I Certificate Course in Medical Diagnostics & Public Health	PSO1	This course introduces System Biology and various functional components of an organism. Emphasis will be on physiological understanding abnormalities and anomalies associated with white blood cells and red blood cells. The course emphasizes cell identification, cell differentiation and cell morphology evaluation procedures. This will enhance hematology analytical skills along with skill of using many instruments.
	PSO 2	The students will learn the basic principles of genetics and how to prepare karyotypes to study the chromosomes. Young learners will fail to understand karyotype and their expressions unless they understand upstream events changes have been made accordingly.
	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, centrifugation and chromatography, and various biochemical techniques, preparation of slides which will help them in getting employment in pathology labs and contribute to health care system.
	PSO 5	<b>Certificate courses will make students eligible for technical positions in govt. &amp; private labs/institutes.</b>
B.Sc. II Diploma in Molecular Diagnostics and Genetic Counselling	PSO1	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. The differential regulation of genes in prokaryotes and eukaryotes leads to the development of an organism from an embryo.
	PSO 2	The students will be able to understand and apply the principles and techniques of 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 principles of genetic engineering, gene cloning, immunology and related technologies will enable students to play an important role in applications of biotechnology in various fields like agriculture, forensic sciences, industry and human health and make a career out of it. Students can have their own start-ups as well.
	PSO 4	The basic tools of bioinformatics will enable students to analyze large amount of genomic data and its application to evolutionary biology. Apply knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics existing software effectively to extract information from large databases and to use this information in computer modeling.
	PSO 5	<b>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.</b>
B.Sc. III Degree in Bachelor of Science	PSO1	This Programme aims to introduce students to animal diversity of invertebrates and vertebrates. The students will be taught about invertebrates and vertebrates using observational strategies, museum specimens and field reports.
	PSO 2	variety of interacting processes generate organism's heterogeneous shapes, size, & structural features.
	PSO 3	Inclusion of ecology and environmental sciences will enrich students with 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	Students will also come to know about the basic principle of life, how a cell divides leading to the growth of an organism and also reproduces to form new organisms.
	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	<b>The Degree courses will enable students to go for higher studies like Masters and Ph.D. in Zoology and Allied subjects.</b>

<b>Programme/Class:</b> Certificate	<b>Year: First; Subject: ZOOLOGY</b>	<b>Semester: First</b>
<b>Course Code: B050101T</b>	<b>Course Title: Cytology, Genetics and Infectious Diseases</b>	
<b>Course outcomes:</b> The student at the completion of the course will be able to: <ul style="list-style-type: none"> <li>• Understand the structure and function of all the cell organelles.</li> <li>• Know about the chromatin structure and its location.</li> <li>• 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.</li> <li>• How one cell communicates with its neighboring cells?</li> <li>• Understand the basic principles of genetics and how genes (earlier called factors) are inherited from one generation to another.</li> <li>• Understand the Mendel's laws and the deviations from conventional patterns of inheritance.</li> <li>• Comprehend how environment plays an important role by interacting with genetic factors.</li> <li>• How to detect chromosomal aberrations in humans and study the pattern of inheritance by pedigree analysis in families.</li> </ul>		
<b>Credits: 4</b>		<b>Core: Compulsory</b>
<b>Max. Marks: 25+75</b>		<b>Min. Passing Marks: as per rules</b>
Total No. of Lectures-Tutorials-Practical (in hours per week): <b>L-T-P:4-0-0</b>		
<b>Unit</b>	<b>Topics</b>	<b>Total No. of Lectures (60)</b>
<b>I</b>	<b>Structure and Function of Cell Organelles I in Animal cell</b> <ul style="list-style-type: none"> <li>• Plasma membrane: chemical structure—lipids and proteins</li> <li>• Endomembrane system: protein targeting and sorting, transport, endocytosis, exocytosis</li> </ul> <b>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)</b> <u>Susruta, Charak, Patanjali, Varahamihira, Prof. H.G. Khorana, Prof. G.N. Ramachandran, Prof. Salim Ali, Prof. JP Thapliyal, Prof Lalji Singh, Prof. MK Chandrashekharan, Prof. R Mishra</u> -to be discussed with the topics being dealt	<b>6</b>
<b>II</b>	<b>Structure and Function of Cell Organelles II in Animal cell</b> <ul style="list-style-type: none"> <li>• Cytoskeleton: microtubules, microfilaments, intermediate filaments</li> <li>• Mitochondria: Structure, oxidative phosphorylation; <b>electron transport system</b></li> <li>• Peroxisome and ribosome: structure and function</li> </ul>	<b>6</b>
<b>III</b>	<b>Nucleus and Chromatin Structure</b> <ul style="list-style-type: none"> <li>• Structure and function of nucleus in eukaryotes</li> <li>• Chemical structure and base composition of DNA and RNA</li> <li>• DNA supercoiling, chromatin organization, structure of chromosomes</li> <li>• Types of DNA and RNA</li> </ul>	<b>8</b>
<b>IV</b>	<b>Cell cycle, Cell Division and Cell Signaling</b> <ul style="list-style-type: none"> <li>• Cell division: mitosis and meiosis</li> <li>• Introduction to Cell cycle and its regulation, apoptosis</li> </ul> Signal transduction: intracellular signaling and cell surface receptors, via G-protein linked receptors <ul style="list-style-type: none"> <li>• Cell-cell interaction: cell adhesion molecules, cellular junctions</li> </ul>	<b>8</b>

<b>V</b>	<b>Mendelism and Sex Determination</b> <ul style="list-style-type: none"> <li>• Basic principles of heredity: Mendel's laws, monohybrid and dihybrid crosses</li> <li>• Complete and Incomplete Dominance</li> <li>• Clinical expressions: Penetrance and expressivity</li> <li>• Genic Sex-Determining Systems, Environmental Sex Determination, Sex Determination with example of <i>Drosophila</i></li> <li>• Sex-linked characteristics and Dosage compensation</li> </ul>	<b>8</b>
<b>VI</b>	<b>Extensions of Mendelism, Genes and Environment</b> <ul style="list-style-type: none"> <li>• Extensions of Mendelism: Multiple Alleles, Gene Interaction</li> <li>• The Interaction Between Sex and Heredity: Sex-Influenced and Sex-Limited Characteristics</li> <li>• Cytoplasmic Inheritance, Genetic Maternal Effects</li> <li>• Interaction Between Genes and Environment: Environmental Effects on Gene Expression, Inheritance of Continuous Characteristics</li> </ul>	<b>8</b>
<b>VII</b>	<b>Human Chromosomes and Patterns of Inheritance</b> <ul style="list-style-type: none"> <li>• Human karyotype</li> <li>• Chromosomal anomalies: Structural and numerical aberrations with examples</li> <li>• Pedigree analysis</li> <li>• Patterns of inheritance: autosomal dominant, autosomal recessive, X-linked recessive, X-linked dominant</li> </ul>	<b>8</b>
<b>VIII</b>	<b>Infectious Diseases</b> <ul style="list-style-type: none"> <li>• Introduction to pathogenic organisms: viruses, bacteria, fungi, protozoa, and worms.</li> <li>• Structure, life cycle, pathogenicity, including diseases, causes, symptoms and control of common parasites: <i>Trypanosoma</i>, <i>Giardia</i> and <i>Wuchereria</i></li> </ul>	<b>8</b>

**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 Kuby- Kuby 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 English and 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/12<sup>th</sup>

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**

<b>Programme/Class:</b> Certificate	<b>Year:</b> First <b>Subject:</b> ZOOLOGY	<b>Semester:</b> First
<b>Course Code:</b> B050102P	<b>Course Title:</b> Cell Biology & Cytogenetics Lab	
<b>Course outcomes:</b> At the completion of the course students will learn Hands-on: 1. To use simple and compound microscopes. 2. To prepare slides and stain them to see the cell organelles. 3. 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. 4. The chromosomal aberrations by preparing karyotypes 5. How chromosomal aberrations are inherited in humans by pedigree analysis in families. 6. The antigen-antibody reaction.		
<b>Credits:</b> 2	<b>Core:</b> Compulsory	
<b>Max. Marks:</b> 25+75	<b>Min. Passing Marks:</b> as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): <b>L-T-P:0-0-4</b>		
<b>Unit</b>	<b>Topics</b>	<b>Total Lectures (60)</b>
<b>I</b>	1. Understanding of simple and compound microscopes. 2. To study different cell types such as buccal epithelial cells, neurons, striated muscle cells using Methylene blue (virtual/ slaughtered tissue). 3. To study the different stages of Mitosis in root tip of onion. 4. To study the different stages of Meiosis in testis (virtual). 5. To check the permeability of cells using salt solution of different concentrations.	<b>15</b>
<b>II</b>	1. Study of parasites (eg. Protozoans, helminths <i>etc.</i> ) from permanent slides. 2. To learn the procedures for preparation of temporary (root tip of onion) and permanent stained/unstained slides, with available mounting material.	<b>15</b>
<b>III</b>	1. Study of mutant phenotypes of <i>Drosophila</i> . 2. Preparation of polytene chromosomes. 3. Preparation of human karyotype and study the chromosomal aberrations with respect to number, translocation, deletion etc. from the pictures provided. (virtual/optional). 4. To prepare family pedigrees.	<b>15</b>
<b>IV</b>	<b>Virtual Labs (Suggestive sites)</b> <a href="https://www.vlab.co.in">https://www.vlab.co.in</a> <a href="https://zoologysan.blogspot.com">https://zoologysan.blogspot.com</a> <a href="http://www.vlab.iitb.ac.in/vlab">www.vlab.iitb.ac.in/vlab</a> www.onlinelabs.in <a href="http://www.powershow.com">www.powershow.com</a> https://vlab.amrita.edu <a href="https://sites.dartmouth.edu">https://sites.dartmouth.edu</a>	
<b>Suggested Readings:</b> 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- Kuby Immunology. W H Freeman (2007). 6. Kesar, Saroj and Vasishta N.2007 Experimental Physiology: Comprehensive Manual. Heritage Publishers, New Delhi <b>Course Books published in Hindi may be prescribed by the Universities and Colleges</b>		
<b>Course prerequisites:</b> To study this course, a student must have had the subject biology in class/12 <sup>th</sup>		
Suggested Continuous Evaluation Methods: <b>Total Marks: 25</b> <b>House Examination/Test:</b> 10 Marks <b>Written Assignment/Presentation/Project / Term Papers/Seminar:</b> 10 Marks <b>Class performance/Participation:</b> 5 Marks		

<b>Programme/Class:</b> Certificate	<b>Year:</b> First	<b>Semester:</b> Second
<b>Subject:</b> ZOOLOGY		
<b>Course Code:</b> B050201T	<b>Course Title:</b> Biochemistry and Physiology	
<b>Course outcomes:</b> The student at the completion of the course will learn:		
<ul style="list-style-type: none"> <li>• To develop a deep understanding of structure of biomolecules like proteins, lipids and carbohydrates</li> <li>• What simple molecules together form complex macromolecules.</li> <li>• To understand the thermodynamics of enzyme catalyzed reactions.</li> <li>• Mechanisms of energy production at cellular and molecular levels.</li> <li>• To understand systems biology and various functional components of an organism.</li> <li>• To explore the complex network of these functional components.</li> <li>• To comprehend the regulatory mechanisms for maintenance of function in the body.</li> </ul>		
<b>Credits:</b> 4	<b>Core:</b> Compulsory	
<b>Max. Marks:</b> 25+75	<b>Min. Passing Marks:</b> as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): <b>L-T-P:4-0-0</b>		
<b>Unit</b>	<b>Topics</b>	<b>Total No. of Lectures (60)</b>
<b>I</b>	<b>Structure and Function of Biomolecules</b> <ul style="list-style-type: none"> <li>• Structure and Biological importance of carbohydrates (Monosaccharides, Disaccharides, Polysaccharides and Glycoconjugates)</li> <li>• Lipids (saturated and unsaturated fatty acids, Tri-acylglycerols, Phospholipids, Glycolipids, Steroids)</li> <li>• Structure, Classification and General properties of <math>\alpha</math>-amino acids; Essential and non-essential <math>\alpha</math>-amino acids, Levels of organization in proteins; Simple and conjugate proteins.</li> </ul>	<b>8</b>
<b>II</b>	<b>Enzyme Action and Regulation</b> <ul style="list-style-type: none"> <li>• Nomenclature and classification of enzymes; Cofactors; Specificity of enzyme action</li> <li>• Isozymes; Mechanism of enzyme action</li> <li>• Enzyme kinetics; Factors affecting rate of enzyme-catalyzed reactions; Equation of Michaelis-Menton, Concept of <math>K_m</math> and <math>V_{max}</math>, Enzyme inhibition</li> <li>• Allosteric enzymes and their kinetics; Regulation of enzyme action</li> </ul>	<b>8</b>
<b>III</b>	<b>M Metabolism of Carbohydrates and Lipids</b> <ul style="list-style-type: none"> <li>• Metabolism of Carbohydrates: glycolysis, citric acid cycle, gluconeogenesis, phosphate pentose pathway</li> <li>• Glycogenolysis and Glycogenesis</li> <li>• Lipids --- Biosynthesis of palmitic acid; Ketogenesis,</li> <li>• <math>\beta</math>-oxidation and omega -oxidation of saturated fatty acids with even and odd number of carbon atoms</li> </ul>	<b>8</b>
<b>IV</b>	<b>Metabolism of Proteins and Nucleotides</b> <ul style="list-style-type: none"> <li>• Catabolism of amino acids: Transamination, Deamination, Urea cycle</li> <li>• Nucleotides and vitamins</li> <li>• peptide linkages</li> </ul>	<b>6</b>
<b>V</b>	<b>Digestion and Respiration in humans</b> <ul style="list-style-type: none"> <li>• Structural organization and functions of gastrointestinal tract and associated glands</li> </ul>	<b>7</b>

	<ul style="list-style-type: none"> <li>Mechanical and chemical digestion of food; Absorptions of carbohydrates, lipids, proteins, water, minerals and vitamins; Histology of trachea and lung</li> <li>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</li> </ul>	
<b>VI</b>	<b>Circulation and Excretion in humans</b> <ul style="list-style-type: none"> <li>Components of blood and their functions; hemopoiesis</li> <li>Blood clotting: Blood clotting system, Blood groups: Rh factor, ABO and MN</li> <li>Structure of mammalian heart</li> <li>Cardiac cycle; Cardiac output and its regulation, Electrocardiogram, Blood pressure and its regulation</li> <li>Structure of kidney and its functional unit; Mechanism of urine formation</li> </ul>	<b>8</b>
<b>VII</b>	<b>Nervous System and Endocrinology in humans</b> <ul style="list-style-type: none"> <li>Structure of neuron, resting membrane potential</li> <li>Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibers</li> <li>Types of synapse</li> <li>Endocrine glands - pineal, pituitary, thyroid, parathyroid, pancreas, adrenal; hormones secreted by them</li> <li>Classification of hormones; Mechanism of Hormone action</li> </ul>	<b>8</b>
<b>VIII</b>	<b>Muscular System in humans</b> 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	<b>7</b>
<b>Suggested Readings:</b> <ol style="list-style-type: none"> <li>Nelson &amp; Cox: Leininger's Principles of Biochemistry: McMillan (2000)</li> <li>Zubay <i>et al</i>: Principles of Biochemistry: WCB (1995)</li> <li>Voet &amp; Voet: Biochemistry Vols 1 &amp; 2: Wiley (2004)</li> <li>Murray <i>et al</i>: Harper's Illustrated Biochemistry: McGraw Hill (2003) Elliott and Elliott: Biochemistry and Molecular Biology: Oxford University Press</li> <li>Guyton, A.C. &amp; Hall, J.E. Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company. (2006).</li> <li>Tortora, G.J. &amp; Grabowski, S. Principles of Anatomy &amp; Physiology. XI Edition John Wiley &amp; sons (2006).</li> <li>Christopher D. Moyes, Patricia M. Schulte. Principles of Animal Physiology. 3rd Edition, Pearson Education (2016).</li> <li>Hill, Richard W., et al. Animal physiology. Vol. 2. Sunderland, MA: Sinauer Associates, (2004).</li> <li>Chatterjee C C Human Physiology Volume 1 &amp; 2. 11th edition. CBS Publishers(2016).</li> </ol> <p style="text-align: center;"><b>Course Books published in Hindi may be prescribed by the Universities and Colleges</b></p>		
<b>Course prerequisites:</b> To study this course, a student must have had the subject biology in class/12 <sup>th</sup>		
Suggested Continuous Evaluation Methods: <b>Total Marks: 25</b>		
<b>House Examination/Test:</b> 10 Marks <b>Written Assignment/Presentation/Project / Term Papers/Seminar:</b> 10 Marks <b>Class performance/Participation:</b> 5 Marks		



<b>Programme/Class:</b> Certificate	<b>Year:</b> First	<b>Semester:</b> Second
<b>Subject:</b> ZOOLOGY		
<b>Course Code:</b> B050202P/R	<b>Course Title:</b> Physiological, Biochemical & Haematology Lab	
<b>Course outcomes:</b> The student at the completion of the course will be able to: <ul style="list-style-type: none"> <li>• Understand the structure of biomolecules like proteins, lipids and carbohydrates</li> <li>• Perform basic hematological laboratory testing,</li> <li>• Distinguish normal/abnormal hematological lab. findings to predict diagnosis of hematological disorders/ diseases.</li> </ul>		
<b>Credits:</b> 2	<b>Core:</b> Compulsory	
<b>Max. Marks:</b> 25+75	<b>Min. Passing Marks:</b> as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): <b>L-T-P:0-0-4</b>		
<b>Unit</b>	<b>Topics</b>	<b>Total Lectures (60)</b>
<b>I</b>	1. Estimation of hemoglobin using Sahli's haemoglobinometer 2. Preparation of hemin and haemochromogen crystals 3. Counting of RBCs and WBCs using Haemocytometer 4. To study different mammalian blood cell types using Leishman stain. 5. Recording of blood pressure using a sphygmomanometer 6. Recording of blood glucose level by using glucometer	<b>20</b>
<b>II</b>	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)	<b>15</b>
<b>III</b>	1. To prepare molecular models of nucleotides, amino acids, dipeptides using bead and stick method. 2. Ninhydrin test for $\alpha$ -amino acids. 3. Benedict's test for reducing sugar and iodine test for starch. 4. Test for sugar and acetone in urine. 5. Qualitative tests of functional groups in carbohydrates, proteins & lipids. 6. Action of salivary amylase under optimum conditions.	<b>10</b>
<b>IV</b>	<b>Virtual Labs (Suggestive sites)</b> <a href="https://www.vlab.co.in">https://www.vlab.co.in</a> <a href="http://www.vlab.iitb.ac.in/vlab">www.vlab.iitb.ac.in/vlab</a> <a href="http://www.powershow.com">www.powershow.com</a> <a href="https://sites.dartmouth.edu">https://sites.dartmouth.edu</a> <a href="https://zoologysan.blogspot.com">https://zoologysan.blogspot.com</a> <a href="http://www.onlinelabs.in">www.onlinelabs.in</a> <a href="https://vlab.amrita.edu">https://vlab.amrita.edu</a>	<b>15</b>
<b>Suggested Readings:</b>		
<ol style="list-style-type: none"> <li>1. Cox, M.M and Nelson, D.L. (2008). Leininger's Principles of Biochemistry, V Ed., W.H. Freeman and Co., New York.</li> <li>2. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2007). Biochemistry, VI Edition, W.H. Freeman and Co., New York.</li> <li>3. Guyton, A.C. &amp; Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hecourt Asia PTE Ltd. /W.B. Saunders Company.</li> <li>4. Tortora, G.J. &amp; Grabowski, S. (2006). Principles of Anatomy &amp; Physiology. XI Edition John Wiley &amp; sons</li> <li>5. Victor P. Eroschenko. (2008). diFiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott W. &amp; Wilkins.</li> <li>6. Arey, L.B. (1974). Human Histology. IV Edition. W.B. Saunders.</li> <li>7. Kesar, Saroj and Vasishtha N. (2007). Experimental Physiology: Comprehensive Manual. Heritage Publishers, N. Delhi</li> </ol>		
<b>Course Books published in Hindi may be prescribed by the Universities and Colleges</b>		
To study this course, a student must have subject biology in class/12 <sup>th</sup> .The eligibility for this paper is 10+2 from Arts/ Commerce/ Science		
Suggested Continuous Evaluation Methods: <b>Total Marks: 25</b>		
<b>House Examination/Test:</b> 10 Marks		
<b>Written Assignment/Presentation/Project / Term Papers/Seminar:</b> 10 Marks		
<b>Class performance/Participation:</b> 5 Marks		

<b>Programme/Class:</b> Diploma	<b>Year:</b> Second	<b>Semester:</b> Third
<b>Subject:</b> ZOOLOGY		
<b>Course Code:</b> B050301T	<b>Course Title:</b> Molecular Biology, Bioinstrumentation & Biotechniques	
<b>Course outcomes:</b> The student at the completion of the course will be able to have: <ul style="list-style-type: none"> <li>• A detailed and conceptual understanding of molecular processes <i>viz.</i> DNA to trait.</li> <li>• A clear understanding of the processes of central dogma <i>viz.</i> transcription, translation <i>etc.</i> underlying survival and propagation of life at molecular level.</li> <li>• Understanding of how genes are ultimately expressed as proteins which are responsible for the structure and function of all organisms.</li> <li>• Learn how four sequences (3 letter codons) generate the transcripts of life and determine the phenotypes of organisms.</li> <li>• How genes are regulated differently at different time and place in prokaryotes and eukaryotes.</li> </ul>		
<b>Credits: 4</b>		<b>Core:</b> Compulsory
<b>Max. Marks: 25+75</b>		<b>Min. Passing Marks:</b> as per rules
Total No. of Lectures-Tutorials-Practical (in hours per week): <b>L-T-P:4-0-0</b>		
Unit	Topic	Total Lectures (60)
<b>I</b>	<b>Protein synthesis I: Process of Transcription</b> <ul style="list-style-type: none"> <li>• Fine structure of gene</li> <li>• RNA polymerases</li> <li>• Transcription factors and machinery</li> <li>• Formation of initiation complex</li> <li>• Initiation, elongation and termination of transcription in prokaryotes and eukaryotes</li> </ul>	<b>7</b>
<b>II</b>	<b>Protein synthesis II: Process of Translation</b> <ul style="list-style-type: none"> <li>• The Genetic code</li> <li>• Ribosome</li> <li>• Factors involved in translation</li> <li>• Aminoacylation of tRNA, tRNA-identity, aminoacyl-tRNA-synthetase</li> <li>• Initiation, elongation and termination of translation in prokaryotes and eukaryotes</li> </ul>	<b>7</b>
<b>III</b>	<b>Regulation of Gene Expression I</b> <ul style="list-style-type: none"> <li>• Regulation of gene expression in prokaryotes: <i>lac</i> and <i>trp</i> operons in <i>E. coli</i></li> <li>• Regulation of gene expression in eukaryotes: Role of chromatin in gene expression</li> <li>• Regulation at transcriptional level, Post-transcriptional modifications: Capping, Splicing, Polyadenylation</li> <li>• RNA editing.</li> </ul>	<b>8</b>
<b>IV</b>	<b>Regulation of Gene Expression II</b> <ul style="list-style-type: none"> <li>• Regulation of gene expression in eukaryotes:</li> <li>• Regulation at translational level, Post- translational modifications etc.</li> <li>• Intracellular protein degradation</li> </ul>	<b>8</b>

	<ul style="list-style-type: none"> <li>Gene silencing, RNA interference (RNAi)</li> </ul>	
<b>V</b>	<b>Principle and Types of Microscopes</b> <ul style="list-style-type: none"> <li>Principle of Microscopy and Applications</li> <li>Types of Microscopes: light microscopy, dark field microscopy, phase-contrast microscopy,</li> <li>Fluorescence microscopy, confocal microscopy, electron microscopy</li> </ul>	<b>6</b>
<b>VI</b>	<b>Centrifugation and Chromatography</b> <ul style="list-style-type: none"> <li>Principle of Centrifugation</li> <li>Types of Centrifuges: high speed and ultracentrifuge</li> <li>Types of rotors: Vertical, Swing-out, Fixed-angle etc.</li> <li>Principle and Types of Chromatography: paper, ion-exchange, gel filtration, HPLC, affinity</li> </ul>	<b>8</b>
<b>VII</b>	<b>Spectrophotometry and Biochemical Techniques</b> <ul style="list-style-type: none"> <li>Biochemical techniques: Measurement of pH, Preparation of buffers and solutions</li> <li>Principle of Colorimetry/Spectrophotometry: Beer-Lambert law</li> <li>Measurement, applications and safety measures of radio-tracer techniques</li> </ul>	<b>8</b>
<b>VIII</b>	<b>Molecular Techniques</b> <ul style="list-style-type: none"> <li>Detection of nucleic acid by gel electrophoresis</li> <li>DNA sequencing; DNA fingerprinting, RFLP</li> <li>Polymerase Chain Reaction (PCR)</li> <li>Detection of proteins, PAGE, ELISA, Western blotting</li> </ul>	<b>8</b>
<b>Suggested Readings:</b> <ol style="list-style-type: none"> <li>Lodish et al: Molecular Cell Biology: Freeman &amp; Co, USA (2004).</li> <li>Alberts et al: Molecular Biology of the Cell: Garland (2002).</li> <li>Cooper: Cell: A Molecular Approach: ASM Press (2000).</li> <li>Karp: Cell and Molecular Biology: Wiley (2002).</li> <li>Watson et al. Molecular Biology of the Gene. Pearson (2004).</li> <li>Lewin. Genes VIII. Pearson (2004).</li> <li>Pierce B. Genetics. Freeman (2004).</li> <li>Sambrook et al. Molecular Cloning Vols I, II, III. CSHL (2001).</li> <li>Primrose. Molecular Biotechnology. Panima (2001).</li> <li>Clark &amp; Switzer. Experimental Biochemistry. Freeman (2000)</li> </ol> <p style="text-align: center;"><b>Course Books published in Hindi may be prescribed by the Universities and Colleges</b></p>		
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: <b>House Examination/Test:</b> 10 Marks <b>Written Assignment/Presentation/Project / Term Papers/Seminar:</b> 10 Marks <b>Class performance/Participation:</b> 5 Marks		

<b>Programme/Class:</b> Diploma	<b>Year:</b> Second	<b>Semester:</b> Third
<b>Subject:</b> ZOOLOGY		
<b>Course Code:</b> B050302P	<b>Course Title:</b> Bioinstrumentation & Molecular Biology Lab	
<b>Course outcomes:</b> The student at the completion of the course will be able to <ul style="list-style-type: none"> <li>• Understand the basic principles of microscopy, working of different types of microscopes</li> <li>• Understand the basic techniques of centrifugation and chromatography for studying cells and separation of biomolecules</li> <li>• Understand the principle of measuring the concentrations of macromolecules in solutions by colorimeter and spectrophotometer and use them in Biochemistry.</li> <li>• Learn about some of the commonly used advance DNA testing methods.</li> </ul>		
<b>Credits:</b> 2	<b>Core:</b> Compulsory	
<b>Max. Marks:</b> 25+75	<b>Min. Passing Marks:</b> as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): <b>L-T-P:</b> 0-0-4		
<b>Unit</b>	<b>Topic</b>	<b>Total No. of Lectures (60)</b>
<b>I</b>	1. To study the working principle and Simple, Compound and Binocular microscopes. 2. To study the working principle of various lab equipment such as pH Meter, Electronic balance, use of glass pipettes and micropipettes, Laminar flow, Incubator, Centrifuge, Chromatography apparatus, etc. (Any three)	<b>15</b>
<b>II</b>	1. To prepare solutions and buffers. 2. To measure absorbance in Colorimeter or Spectrophotometer. 3. Demonstration of differential centrifugation to fractionate different components in a mixture (optional).	<b>15</b>
<b>III</b>	1. To identify different amino acids in a mixture using paper chromatography. 2. Demonstration of DNA extraction from blood or tissue samples. 3. To estimate amount of DNA using spectrophotometer	<b>15</b>
<b>IV</b>	<b>Virtual Labs (Suggestive sites)</b> <a href="http://www.labinapp.com">www.labinapp.com</a> <a href="http://www.uwlax.edu">www.uwlax.edu</a> <a href="http://www.labster.com">www.labster.com</a> <a href="http://www.onlinelabs.in">www.onlinelabs.in</a> <a href="http://www.powershow.in">www.powershow.in</a> <a href="https://vlab.amrita.edu">https://vlab.amrita.edu</a> <a href="mailto:info@premiereducationaltechnologyies.com">info@premiereducationaltechnologyies.com</a> <a href="https://li.wsu.edu">https://li.wsu.edu</a>	<b>15</b>
Suggested Readings: <ol style="list-style-type: none"> <li>1. Sambrook <i>et al</i> .Molecular Cloning Vols I, II, III. CSHL (2001).</li> <li>2. Primrose. Molecular Biotechnology. Panima (2001).</li> <li>3. Clark &amp; Switzer. Experimental Biochemistry. Freeman (2000)</li> </ol>		
<b>Course Books published in Hindi may be prescribed by the Universities and Colleges</b>		
This course can be opted as an elective. The eligibility for this paper is 10+2 from Arts/Commerce/Science		
Suggested Continuous Evaluation Methods: <b>House Examination/Test:</b> 10 Marks <b>Written Assignment/Presentation/Project / Term Papers/Seminar:</b> 10 Marks <b>Class performance/Participation:</b> 5 Marks		

<b>Programme/Class:</b> Diploma	<b>Year:</b> Second	<b>Semester:</b> Fourth
<b>Subject:</b> ZOOLOGY		
<b>Course Code:</b> B050401T	<b>Course Title:</b> Gene Technology, Immunology and Computational Biology	
<b>Course outcomes:</b> The student at the completion of the course will be able to: <ul style="list-style-type: none"> <li>• Understand the principles of genetic engineering, how genes can be cloned in bacteria and the various technologies involved in it.</li> <li>• Know the applications of biotechnology in various fields like agriculture, industry and human health.</li> <li>• To have an in depth understanding about Immune System &amp; its mechanisms.</li> <li>• Get introduced to DNA testing and utility of genetic engineering in forensic sciences.</li> <li>• Get introduced to computers and use of bioinformatics tools.</li> <li>• <b>Enable students to get employment in pathology/Hospital.</b></li> <li>• <b>Take up research in biological sciences.</b></li> </ul>		
<b>Credits:</b> 4		<b>Core:</b> Compulsory
<b>Max. Marks:</b> 25+75		<b>Min. Passing Marks:</b> as per rules
Total No. of Lectures-Tutorials-Practical (in hours per week): <b>L-T-P:</b> 4-0-0		
<b>Unit</b>	<b>Topic</b>	<b>Total Lectures (60)</b>
<b>I</b>	<b>Principles of Gene Manipulation</b> <ul style="list-style-type: none"> <li>• Recombinant DNA Technology</li> <li>• Selection and identification of recombinant cells</li> <li>• Restriction Enzymes, DNA modifying enzymes, Cloning Vectors, Ligation</li> <li>• Gene transfer techniques, Gene therapy</li> </ul>	<b>10</b>
<b>II</b>	<b>Applications of Genetic Engineering</b> <ul style="list-style-type: none"> <li>• Single cell proteins</li> <li>• Biosensors, Biochips</li> <li>• Crop and livestock improvement, development of transgenics</li> <li>• Introduction to DNA drugs and vaccines</li> </ul>	<b>8</b>
<b>III</b>	<b>DNA Diagnostics</b> <ul style="list-style-type: none"> <li>• Genetic analysis of human diseases, detection of known and unknown mutations</li> <li>• Concept of pharmacogenomics and pharmacogenetics</li> </ul>	<b>4</b>
<b>IV</b>	<b>Immune System and its Components</b> <ul style="list-style-type: none"> <li>• Historical perspective of Immunology, Innate and Adaptive Immunity, clonal selection, complement system</li> <li>• Humoral immunity and cell mediated immunity</li> <li>• Structure and functions of different classes of immunoglobulins, Hypersensitivity</li> <li>• Suitable examples of Autoimmunity, immune deficiency, transplantation rejection</li> </ul>	<b>10</b>
<b>V</b>	<b>Biostatistics I</b> <ul style="list-style-type: none"> <li>• Calculations of mean, median, mode, variance, standard deviation</li> <li>• Concepts of coefficient of variation, Skewness, Kurtosis</li> <li>• Elementary idea of probability and application</li> </ul>	<b>7</b>
<b>VI</b>	<b>Biostatistics II</b> <ul style="list-style-type: none"> <li>• Data summarizing: frequency distribution, graphical presentation—bar diagram, histogram</li> <li>• Tests of significance: one and two sample tests, t-test and Chi-square test</li> </ul>	<b>7</b>
<b>VII</b>	<b>Basics of Computers</b>	<b>6</b>

	<ul style="list-style-type: none"> <li>• Basics (CPU, I/O units) and operating systems</li> <li>• Concept of homepages and websites, World Wide Web, URLs, using search engines</li> </ul>	
<b>VIII</b>	<b>Bioinformatics</b> <ul style="list-style-type: none"> <li>• Databases: nucleic acids, genomes, protein sequences and structures, FASTA format, Bibliography</li> <li>• Sequence analysis (homology): pairwise and multiple sequence alignments-BLAST</li> </ul>	<b>8</b>
<b>Suggested Readings:</b> <ol style="list-style-type: none"> <li>1. Primrose &amp; Twyman. Principles of Genome Analysis and Genomics. Blackwell (2003).</li> <li>2. Hartl &amp; Jones. Genetics: principles &amp; Analysis of Genes &amp; Genomes. Jones &amp; Bartlett (1998).</li> <li>3. Sambrook <i>et al</i>. Molecular Cloning Vols I, II, III. CSHL (2001).</li> <li>4. Primrose. Molecular Biotechnology. Panima (2001).</li> <li>5. Clark &amp; Switzer. Experimental Biochemistry. Freeman (2000)</li> <li>6. Sudbery. Human Molecular Genetics. Prentice-Hall (2002).</li> <li>7. Wilson. Clinical Genetics-A Short Course, Wiley (2000).</li> <li>8. Pasternak. An Introduction to Molecular Human Genetics. Fitzgerald (2000).</li> <li>9. Biostatistical Analysis (Fourth Edition) by Jerrold H. Zarr, Pearson Education Inc., Delhi.</li> <li>10. Statistical Methods (Eighth Edition) by G. W. Snedecor and W. G. Cochran, Wiley Blackwell</li> <li>11. Biostatistics (Tenth Edition) by W.W. Daniel and C. L. Cross, Wiley</li> <li>12. Introductory Biological Statistics (Fourth Edition) by John E. Havel, Raymond E. Hampton and Scott J. Meiners</li> <li>13. Westhead <i>et al</i> Bioinformatics: Instant Notes. Viva Books (2003).</li> </ol>		
<b>Course Books published in Hindi may be prescribed by the Universities and Colleges</b>		
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: <b>House Examination/Test:</b> 10 Marks <b>Written Assignment/Presentation/Project / Term Papers/Seminar:</b> 10 Marks <b>Class performance/Participation:</b> 5 Marks		

<b>Programme/Class:</b> Diploma	<b>Year:</b> Second	<b>Semester:</b> Fourth
<b>Subject:</b> ZOOLOGY		
<b>Course Code:</b> B050402P/R	<b>Course Title:</b> Genetic Engineering and Counselling Lab	
<b>Course outcomes:</b> The student at the completion of the course will be able to:		
<ul style="list-style-type: none"> <li>• Understand the principles of genetic engineering with hands-on experiments in mutation detection, testing of infectious diseases like Covid 19.</li> <li>• Get introduced to DNA testing and utility of genetic engineering in forensic sciences.</li> <li>• Apply knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics existing software effectively to extract information from large databases and to use this information in computer modeling.</li> <li>• Use bioinformatics tools to find out evolutionary/phylogenetic relationship of organisms using gene sequences.</li> <li>• Get employment in Hospitals/Diagnostic and forensic labs/Counsel families with genetic disorders.</li> <li>• <b>Enable students to take up research in biological sciences.</b></li> </ul>		
<b>Credits:</b> 2	<b>Core:</b> Compulsory	
<b>Max. Marks:</b> 25+75	<b>Min. Passing Marks:</b> as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): <b>L-T-P:0-0-4</b>		
<b>Unit</b>	<b>Topic</b>	<b>Total No. of Lectures (60)</b>
<b>I</b>	1. calculate mean, median, mode, standard deviation etc. with suitable biological example. 2. Measure the height and weight of all students in the class and apply statistical measures of central and variability tendencies.	<b>10</b>
<b>II</b>	1. Determination of ABO Blood group 2. To perform bacterial culture and calculate generation time of bacteria. 3. To study Restriction enzyme digestion using teaching kits. 4. To detect genetic mutations by Polymerase Chain Reaction (PCR) using teaching kits.(optional) 5. Demonstration of agarose gel electrophoresis for detection of DNA. 6. Demonstration of Polyacrylamide Gel Electrophoresis (PAGE) for detection of proteins. 7. To calculate molecular weight of unknown DNA and protein fragments from gel pictures.	<b>20</b>
<b>III</b>	1. To learn the basics of computer applications 2. To learn sequence analysis using BLAST. (NCBI) 3. To learn how to perform Primer designing for PCR using available softwares etc.	<b>15</b>
<b>IV</b>	<b>Virtual Labs (Suggestive sites)</b>  1. Gel Documentation System- <a href="https://youtu.be/WPpt3-FanNE">https://youtu.be/WPpt3-FanNE</a> 2. Colorimeter- <a href="https://youtu.be/v4aK6G0bGuU">https://youtu.be/v4aK6G0bGuU</a> 3. PCR Part 1- <a href="https://youtu.be/CpGX1UFS14A">https://youtu.be/CpGX1UFS14A</a> 4. PCR Part 2- <a href="https://youtu.be/6IcHAYPTAEw">https://youtu.be/6IcHAYPTAEw</a> 5. DNA isolation Part 1- <a href="https://youtu.be/QE7UI0JnY9A">https://youtu.be/QE7UI0JnY9A</a> 6. DNA isolation part 2- <a href="https://youtu.be/-efr_HFeHxM">https://youtu.be/-efr_HFeHxM</a> 7. DNA curve- <a href="https://youtu.be/ubL8QxTeuG4">https://youtu.be/ubL8QxTeuG4</a> 8. Spectrophotometer- <a href="https://youtu.be/ubL8QxTeuG4">https://youtu.be/ubL8QxTeuG4</a> 9. Agarose Part 1- <a href="https://youtu.be/7gvHPFww--g">https://youtu.be/7gvHPFww--g</a> 10. Agarose part 2- <a href="https://youtu.be/j_BOZCHNsSg">https://youtu.be/j_BOZCHNsSg</a>	<b>15</b>

	11. Use softwares like Primer3, NEB cutter 12. NCBI, BLAST, CLUSTAL W, PHYLIP	
<b>Suggested Readings:</b>		
<ol style="list-style-type: none"> <li>1. Primrose &amp; Twyman. Principles of Genome Analysis and Genomics. Blackwell (2003).</li> <li>2. Hartl &amp; Jones. Genetics: principles &amp; Analysis of Genes &amp; Genomes. Jones &amp; Bartlett (1998).</li> <li>3. Sambrook <i>et al</i>. Molecular Cloning Vols I, II, III. CSHL (2001).</li> <li>4. Primrose. Molecular Biotechnology. Panima (2001).</li> </ol>		
<b>Course Books published in Hindi may be prescribed by the Universities and Colleges</b>		
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:		
<b>House Examination/Test:</b> 10 Marks		
<b>Written Assignment/Presentation/Project / Term Papers/Seminar:</b> 10 Marks		
<b>Class performance/Participation:</b> 5 Marks		



<b>Programme/Class:</b> Degree	<b>Year:</b> Third	<b>Semester:</b> Fifth
<b>Subject:</b> ZOOLOGY		
<b>Course Code:</b> B050501T	<b>Course Title:</b> Diversity of Non-Chordates & Economic Zoology	
<b>Course outcomes:</b> The student at the completion of the course will be able to:		
<ul style="list-style-type: none"> <li>• demonstrate comprehensive identification abilities of non-chordate diversity</li> <li>• explain structural and functional diversity of non-chordate</li> <li>• explain evolutionary relationship amongst non-chordate groups</li> <li>• Get employment in different applied sectors</li> <li>• Students can start their own business i.e. self employments.</li> <li>• Enable students to take up research in Biological Science</li> </ul>		
<b>Credits:</b> 4		<b>Core:</b> Compulsory
<b>Max. Marks:</b> 25+75		<b>Min. Passing Marks:</b> as per rules
Total No. of Lectures-Tutorials-Practical (in hours per week): <b>L-T-P:</b> 4-0-0		
<b>Unit</b>	<b>Topic</b>	<b>Total No. of Lectures (60)</b>
<b>I</b>	<b>Protozoa to Coelenterate- Salient features and outline classification included</b> <ul style="list-style-type: none"> <li>• Protozoa – <i>Paramecium</i> (Morphology and Reproduction)</li> <li>• Porifera – <i>Sycon</i>(Canal System)</li> <li>• Coelenterata – <i>Obelia</i> (Morphology and Reproduction)</li> </ul>	<b>7</b>
<b>II</b>	<b>Ctenophora to Nemathelminthes- Salient features and outline classification included</b> <ul style="list-style-type: none"> <li>• Ctenophora - Salient features</li> <li>• Platyhelminthes - <i>Taenia</i> (Tape worm) (Morphology and Reproduction)</li> <li>• Nemathelminthes –<i>Ascaris lumbricoides</i> (Morphology and Reproduction)</li> </ul>	<b>7</b>
<b>III</b>	<b>Annelida- Salient features and outline classification included</b> <ul style="list-style-type: none"> <li>• Annelida –<i>Hirudinaria</i> (Leech) (Morphology and Reproduction)</li> </ul>	<b>8</b>
<b>IV</b>	<b>Arthropoda- Salient features and outline classification included</b> <ul style="list-style-type: none"> <li>• Arthropoda – <i>Palaemon</i> (Prawn) (Morphology, Appendages, Nervous System and Reproduction)</li> </ul>	<b>8</b>
<b>V</b>	<b>Mollusca to Hemichordata- Salient features and outline classification included</b> <ul style="list-style-type: none"> <li>• Mollusca – <i>Pila</i>(Morphology, Shell, Respiration, Nervous System and Reproduction)</li> <li>• Echinodermata –<i>Pentaceros</i> (Morphology and Water Vascular System)</li> </ul>	<b>8</b>
<b>VI</b>	<b>Vectors and pests</b> Life cycle and their control of following pests: Gundhi bug, Sugarcane leafhopper, Rodents. Termites and Mosquitoes and their control	<b>8</b>
<b>VII</b>	<b>Economic Zoology-1</b> Animal breeding and culture: Pisciculture	<b>7</b>
<b>VIII</b>	<b>Economic Zoology- 2</b> Sericulture, Apiculture, Lac-culture, Vermiculture	<b>7</b>

**Suggested Readings:**

1. Barnes et al (2009). The Invertebrates: A synthesis. Wiley Backwell 17
2. Hunter: Life of Invertebrates (1979, Collier Macmillan)
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. Thomos C. Chung. General Parasitology. Hardcourt Brace and Co. Ltd. Asia, New Delhi.
11. Gerard D. Schmidt and Larry S Roberts. Foundations of Parasitology. McGraw Hill.
12. Bisht. D.S., *Apiculture*, ICAR Publication.
13. Singh S., *Beekeeping in India*, Indian council of Agricultural Research, New Delhi.
14. Jhingran. V.G. Fish and fisheries in India.,
15. Khanna. S.S, An introduction to fishes
16. Boyd. C.E. & Tucker. C.S, Pond aquaculture water quality management,
17. Biswas. K.P, Fish and prawn diseases,
18. Pedigo, L.P. (2002). *Entomology and Pest Management*, Prentice Hall.
19. Lee, Earthworm Ecology
20. Stevenson, Biology of Earthworms
21. Destructive and Useful Insects by C. L. Metcalf
22. Sericulture for Rural Development : Hanumappa (1978), Himalaya Publication,
23. Sericulture in India Sarkar, D.C. (1988), CSB, Bangalore.

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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

<b>Programme/Class:</b> Degree	<b>Year:</b> Third	<b>Semester:</b> Fifth
<b>Subject:</b> ZOOLOGY		
<b>Course Code:</b> B050502T	<b>Course Title:</b> Diversity of Chordates & Comparative Anatomy	
<b>Course outcomes:</b> The student at the completion of the course will be able to: <ul style="list-style-type: none"> <li>• Demonstrate comprehensive identification abilities of chordate diversity</li> <li>• Explain structural and functional diversity of chordates</li> <li>• Explain evolutionary relationship amongst chordates</li> <li>• Take up research in biological sciences.</li> </ul>		
<b>Credits:</b> 4		<b>Core Compulsory/Elective</b>
<b>Max. Marks:</b> 25+75		<b>Min. Passing Marks:</b> as per rules
Total No. of Lectures-Tutorials-Practical (in hours per week): <b>L-T-P:</b> 4-0-0		
<b>Unit</b>	<b>Topic</b>	<b>Total No. of Lectures (60)</b>
<b>I</b>	<b>Origin of Chordates &amp; Hemichordata- Salient features and outline classification included</b> <ul style="list-style-type: none"> <li>• Origin of Chordates. Classification of Phylum Chordata upto the class.</li> <li>• Hemichordata: General characteristics, classification and detailed study of <i>Balanoglossus</i>(Habit and Habitat, Morphology, Anatomy, Physiology and Development).</li> </ul>	<b>6</b>
<b>II</b>	<b>Cephalochordata and Urochordata- Salient features and outline classification included</b> <ul style="list-style-type: none"> <li>• Urochordata : General characteristics, classification and detailed study of <i>Herdmania</i>(Habit and Habitat, Morphology, Anatomy, Physiology and Post Embryonic Development).</li> <li>• Cephalochordata : General characteristics, classification and detailed study of <i>Branchiostoma (Amphioxus)</i> (Habit and Habitat, Morphology, Anatomy, Physiology).</li> </ul>	<b>6</b>
<b>III</b>	<b>Classification and General Characteristics of Vertebrates</b> <ul style="list-style-type: none"> <li>• General characters and Classification of different classes of vertebrates (Pisces, Amphibia, Reptilia, Aves, Mammalia) up to the order with examples.</li> <li>• Poisonous and Non Poisonous Snakes and biting mechanism.</li> <li>• Neoteny and Paedogenesis</li> <li>• Migration in birds</li> </ul>	<b>8</b>
<b>IV</b>	<b>Comparative Anatomy and Physiology of Vertebrates</b> <b>Integumentary System</b> Structure, functions and derivatives of integument <b>Skeletal System</b> Overview of axial and appendicular skeleton, Jaw suspensorium, Visceral arches	<b>8</b>
<b>V</b>	<b>Digestive System</b> Alimentary canal and associated glands, dentition	<b>8</b>
<b>VI</b>	<b>Respiratory System</b> Skin, gills, lungs and air sacs; Accessory respiratory organs	<b>8</b>
<b>VII</b>	<b>Circulatory System</b> General plan of circulation, evolution of heart and aortic arches <b>Urinogenital System</b>	<b>8</b>

	Succession of kidney, Evolution of urinogenital ducts, Types of mammalian uteri	
<b>VIII</b>	<b>Nervous System</b> Comparative account of brain, Structure and evolution of brain in vertebrates Autonomic nervous system, Spinal cord, Cranial nerves in mammals <b>Sense Organs</b> Classification of receptors Brief account of visual and auditory receptors in man	<b>8</b>
<b>Suggested Readings:</b> <ol style="list-style-type: none"> <li>1. Harvey et al: The Vertebrate Life (2006)</li> <li>2. Colbert et al: Colbert's Evolution of the Vertebrates: A history of the backboned animals through time (5th ed 2002, Wiley - Liss)</li> <li>3. Hildebrand: Analysis of Vertebrate Structure (4th ed 1995, John Wiley)</li> <li>4. Kenneth V. Kardong (2015) Vertebrates: Comparative Anatomy, Function, Evolution McGraw Hill</li> <li>5. McFarland et al: Vertebrate Life(1979, Macmillan Publishing)</li> <li>6. Parker and Haswell: TextBook of Zoology, Vol. II (1978, ELBS)</li> <li>7. Romer and Parsons: The Vertebrate Body (6th ed 1986, CBS Publishing Japan)</li> <li>8. Young: The Life of vertebrates (3rd ed 2006, ELBS/Oxford)</li> <li>9. Weichert C.K and William Presch (1970). Elements of Chordate Anatomy, Tata McGraw Hills</li> </ol> <p style="text-align: center;"><b>Course Books published in Hindi may be prescribed by the Universities and Colleges</b></p>		
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: <b>House Examination/Test:</b> 10 Marks <b>Written Assignment/Presentation/Project / Term Papers/Seminar:</b> 10 Marks <b>Class performance/Participation:</b> 5 Marks		

<b>Programme/Class:</b> Degree	<b>Year:</b> Third	<b>Semester:</b> Fifth
<b>Subject:</b> ZOOLOGY		
<b>Course Code:</b> B050503P	<b>Course Title:</b> Lab on Virtual Dissection, Anatomy, Economic Zoology and Parasitology	
<b>Course outcomes:</b> The student at the completion of the course will be able to: <ul style="list-style-type: none"> <li>• demonstrate comprehensive identification abilities of chordate and non- chordates diversity</li> <li>• explain structural and functional diversity of chordates and non- chordates</li> <li>• explain evolutionary relationship amongst chordates and non- chordates</li> <li>• Generate self employment</li> <li>• Enable students to take up research in biological sciences.</li> </ul>		
<b>Credits:</b> 2	<b>Core:</b> Compulsory	
<b>Max. Marks:</b> 25+75	<b>Min. Passing Marks:</b> as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): <b>L-T-P:</b> 0-0-4		
<b>Unit</b>	<b>Topic</b>	<b>Total No. of Lectures (60)</b>
<b>I</b>	1.To prepare permanent stained slide of septal nephridia of earthworm. 2.To take out the nerve ring of earthworm. 3.To study statocyst, appendages and hastate plate from <i>Palaemon</i> (demo/online allowed).	<b>15</b>
<b>II</b>	1.Study of animal specimens of various animal phyla 2. Study on use and ethical handling of model organisms (Mice, rats, rabbit and pig). 3. To prepare stained/unstained slide of placoid scales. 1. Comparative study of bones of different vertebrates. 2. Comparative study of histological slides of different tissues of amphibia and mammals.	<b>15</b>
<b>III</b>	1. Permanent Preparation of: <i>Euglena</i> , <i>Paramecium</i> 2. Study of prepared slides/specimens of <i>Entamoeba</i> , <i>Giardia</i> , <i>Leishmania</i> , <i>Trypanosoma</i> , <i>Plasmodium</i> , <i>Fasciola</i> , <i>Taenia</i> , <i>Polystoma</i> <i>Schistosoma</i> , <i>Echinococcus</i> , <i>Enterobius</i> , <i>Ascaris</i> and <i>Ancylostoma</i> 3. Permanent Preparation of <i>Cimex</i> (bed bug)/ <i>Pediculus</i> (Louse), <i>Haematopinus</i> (cattle louse), fresh water annelids, arthropods; and soil arthropods as per availability. Manual microtomy has been proposed subject to consideration of members (Demo system allowable). 4. Larval stages of helminths and arthropods. 5. Permanent mount of wings, mouth parts and developmental stages of mosquito and house fly. Permanent preparation of ticks/ mites, abdominal gills of aquatic insects viz. Chironomus larva/ mayfly nymphs, preparation of antenna of housefly. 6. Identification of pests. 7. Life history of silkworm, honeybee and lac insect. 8. Different types of important edible fishes of India. 9. Study of an aquatic ecosystem, its biotic components and food chain. 10. Project Report/ model chart making. 11. <b>Dissections</b> : through multimedia / models 12. <b>Cockroach</b> : Central nervous system 13. <b>Wallago</b> : Afferent and efferent branchial vessels, Cranial	<b>15</b>

	nerves, Weberian ossicles.	
<b>IV</b>	<b>Virtual Labs (Suggestive sites)</b> <a href="https://www.vlab.co.in">https://www.vlab.co.in</a> <a href="https://zoologysan.blogspot.com">https://zoologysan.blogspot.com</a> <a href="http://www.vlab.iitb.ac.in/vlab">www.vlab.iitb.ac.in/vlab</a> <a href="https://www.vlab.co.in">https://www.vlab.co.in</a> <a href="https://zoologysan.blogspot.com">https://zoologysan.blogspot.com</a> <a href="http://www.vlab.iitb.ac.in/vlab">www.vlab.iitb.ac.in/vlab</a> <a href="http://www.onlinelabs.in">www.onlinelabs.in</a> <a href="http://www.powershow.com">www.powershow.com</a> <a href="https://vlab.amrita.edu">https://vlab.amrita.edu</a> <a href="https://sites.dartmouth.edu">https://sites.dartmouth.edu</a>	<b>15</b>
<b>Suggested Readings:</b>		
<ol style="list-style-type: none"> <li>1. Harvey et al: The Vertebrate Life (2006)</li> <li>2. Colbert et al: Colbert's Evolution of the Vertebrates: A history of the backboned animals through time (5th ed 2002,Wiley - Liss)</li> <li>3. Hildebrand: Analysis of Vertebrate Structure (4th ed 1995, John Wiley)</li> <li>4. Kenneth V. Kardong (2015) Vertebrates: Comparative Anatomy, Function, Evolution McGraw Hill</li> <li>5. McFarland et al: Vertebrate Life (1979, Macmillan Publishing)</li> <li>6. Parker and Haswell: TextBook of Zoology, Vol. II (1978, ELBS)</li> <li>7. Romer and Parsons: The Vertebrate Body (6th ed 1986, CBS Publishing Japan)</li> <li>8. Young: The Life of vertebrates (3rd ed 2006, ELBS/Oxford)</li> <li>9. Barnes et al (2009). The Invertebrates: A synthesis. Wiley Backwell 17</li> <li>10. Marshall: Parker &amp;Haswell Text Book of Zoology, Vol. I (7th ed 1972, Macmillan)</li> <li>11. Moore: An Introduction to the Invertebrates (2001, Cambridge University Press)</li> <li>12. Brusca and Brusca (2016) Invertebrates. Sinauer</li> <li>13. Jan Pechenik (2014) Biology of the invertebrates. McGraw Hill</li> <li>14. Boradale, L.A. and Potts, E.A. (1961). Invertebrates: A Manual for the use of Students. Asia Publishing Home</li> <li>15. Robert Leo Smith Ecology and field biology Harper and Row publisher</li> <li>16. Handbook of Practical Sericulture :Ullal, S.R. and Narasimhanna, M.N. (1987),Central Silk Board Publication, Bangalore.</li> <li>17. Prost, P. J. (1962). <i>Apiculture</i>. Oxford and IBH, New Delhi.</li> <li>18. Bisht. D.S., <i>Apiculture</i>, ICAR Publication.</li> <li>19. Singh S., <i>Beekeeping in India</i>, Indian council of Agricultural Research, New Delhi.</li> <li>20. Ullal S.R. and Narasimhanna, M.N. Handbook of Practical Sericulture: CSB,Bangalore</li> <li>21. Jolly. M. S. Appropriate Sericultural Techniques; Ed., Director, CSR &amp; TI, Mysore.</li> <li>22. Handbook of Silkworm Rearing: Agriculture and Technical Manual-1, Fuzi Pub. Co.</li> <li>23. Santanam, B. <i>et al</i>, A manual of freshwater aquaculture</li> <li>24. Boyd. C.E. &amp;Tucker.C.S, Pond aquaculture water quality management</li> <li>25. Pedigo, L.P. (2002). <i>Entomology and Pest Management</i>, Prentice Hall.</li> <li>26. Ranganathan L.S, Vermicomposting technology- soil health to human health</li> </ol>		
<b>Course Books published in Hindi may be prescribed by the Universities and Colleges</b>		
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:		
<b>House Examination/Test:</b> 10 Marks		
<b>Written Assignment/Presentation/Project / Term Papers/Seminar:</b> 10 Marks		
<b>Class performance/Participation:</b> 5 Marks		

<b>Programme/Class:</b> Degree	<b>Year:</b> Third	<b>Semester:</b> Sixth
<b>Subject:</b> ZOOLOGY		
<b>Course Code:</b> B050601T	<b>Course Title:</b> Evolutionary and Developmental Biology	
<b>Course outcomes:</b> The student at the completion of the course will be able to:		
<ul style="list-style-type: none"> <li>• 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.</li> <li>• Understand that natural selection is one of several processes that can bring about evolution, although it can also promote stability rather than change.</li> <li>• Understand how the single cell formed at fertilisation forms an embryo and then a full adult organism.</li> <li>• Integrate genetics, molecular biology, biochemistry, cell biology, anatomy and physiology during embryonic development.</li> <li>• Understand a variety of interacting processes, which generate an organism's heterogeneous shapes, size, and structural features.</li> <li>• Understand how a cell behaves in response to an autonomous determinant or an external signal, and the scientific reasoning exhibited in experimental life science.</li> </ul>		
<b>Credits:</b> 4	<b>Core:</b> Compulsory	
<b>Max. Marks:</b> 25+75	<b>Min. Passing Marks:</b> as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): <b>L-T-P:</b> 4-0-0		
<b>Unit</b>	<b>Topic</b>	<b>Total No. of Lectures (60)</b>
<b>I</b>	<b>Theories of Evolution</b> <ul style="list-style-type: none"> <li>• Origin of Life</li> <li>• Historical review of evolutionary concept: Lamarckism, Darwinism (Natural, Sexual and Artificial selection)</li> <li>• Modern synthetic theory of evolution</li> <li>• Adaptive radiations: Patterns of evolution (Divergence, Convergence, Parallel, Coevolution)</li> </ul>	<b>8</b>
<b>II</b>	<b>Population Genetics</b> <ul style="list-style-type: none"> <li>• Microevolution and Macroevolution: allele frequencies, genotype frequencies, Hardy-Weinberg equilibrium and conditions for its maintenance</li> <li>• Forces of evolution: mutation, selection, genetic drift</li> </ul>	<b>8</b>
<b>III</b>	<b>Direct Evidences of Evolution</b> Types of fossils, Incompleteness of fossil record, Dating of fossils, Phylogeny of horse	<b>7</b>
<b>IV</b>	<b>Species Concept and Extinction</b> <ul style="list-style-type: none"> <li>• Biological species concept (Advantages and Limitations); Modes of speciation (Allopatric, Sympatric)</li> <li>• Mass extinction (Causes, Names of five major extinctions)</li> </ul>	<b>7</b>
<b>V</b>	<b>Gamete Fertilization and Early Development</b> <ul style="list-style-type: none"> <li>• Gametogenesis, Fertilization</li> <li>• Cleavage pattern</li> <li>• Gastrulation, fate maps</li> <li>• Morphogenesis</li> </ul>	<b>6</b>
<b>VI</b>	<b>Developmental Genes</b>	<b>8</b>

	<ul style="list-style-type: none"> <li>• General concepts of organogenesis</li> <li>• Introduction to genetic basis of embryonic development</li> <li>• Developmental control genes (Homeobox genes)</li> </ul>	
<b>VII</b>	<b>Early Vertebrate Development</b> <ul style="list-style-type: none"> <li>• Early development of mammals including placentation</li> <li>• Metamorphosis, regeneration</li> <li>• Environmental regulation of development</li> </ul>	<b>8</b>
<b>VIII</b>	<b>Late Developmental Processes</b> <ul style="list-style-type: none"> <li>• Development of eye, kidney, limb in amphibian</li> <li>• Mammalian female reproductive cycles estrous cycle and menstruation</li> <li>• Aging: the biology of senescence</li> </ul>	<b>8</b>

**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).

**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



<b>Programme/Class:</b> Degree	<b>Year:</b> Third	<b>Semester:</b> Six
<b>Subject:</b> ZOOLOGY		
<b>Course Code:</b> B050602T	<b>Course Title:</b> Ecology, Ethology, Environmental Science and Wildlife	
<b>Course outcomes:</b> The student at the completion of the course will learn: <ul style="list-style-type: none"> <li>• Complexities and interconnectedness of various environmental levels and their functioning.</li> <li>• Global environmental issues, their causes, consequences and amelioration.</li> <li>• To understand and identify behaviours in a variety of taxa.</li> <li>• The proximate and ultimate causes of various behaviours.</li> <li>• About the molecules, cells, and systems of biological timing systems.</li> <li>• Conceptualizing how species profitably inhabit in the temporal environment and space out their activities at different times of the day and seasons.</li> <li>• To interpret the cause and effect of lifestyle disorders contributing to public understanding of biological timing.</li> <li>• To understand the importance of wildlife conservation.</li> </ul>		
<b>Credits:</b> 4		<b>Core:</b> Compulsory
<b>Max. Marks:</b> 25+75		<b>Min. Passing Marks:</b> as per rules
Total No. of Lectures-Tutorials-Practical (in hours per week): <b>L-T-P:</b> 4-0-0		
<b>Unit</b>	<b>Topic</b>	<b>Total No. of Lectures (60)</b>
<b>I</b>	<b>Introduction to Ecology</b> <ul style="list-style-type: none"> <li>• History of ecology, Autecology and synecology, Levels of organization, Laws of limiting factors, Study of physical factors</li> </ul>	<b>4</b>
<b>II</b>	<b>Organization of Ecosystem</b> <ul style="list-style-type: none"> <li>• Levels of organization, Laws of limiting factors, Study of physical factors,</li> <li>• Population: Density, natality, mortality, life tables, fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion, Exponential and logistic growth,</li> <li>• Types of ecosystems with one example in detail, Food chain: Detritus and grazing food chains, Food web, Energy flow through the ecosystem,</li> <li>• Ecological pyramids and Ecological efficiencies, Nutrient and biogeochemical cycle with one example of Carbon cycle</li> </ul>	<b>12</b>
<b>III</b>	<b>Community Ecology</b> Community characteristics: species richness, dominance, diversity, abundance, Ecological succession with one example	<b>7</b>
<b>IV</b>	<b>Environmental Hazards</b> <ul style="list-style-type: none"> <li>• Sources of Environmental hazards</li> <li>• Climate changes. Basics of environmental impact assessment</li> <li>• Greenhouse gases and global warming</li> <li>• Acid rain, Ozone layer destruction</li> </ul>	<b>7</b>
<b>V</b>	<b>Effects of Climate Change</b> <ul style="list-style-type: none"> <li>• Effect of climate change on public health</li> <li>• Sources of waste, types and characteristics, Sewage disposal and its management, Solid waste disposal, Biomedical waste handling and disposal,</li> </ul>	<b>6</b>

	<ul style="list-style-type: none"> <li>• Nuclear waste handling and disposal, Waste from thermal power plants,</li> <li>• Case histories on Bhopal gas tragedy, Chernobyl disaster, and their aftermath.</li> </ul>	
<b>VI</b>	<b>Behavioural Ecology and Chronobiology</b> <ul style="list-style-type: none"> <li>• Origin and history of Ethology,</li> <li>• Instinct vs. Learnt Behaviour</li> <li>• Associative learning, classical and operant conditioning, Habituation, Imprinting,</li> <li>• Biological clocks, Circadian rhythms; Tidal rhythms and Lunar rhythms, Circannual rhythms</li> <li>• Chronomedicine</li> </ul>	<b>8</b>
<b>VII</b>	<b>Introduction to Wild-Life</b> <ul style="list-style-type: none"> <li>• Values of wildlife - positive and negative; Conservation ethics; Importance of conservation; Causes of depletion; World conservation strategies.</li> </ul>	<b>8</b>
<b>VIII</b>	<b>Protected areas</b> <ul style="list-style-type: none"> <li>• National parks &amp; sanctuaries, Community reserve; Important features of protected areas in India; Tiger conservation - Tiger reserves in India; Management challenges in Tiger reserve</li> </ul>	<b>8</b>

**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 subjects

Suggested Continuous Evaluation Methods:

**House Examination/Test:** 10 Marks

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

**Class Performance/Participation:** 5 Marks

<b>Programme/Class:</b> Degree	<b>Year:</b> Third	<b>Semester:</b> Sixth
<b>Subject:</b> ZOOLOGY		
<b>Course Code:</b> B050603P	<b>Course Title:</b> Lab on Ecology, Environmental Science, Behavioral Ecology & wildlife	
<b>Course outcomes:</b> The student at the completion of the course will be able to: <ul style="list-style-type: none"> <li>To understand the basic concepts, importance, status and interaction between organisms and environment.</li> <li>Get employment in forest services, sanctuaries, conservatories etc.</li> <li>Enable students to take up research in wildlife.</li> </ul>		
<b>Credits:</b> 2	<b>Core:</b> Compulsory	
<b>Max. Marks:</b> 25+75	<b>Min. Passing Marks:</b> as per rules	
<b>Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4</b>		
<b>Unit</b>	<b>Topic</b>	<b>Total Lectures (60)</b>
<b>I</b>	1.Study of life tables from the hypothetical/real data provided. 2.Study of population dynamics through numerical problems. 3.Study of circadian functions in humans (daily eating, sleep and temperature patterns).	<b>26</b>
<b>II</b>	Report on visit- National/Biodiversity Park/Wildlife sanctuary	<b>4</b>
<b>III</b>	1. Demonstration of basic equipment needed in wildlife studies use, care and maintenance (Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System, Various types of Cameras and lenses) 2. Familiarization and study of animal evidence in the field; Identification of animals through pug marks, hoof marks, scats, pellet groups, nest, antlers etc. 3. Demonstration of different field techniques for flora and fauna	<b>15</b>
<b>IV</b>	<b>Virtual Labs (Suggestive sites)</b> <a href="https://www.vlab.co.in">https://www.vlab.co.in</a> <a href="https://zoologysan.blogspot.com">https://zoologysan.blogspot.com</a> <a href="http://www.vlab.iitb.ac.in/vlab">www.vlab.iitb.ac.in/vlab</a>	<b>15</b>
<b>Suggested Readings:</b> <ol style="list-style-type: none"> <li>Ecology: The Experimental Analysis of Distribution and Abundance. Charles J. Krebs, 2016, Pearson Education Inc.</li> <li>Fundamentals of Ecology. E.P. Odum&amp; Gray. W. Barrett, 1971, Saunders.</li> <li>Robert Leo Smith Ecology and field biology Harper and Row publisher</li> <li>Bookhout, T.A. (1996). Research and Management Techniques for Wildlife and Habitats, 5th edition. The Wildlife Society, Allen Press.</li> <li>Methods and Practice in biodiversity Conservation by David Hawks worth, Springer publication.</li> </ol>		
<b>Course Books published in Hindi may be prescribed by the Universities and Colleges</b>		
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:		
<b>House Examination/Test:</b> 10 Marks		
<b>Written Assignment/Presentation/Project / Term Papers/Seminar:</b> 10 Marks		
<b>Class performance/Participation:</b> 5 Marks		

<b>Programme/Class:</b> Certificate	<b>Year:</b> First	<b>Semester:</b> First
<b>Subject:</b> ZOOLOGY (Elective)		
<b>Course Code:</b>	<b>Course Title:</b> Environment and Public Health challenges	
<b>Course outcomes:</b> The student at the completion of the course will be able to: <ul style="list-style-type: none"> <li>• contribute to capacity building to limit greenhouse gases and carbon footprint.</li> <li>• understand importance of biodiversity and wildlife sustainability.</li> <li>• take up green jobs contributing to preserve the environment, eco-sensitization programmes, emerging green sectors like renewable energy etc.</li> <li>• append lifestyle correction to prevent diseases- like daily rhythm correction, yoga and meditation</li> <li>• work in programmes addressing challenges of health and sanitation, epidemiology of communicable &amp; non-Communicable diseases</li> <li>• assist in strategizing for control of diseases of important public health problems.</li> </ul>		
<b>Credits:</b> 4	<b>Core:</b> Elective	
<b>Max. Marks:</b> 25+75	<b>Min. Passing Marks:</b> as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): <b>L-T-P:4-0-0</b>		
<b>Unit</b>	<b>Topics</b>	<b>Total No. of Lectures (60)</b>
<b>I</b>	<b>Biological inputs to a low-carbon economy</b> <ul style="list-style-type: none"> <li>• Introducing low-carbon economies for ecosystem resilience</li> <li>• Biological impacts of global warming, rising sea levels, extremities of storms and cyclones</li> <li>• Current trends of Climate change and it's mitigation in India</li> <li>• CPCB central pollution control board</li> </ul>	<b>8</b>
<b>II</b>	<b>Sustainable wildlife protection</b> <ul style="list-style-type: none"> <li>• Government legislations and bodies</li> <li>• CPCSEA, MoEFW, AWB, BNHS, WWF</li> <li>• rationalizing protected area boundaries: man animal conflict in modern India</li> </ul>	<b>4</b>
<b>III</b>	<b>India: A bioreserve hub</b> <ul style="list-style-type: none"> <li>• Project tiger</li> <li>• wildlife sanctuaries and national parks special reference to Hastinapur sanctuary</li> <li>• endangered wild species in India</li> </ul>	<b>8</b>
<b>IV</b>	<b>Methods to promote environmental skills</b> <ul style="list-style-type: none"> <li>• Recycling / New skilled waste treatment</li> <li>• use of modern biotechnology for Energy efficiency; green transport</li> <li>• knowledge of renewable energy, Solar energy, wind power energy,</li> </ul>	<b>8</b>

	<ul style="list-style-type: none"> <li>biofuel usage</li> <li>sustainable construction techniques with Energy Performance, legislation, resource management.</li> </ul>	
<b>V</b>	<b>Food Nutrition and Health</b> <ul style="list-style-type: none"> <li>balanced diet , Mediterranean diet</li> <li>time of eating; intermittent fasting</li> <li>calorie and food timings</li> <li>health consequences of empty calorie diets in young adults</li> </ul>	<b>8</b>
<b>VI</b>	<b>Lifestyle and Indian methods to improve health</b> <ul style="list-style-type: none"> <li>Circadian rhythms for better life</li> <li>Ayurveda Clock</li> <li>Exercise</li> <li>Yoga</li> <li>Meditation</li> </ul>	<b>8</b>
<b>VII</b>	<b>Sleep disorders in 24X 7 Society</b> <ul style="list-style-type: none"> <li>ASPS; DSPS; Sleep Apnea</li> <li>Role of morning sunlight</li> <li>Shift work and occupational health challenges</li> <li>sleep and mental health</li> </ul>	<b>8</b>
<b>VIII</b>	<b>Non-communicable diseases as lifestyle disorders</b> <ul style="list-style-type: none"> <li>Cancer; Hypertension; PCOS</li> <li>Diabetes; obesity</li> </ul>	<b>8</b>
<b>Suggested Readings:</b> <ol style="list-style-type: none"> <li>Sanjay Upadhyay et all; Environmental Laws in India (Vol -I, II, III), Butterworth: New Delhi:2004</li> <li>Raj Punjwani, Wildlife Conservation in India, Natraj; Dehradun;2000</li> <li>M. Zafar Mahfooz Normani, Natural resources, Law and Policy, Uppal: New Delhi-2004</li> <li>Health Education and Community Pharmacy for First Year Diploma in Pharmacy 3<sup>rd</sup> ed. V.N. Raje, CBS</li> <li>Textbook of Community Health Nursing I, S.D. Manivannan CBS Nursing</li> </ol>		
<b>Course Books published in Hindi may be prescribed by the Universities and Colleges</b>		
<b>Course prerequisites:</b> To study this course, a student must have had the subject biology in class/12 <sup>th</sup>		
Suggested Continuous Evaluation Methods: <b>Total Marks: 25</b> <b>House Examination/Test: 10 Marks</b> <b>Written Assignment/Presentation/Project / Term Papers/Seminar: 10 Marks</b> <b>Class performance/Participation: 5 Marks</b>		

<b>Programme/Class:</b> Certificate	<b>Year:</b> First	<b>Semester:</b> First
<b>Subject:</b> ZOOLOGY (Skill course)		
<b>Course Code:</b>	<b>Course Title:</b> Basic Clinical Techniques- Part-I	
<b>Course outcomes:</b> The student at the completion of the course will be able to: <ul style="list-style-type: none"> <li>• adjust to protocols and guidelines relevant to the assistant role in clinical practice</li> <li>• recognize the boundary of the clinical assistant responsibility</li> <li>• exhibit managing potential to risks to the quality and patient safety.</li> <li>• be aware of relevant legislation, standards, policies, and procedures followed in the clinics</li> <li>• engage and supervise other providers in order to maintain quality continued care.</li> <li>• PRACTICAL AND INTERNSHIP ON ALL UNITS WITH SKILL PARTNERS</li> </ul>		
<b>Credits:</b> 3	<b>Core:</b> Skill	
<b>Max. Marks:</b> 25+75	<b>Min. Passing Marks:</b> as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): <b>L-T-P:</b> 1-0-2		
<b>Unit</b>	<b>Topics</b>	<b>Total No. of Lectures (15T+60P)</b>
<b>I</b>	<b>Health and Healthcare</b> <ul style="list-style-type: none"> <li>• Basic structure and functioning of the human body and healthcare in India; Biomedical terminology and abbreviation</li> <li>• IEC document and safety, Record keeping and report</li> </ul>	<b>5T+6P</b>
<b>II</b>	<b>Laboratory Safety System</b> <ul style="list-style-type: none"> <li>• Good laboratory practices,</li> <li>• Autoclave- Working principle, parts.</li> <li>• Deep freezers, Hot Air Oven</li> <li>• Biomedical waste disposal- Theory and Practice, waste segregation</li> </ul>	<b>2T+12P</b>
<b>III</b>	<b>Collection of blood for various tests</b> <ul style="list-style-type: none"> <li>• Collection of blood and other samples for analysis</li> <li>• Preparation of blood smears, Antigen testing,</li> <li>• PH meter- working and applications, Clinical relevance of blood PH</li> <li>• Labelling, Storage and Sample transportation</li> </ul>	<b>2T+12P</b>
<b>IV</b>	<b>Introduction to 24X7 Patient care</b> <ul style="list-style-type: none"> <li>• Ambulatory blood pressure monitoring; Clinical Laboratory Improvement amendments</li> <li>• Point-of-Care testing (Glucometer), oximeter, continuous glucose monitoring; maintaining data for sleep</li> <li>• Diabetes care understanding of hypoglycaemia, its consequences</li> </ul>	<b>3T+24P</b>

<b>V</b>	<b>Care of Elderly</b> <ul style="list-style-type: none"> <li>• Anatomy of ear and hearing function.</li> <li>• Types of audiometers - Pure tone audiometer and speech audiometer, parts and operation of hearing aids.</li> <li>• Walking support, wheelchair,</li> <li>• National Programme for Health Care of the Elderly (NPHCE)</li> </ul>	<b>3T+6P</b>
<b>Suggested Readings:</b> <ol style="list-style-type: none"> <li>1. Text book of medical laboratory technology, Praful Godkar; Bhalani Bhalani Publishing House</li> <li>2. Manual of FIRST AID: Management of General injuries, Sports injuries and Common Ailments LC Gupta, Abhitabh Gupta Jaypee</li> <li>3. Health Education and Community Pharmacy for First Year Diploma in Pharmacy 3Ed V.N. Raje, CBS</li> <li>4. Textbook of Community Health Nursing I, S.D. Manivannan CBS Nursing</li> </ol> <p style="text-align: center;"><b>Course Books published in Hindi may be prescribed by the Universities and Colleges</b></p>		
<p style="text-align: center;"><b>Course prerequisites:</b> To study this course, a student must have had the subject biology in class 12<sup>th</sup></p>		
<p>Suggested Continuous Evaluation Methods:</p> <p><b>Total Marks: 25</b></p> <p><b>House Examination/Test: 10 Marks</b></p> <p><b>Written Assignment/Presentation/Project / Term Papers/Seminar: 10 Marks</b></p> <p><b>Class performance/Participation: 5 Marks</b></p>		

<b>Programme/Class:</b> Certificate	<b>Year:</b> First	<b>Semester:</b> First
<b>Subject:</b> ZOOLOGY (Skill course)		
<b>Course Code:</b>	<b>Course Title:</b> Basic Clinical Techniques- Part-II	
<b>Course outcomes:</b> The student at the completion of the course will be able to: <ul style="list-style-type: none"> <li>• adjust to protocols and guidelines relevant to the assistant role in clinical practice</li> <li>• recognize the boundary of the clinical assistant responsibility</li> <li>• exhibit managing potential to risks to the quality and patient safety.</li> <li>• be aware of relevant legislation, standards, policies, and procedures followed in the clinics</li> <li>• engage and supervise other providers in order to maintain quality continued care.</li> <li>• PRACTICAL AND INTERNSHIP ON ALL UNITS WITH SKILL PARTNERS</li> </ul>		
<b>Credits:</b> 3		<b>Core:</b> Skill
<b>Max. Marks:</b> 25+75		<b>Min. Passing Marks:</b> as per rules
Total No. of Lectures-Tutorials-Practical (in hours per week): <b>L-T-P:</b> 1-0-2		
<b>Unit</b>	<b>Topics</b>	<b>Total No. of Lectures (15T+60P)</b>
<b>I</b>	<b>Laboratory Instruments- I</b> <ul style="list-style-type: none"> <li>• Microscopy - introduction , different types of microscopes, parts, magnification, adjustments, compound microscope</li> <li>• photoelectric colorimeter - working principle, block diagram, applications</li> <li>• Centrifuge- parts, working, maintenance of tabletop centrifuge</li> </ul>	<b>3T+18P</b>
<b>II</b>	<b>Laboratory Instruments- II</b> <ul style="list-style-type: none"> <li>• Introduction to dialysis - Importance of dialysis, Types of dialysis - peritoneal dialysis and hemo dialysis, Hemodialysis</li> <li>• Idea about liquid oxygen supply, defibrillators.</li> <li>• First aid to pulmonary exacerbation</li> </ul>	<b>3T+12P</b>
<b>III</b>	<b>Laboratory Instruments- III</b> <ul style="list-style-type: none"> <li>• Fundamentals of Eletrolyte analyser, Blood gas analyser, incubator and waterbath ,</li> <li>• Familiarise Automatic Hemoanalysers and blood cell counters,</li> <li>• name and uses of Blood bank equipments-Blood bank refrigerators, cryo centrifuge,cry bath, Apheresis machines, donor couch, blood bag sealer, platelet agitator, blood shaker.</li> </ul>	<b>3T+20P</b>
<b>IV</b>	<b>Patient-Home and Hospital care</b> <ul style="list-style-type: none"> <li>• sleep and sleep Hygeine</li> <li>• Handling of pre-and post-disease anxiety</li> <li>• Pre-and post- operative therapies</li> <li>• Rehabilitation</li> </ul>	<b>6T+10P</b>
<b>Suggested Readings:</b>		



1. Text book of medical laboratory technology, Praful Godkar; Bhalani Publishing House
2. Manual of FIRST AID: Management of General injuries, Sports injuries and Common Ailments LC Gupta, Abhitabh Gupta Jaypee
3. Health Education & Community Pharmacy 1<sup>st</sup> yr Diploma in Pharmacy 3EdVN. Raje, CBS
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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**

**Syllabus was approved after incorporating minor changes by BoS meeting held on 27<sup>th</sup> May 2021 at 4:00 p.m. Members present in the meeting –**

Members	Designation
Prof. Mridul Kumar Gupta	Dean of Science, C.C.S University, Meerut, U.P.
Prof. Neelu Jain Gupta	Convener and Head, Head, Department of Zoology, C.C.S University, Meerut, U.P.
Prof. Sanjay Kumar Bhardwaj	Department of Zoology, C.C.S University, Meerut U.P.
Prof. Anju Srivastav	Department of Zoology, University of Delhi, Delhi
Prof. Vineeta Shukla	Department of Zoology, Maharshi Dayanand University, Rohtak
Dr. Sushil Kumar Jha	School of Life Sciences, Jawaharlal Nehru University, Delhi
Dr. Ranjan Kumar Nanda	Group Leader Scientist, ICGEB, New Delhi
Dr. Dilip Kumar Gupta	Department of Zoology, Bareilly College, Bareilly, U.P.
Dr. Sneha Lata Goyal	Convener II Head, Department of Zoology, MMH College, Ghaziabad, U.P.
Dr. Neeraj Singh	Head, Department of Zoology, Meerut. College, Meerut, U.P.
Dr. RS Gupta	Ex-Principal, RSS College Pillakhua, U.P.