

**SIDDHARTH UNIVERSITY KAPILVASTU**  
**SIDDHARTH NAGAR (U. P.)**

**B.Sc. Zoology**

**Faculty of Science**

**Syllabus Structure CBCS (NEP)**



**National Education Policy-2020**

Syllabus as per the guidelines of State Higher Education Council  
(Partially modified: Board of Studies meeting on 13 July 2023)

2023



# Siddharth University Kapilvastu

## Siddharth Nagar, U.P

B.Sc. Syllabus Structure CBCS (NEP) 2023-24  
(Partially modified: Board of Studies meeting on 13 July 2023)  
Subject: Zoology

Year	Course Code	Paper Title	Theory/Practical (Marks)	Credits
First	<b>Semester-I</b>			
	B050101T	Cytology, Genetics and Immunology	Theory (50)	04
	B050102P	Cell Biology and Cytogenetics Lab	Practical (25)	02
	<b>Semester-II</b>			
	B050201T	Biochemistry and Physiology	Theory (50)	04
	B050202P	Physiological, Biochemical & Hematology Lab	Practical/Field work (25)	02
Second	<b>Semester-III</b>			
	B050301T	Molecular Biology, Bioinstrumentation & Biotechniques	Theory (50)	04
	B050302P	Bioinstrumentation & Molecular Biology Lab	Practical (25)	02
	<b>Semester-IV</b>			
	B050401T	Gene Technology and Human Welfare	Theory (50)	04
	B050402P	Genetic Engineering Lab, Genetic Counselling & Telemedicine	Practical/Field work (25)	02
Third	<b>Semester-V</b>			
	B050501T	Diversity of Non-Chordates, Parasitology and Economic Zoology	Theory (50)	04
	B050502T	Diversity of Chordates and Comparative Anatomy	Theory (50)	04
	B050503P	Lab on Non-chordate virtual Dissection, Anatomy, Economic Zoology and Parasitology	Practical (25)	02
	B050504P	Lab on Chordates Virtual Dissection and Anatomy	Practical (25)	02
	<b>Semester-VI</b>			
	B050601T	Evolutionary and Developmental Biology	Theory (50)	04
	B050602T	Ecology, Ethology, Environmental Science and Wildlife	Theory (50)	04
	B050603P	Lab on Evolutionary and Developmental Biology	Practical (25)	02
	B050604P	Lab on Ecology, Ethology, Developmental Biology and Wildlife	Practical (25)	02

**Marking Distribution out of 100: -**

Subjects with Practical:- 25 Marks for Int. Assessment + 25 Marks Ext. Practical Exam + 50 Marks Theory Paper

## Subject: Zoology

<b>Subject prerequisite</b>  To study Zoology in undergraduate, a student must have studied Biology, Biotechnology or Life Science in Class 12.	
<b>Programme Objectives (POs)</b>  <ol style="list-style-type: none"><li>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.</li><li>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.</li><li>3. The lab courses have been designed in such a way that students will be trained to join public or private labs.</li></ol>	
<b>Certificate Course in Medical Diagnostics &amp; Public Health</b>	
<b>B.Sc. I Programme Specific Outcomes (PSOs)</b>	
<b>PSO1</b>	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.
<b>PSO 2</b>	The students will learn the basic principles of genetics and how to prepare karyotypes to study the chromosomes.
<b>PSO 3</b>	How chromosomal aberrations are inherited in humans by pedigree analysis in families.
<b>PSO 4</b>	The students will have hands-on training in the techniques like microscopy, centrifugation and chromatography, and various biochemical techniques, which will help them in getting employment in pathology labs and contribute to health care system.
<b>PSO 5</b>	<b>The Certificate courses will enable students to apply for technical positions in government and private labs/institutes.</b>

<b>Diploma in Molecular Diagnostics and Genetic Counselling</b>	
<b>B.Sc. II Programme Specific Outcomes (PSOs)</b>	
<b>PSO1</b>	The student at the completion of the course will be able to have a detailed and conceptual understanding of molecular processes <i>viz.</i> DNA to trait. The differential regulation of genes in prokaryotes and eukaryotes leads to the development of an organism from an embryo.
<b>PSO 2</b>	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.
<b>PSO 3</b>	The principles of genetic engineering, gene cloning 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.
<b>PSO 4</b>	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.
<b>PSO 5</b>	<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>Degree in Bachelor of Science</b>	
<b>B.Sc III Programme Specific Outcomes (PSOs)</b>	
<b>PSO1</b>	<ul style="list-style-type: none"> <li>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.</li> </ul>
<b>PSO 2</b>	<ul style="list-style-type: none"> <li>A variety of interacting processes generate an organism's heterogeneous shapes, size, and structural features.</li> </ul>
<b>PSO 3</b>	<ul style="list-style-type: none"> <li>Inclusion of ecology and environmental sciences will enrich students with our world which is crucial for human wellbeing 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.</li> </ul>
<b>PSO 4</b>	<ul style="list-style-type: none"> <li>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.</li> </ul>
<b>PSO 5</b>	<ul style="list-style-type: none"> <li>The basic concepts of biosystematics, evolutionary biology and biodiversity will enable students to solve the biological problems related to environment.</li> </ul>
<b>PSO 6</b>	<ul style="list-style-type: none"> <li>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.</li> </ul>
<b>PSO 7</b>	<ul style="list-style-type: none"> <li><b>The Degree courses will enable students to go for higher studies like Masters and Ph.D in Zoology and Allied subjects.</b></li> </ul>

<b>Year:</b> First		<b>Semester:</b> First	
<b>Subject:</b> ZOOLOGY			
<b>Course Code:</b> B050101T		<b>Course Title:</b> Cytology, Genetics and Immunology	
<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> <li>• To have an in depth understanding about Immune System &amp; its mechanisms.</li> </ul>			
<b>Credits:</b> 4		<b>Core:</b> Compulsory	
<b>Max. Marks:</b> 25+50		<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>Topics</b>	<b>Total No. of Lectures/Teaching Hours (60)</b>	
<b>I</b>	<b>Structure and Function of Cell Organelles I</b> <ul style="list-style-type: none"> <li>• Plasma membrane: chemical structure—lipids and proteins</li> <li>• Cell-cell interaction: cellular junctions</li> <li>• Endomembrane system: endocytosis, exocytosis</li> <li>• <b>Introduction to all national Biologists (Zoologists) and their contribution in Life Sciences</b></li> </ul>	<b>6</b>	
<b>II</b>	<b>Structure and Function of Cell Organelles II</b> <ul style="list-style-type: none"> <li>• Cytoskeleton: microtubules, microfilaments, intermediate filaments</li> <li>• Mitochondria: Structure and overview of ATP synthesis</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>• Types of DNA and RNA</li> <li>• Chromatin organization and structure of chromosome</li> </ul>	<b>8</b>	
<b>IV</b>	<b>Cell cycle and Cell Division</b> <ul style="list-style-type: none"> <li>• Cell division: mitosis and meiosis</li> <li>• Cell cycle and its regulation</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>• Sex-Determining Systems, Environmental Sex Determination, Sex Determination in Humans</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</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>• Basics of human karyotype</li> <li>• Chromosomal 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>Immune System and its Components</b> <ul style="list-style-type: none"> <li>• Historical perspective of Immunology, Structure and functions of different classes of immunoglobulins, Hypersensitivity</li> <li>• Immune system: innate and adaptive immunity, clonal selection</li> <li>• Humoral immunity and cell mediated immunity</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 Hindi must 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/Research Orientation / Term Papers/Seminar:** 10 Marks

**Class performance/Participation:** 5 Marks

Further Suggestions: None

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



<b>Year: First</b>		<b>Semester: First</b>	
<b>Subject: ZOOLOGY</b>			
<b>Course Code: B050102P</b>		<b>Course Title: Cell Biology &amp; Cytogenetics Lab</b>	
<b>Course outcomes:</b> At the completion of the course students will learn Hands-on: <ol style="list-style-type: none"> <li>1. To use simple and compound microscopes.</li> <li>2. To prepare slides and stain them to see the cell organelles.</li> <li>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.</li> <li>4. The chromosomal aberrations by preparing karyotypes.</li> <li>5. How chromosomal aberrations are inherited in humans by pedigree analysis in families.</li> <li>6. The antigen-antibody reaction.</li> </ol>			
<b>Credits: 2</b>		<b>Core: Compulsory</b>	
<b>Max. Marks: 25</b>		<b>Min. Passing Marks: as per rules</b>	
<b>Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4</b>			
<b>Unit</b>	<b>Topics</b>		<b>Total No. of Lectures/Teaching Hours (60)</b>
<b>I</b>	<ol style="list-style-type: none"> <li>1. To study buccal epithelial cells using Methylene blue.</li> <li>2. To study the different stages of Mitosis in root tip of onion.</li> <li>3. To study the different stages of Meiosis in grasshopper testis.</li> <li>4. To prepare molecular models of nucleotides, amino acids, dipeptides using bead and stick method.</li> <li>5. To check the permeability of cells using salt solution of different concentrations.</li> </ol>		<b>15</b>
<b>II</b>	<ol style="list-style-type: none"> <li>1. To study different mammalian blood cell types using Leishman stain.</li> <li>2. Determination of ABO Blood group</li> <li>3. Enumeration of red blood cells and white blood cells using haemocytometer</li> </ol>		<b>15</b>
<b>III</b>	<ol style="list-style-type: none"> <li>1. Preparation of polytene chromosomes.</li> <li>2. Study of sex chromatin (Barr bodies) in buccal smear and hair budcells (Human).</li> <li>3. Preparation of human karyotype and study the chromosomal aberrations with respect to number, translocation, deletion etc. from the pictures provided.</li> <li>4. To prepare family pedigrees.</li> </ol>		<b>15</b>
<b>IV</b>	<b>Virtual Labs</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="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>

**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 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 must 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>  
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 / Term Papers/Seminar:** 10 Marks

**Class performance/Participation:** 5 Marks

Further Suggestions: None

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

<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>How 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+50		<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>Topics</b>	<b>Total No. of Lectures/ Teaching Hours (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, and Polysaccharides)</li> <li>Lipids (saturated and unsaturated fatty acids, Tri-acylglycerols, Phospholipids)</li> <li>Proteins: Structure and classification of <math>\alpha</math>-amino acids; Levels of organization in 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 and Allozymes</li> <li>Enzyme kinetics; Factors affecting rate of enzyme-catalyzed reactions; Enzyme inhibition;</li> <li>Allosteric enzymes</li> </ul>	<b>8</b>
<b>III</b>	<b>Metabolism of Carbohydrates and Lipids</b> <ul style="list-style-type: none"> <li>Metabolism of Carbohydrates: glycolysis, Pyruvate carboxylation, Citric acid cycle</li> <li>Lipids metabolism: <math>\beta</math>-oxidation of fatty acid</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 metabolism</li> </ul>	<b>6</b>
<b>V</b>	<b>Digestion and Respiration</b> <ul style="list-style-type: none"> <li>• Structural organization and functions of gastrointestinal tract and associated glands</li> <li>• Mechanical and chemical digestion of food; Absorptions of carbohydrates, lipids, proteins, Structure of trachea and lung</li> <li>• Mechanism of respiration, Pulmonary ventilation; Transport of oxygen and carbon dioxide through hemoglobin and plasma</li> </ul>	<b>7</b>
<b>VI</b>	<b>Circulation and Excretion</b> <ul style="list-style-type: none"> <li>• Components of blood and their functions</li> <li>• Haemostasis: Blood clotting system, Blood groups: Rh factor, ABO and MN</li> <li>• Structure of mammalian heart</li> <li>• Cardiac cycle; Electrocardiogram, Blood pressure and its regulation</li> <li>• Structure of kidney and its functional unit; Urine formation</li> </ul>	<b>8</b>
<b>VII</b>	<b>Nervous System and Endocrinology</b> <ul style="list-style-type: none"> <li>• Structure of neuron and nerve conduction</li> <li>• Synaptic transmission</li> <li>• Location of Endocrine glands and their hormones</li> <li>• Classification of hormones and their action</li> </ul>	<b>8</b>
<b>VIII</b>	<b>Muscular System</b> <ul style="list-style-type: none"> <li>• Types of muscle; Ultra structure of skeletal muscle</li> <li>• Molecular and chemical basis of muscle contraction</li> </ul>	<b>7</b>

**Suggested Readings:**

1. Nelson & Cox: Lehninger's Principles of Biochemistry: McMillan (2000)
2. Zubay *et al*: Principles of Biochemistry: WCB (1995)
3. Voet & Voet: Biochemistry Vols 1 & 2: Wiley (2004)
4. Murray *et al*: Harper's Illustrated Biochemistry: McGraw Hill (2003) Elliott and Elliott: Biochemistry and Molecular Biology: Oxford University Press
5. Guyton, A.C. & Hall, J.E. Textbook of Medical Physiology. XI Edition. Hercourt 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 must be prescribed by the Universities and Colleges**

<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/ Research Orientation/ Term Papers/Seminar:</b> 10 Marks
<b>Class performance/Participation:</b> 5 Marks
Further Suggestions: None

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

<b>Year:</b> First		<b>Semester:</b> Second
<b>Subject:</b> ZOOLOGY		
<b>Course Code:</b> B050202P	<b>Course Title:</b> Physiological, Biochemical & Hematology 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 and abnormal hematological laboratory findings to predict the diagnosis of hematological disorders and diseases.</li> </ul>		
<b>Credits:</b> 2		<b>Core:</b> Compulsory
<b>Max. Marks:</b> 25		<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>Topics</b>	<b>Total No. of Lectures/ Teaching Hours (60)</b>
<b>I</b>	<ol style="list-style-type: none"> <li>1. Estimation of haemoglobin using Sahli's haemoglobinometer</li> <li>2. Preparation of haemin and haemochromogen crystals</li> <li>3. Recording of blood pressure using a sphygmomanometer</li> <li>4. Recording of blood glucose level by using glucometer</li> <li>5. Preparation of molecular models of amino acids, dipeptides etc.</li> </ol>	<b>15</b>
<b>II</b>	<ol style="list-style-type: none"> <li>1. Study of permanent slides of Mammalian skin, Cartilage, Bone, Spinal cord, Nerve cell, Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid</li> <li>2. Recording of simple muscle twitch with electrical stimulation (or Virtual)</li> <li>3. Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee jerk reflex)</li> </ol>	<b>15</b>
<b>III</b>	<ol style="list-style-type: none"> <li>1. Ninhydrin test for <math>\alpha</math>-amino acids.</li> <li>2. Benedict's test for reducing sugar and iodine test for starch.</li> <li>3. Test for sugar and acetone in urine.</li> <li>4. Qualitative tests of functional groups in carbohydrates, proteins and lipids.</li> <li>5. Paper chromatography of amino acids.</li> <li>6. Action of salivary amylase under optimum conditions.</li> </ol>	<b>15</b>

<b>IV</b>	<b>Virtual Labs</b> <ol style="list-style-type: none"> <li>1. <a href="https://www.vlab.co.in">https://www.vlab.co.in</a></li> <li>2. <a href="https://zoologysan.blogspot.com">https://zoologysan.blogspot.com</a></li> <li>3. <a href="http://www.vlab.iitb.ac.in/vlab">www.vlab.iitb.ac.in/vlab</a></li> <li>4. <a href="http://www.onlinelabs.in">www.onlinelabs.in</a></li> <li>5. <a href="http://www.powershow.com">www.powershow.com</a></li> <li>6. <a href="https://vlab.amrita.edu">https://vlab.amrita.edu</a></li> <li>7. <a href="https://sites.dartmouth.edu">https://sites.dartmouth.edu</a></li> </ol>	<b>15</b>
-----------	---	-----------

<b>Suggested Readings:</b>
<ol style="list-style-type: none"> <li>1. Cox, M.M and Nelson, D.L. (2008). Lehninger's Principles of Biochemistry, V Edition, 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 Vashishta N. (2007). Experimental Physiology: Comprehensive Manual. Heritage Publishers, New Delhi</li> </ol>
<b>Course Books published in Hindi must 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> 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 / Term Papers/Seminar:</b> 10 Marks
<b>Class performance/Participation:</b> 5 Marks
Further Suggestions: None

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

<b>Year: Second</b>		<b>Semester: Third</b>	
<b>Subject: ZOOLOGY</b>			
<b>Course Code: B050301T</b>		<b>Course Title: Molecular Biology, Bioinstrumentation &amp; Biotechniques</b>	
<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 viz. DNA to trait.</li> <li>• A clear understanding of the processes of central dogma viz. transcription, translation etc. 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: Compulsory</b>	
<b>Max. Marks: 25+50</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>Topic</b>	<b>Total No. of Lectures/ Teaching Hours (60)</b>	
<b>I</b>	<b>Process of Transcription</b> <ul style="list-style-type: none"> <li>• Fine structure of gene</li> <li>• RNA polymerases</li> <li>• Transcription factors</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>Process of Translation</b> <ul style="list-style-type: none"> <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 Regulation at transcriptional level, Post-transcriptional modifications: Capping, Splicing, Polyadenylation</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: protein folding</li> </ul>	<b>8</b>
<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, phase-contrast microscopy</li> <li>• 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>• Principle and Types of Chromatography: paper and thin layer</li> </ul>	<b>8</b>
<b>VII</b>	<b>Spectrophotometry and Biochemical Techniques</b> <ul style="list-style-type: none"> <li>• Spectrophotometry: Beer-lambert law, absorption spectrum</li> <li>• Biochemical techniques: Measurement of pH, Preparation of buffers and solutions</li> </ul>	<b>8</b>
<b>VIII</b>	<b>Molecular Techniques</b> <ul style="list-style-type: none"> <li>• Nucleic acid fractionation, detection by electrophoresis, Polymerase Chain Reaction (PCR), DNA fingerprinting</li> <li>• PAGE, ELISA, Western blotting</li> <li>• Hybridoma technology</li> </ul>	<b>8</b>
<b>Suggested Readings:</b> <ol style="list-style-type: none"> <li>1. Lodish et al: Molecular Cell Biology: Freeman &amp; Co, USA (2004).</li> <li>2. Alberts et al: Molecular Biology of the Cell: Garland (2002).</li> <li>3. Cooper: Cell: A Molecular Approach: ASM Press (2000).</li> <li>4. Karp: Cell and Molecular Biology: Wiley (2002).</li> <li>5. Watson et al. Molecular Biology of the Gene. Pearson (2004).</li> <li>6. Lewin. Genes VIII. Pearson (2004).</li> <li>7. Pierce B. Genetics. Freeman (2004).</li> <li>8. Sambrook <i>et al</i> .Molecular Cloning Vols I, II, III. CSHL (2001).</li> <li>9. Primrose. Molecular Biotechnology. Panima (2001).</li> <li>10. Clark &amp; Switzer. Experimental Biochemistry. Freeman (2000)</li> </ol> <p style="text-align: center;"><b>Course Books published in Hindi must be prescribed by the Universities and Colleges</b></p>		
<p>This course can be opted as an elective by the students.</p> <p>The eligibility for this paper is 10+2 with Biology as one of the subject</p>		
<p>Suggested Continuous Evaluation Methods:</p> <p><b>House Examination/Test: 10 Marks</b></p> <p><b>Written Assignment/Presentation/Research Orientation / Term Papers/Seminar: 10 Marks</b></p> <p><b>Class performance/Participation: 5 Marks</b></p>		

Further Suggestions: None

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

.....

<b>Year: Second</b>		<b>Semester: Third</b>
<b>Subject: ZOOLOGY</b>		
<b>Course Code: B050302P</b>	<b>Course Title: Bioinstrumentation &amp; Molecular Biology Lab</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 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: 2</b>		<b>Core: Compulsory</b>
<b>Max. Marks: 25</b>		<b>Min. Passing Marks: as per rules</b>
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/Teaching Hours (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 equipments such as pH Meter, Electronic balance, vortex mixer, use of glass and micropipettes, Laminar flow, Incubator shaker, Water bath, Centrifuge, Chromatography apparatus, etc.	<b>15</b>
<b>II</b>	1. To prepare solutions and buffers. 2. To learn the working of Spectrophotometer. 3. Demonstration of differential centrifugation to fractionate different components in a mixture.	<b>15</b>
<b>III</b>	1. To prepare dilutions of Riboflavin and verify the principle of spectrophotometry. 2. To identify different amino acids in a mixture using paper chromatography. 3. Demonstration of DNA extraction from blood or tissue samples. 4. To estimate amount of DNA using spectrophotometer.	<b>15</b>
<b>IV</b>	<b>Virtual Labs</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>	<b>15</b>

	<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>	
<p>Suggested Readings:</p> <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> <p style="text-align: center;"><b>Course Books published in Hindi must be prescribed by the Universities and Colleges</b></p>		
<p>This course can be opted as an elective by the students.</p> <p>The eligibility for this paper is 10+2 from Arts/Commerce/Science</p>		
<p>Suggested Continuous Evaluation Methods:</p> <p><b>House Examination/Test: 10 Marks</b></p> <p><b>Written Assignment/Presentation / Term Papers/Seminar: 10 Marks</b></p> <p><b>Class performance/Participation: 5 Marks</b></p>		
<p>Further Suggestions: None</p>		

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

.....

<b>Year: Second</b>		<b>Semester: Fourth</b>
<b>Subject: ZOOLOGY</b>		
<b>Course Code: B050401T</b>	<b>Course Title: Gene Technology and Human Welfare</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 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>• Know the basics of industrial biotechnology.</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: 4</b>		<b>Core: Compulsory</b>
<b>Max. Marks: 25+50</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>Topic</b>	<b>Total No. of Lectures/Teaching Hours (60)</b>
<b>I</b>	<b>Principles of Gene Manipulation</b> <ul style="list-style-type: none"> <li>• Recombinant DNA Technology</li> <li>• Restriction Enzymes, Cloning Vectors, Ligation</li> <li>• Gene transfer and 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>• Crop and livestock improvement, development of transgenic animals</li> <li>• Development of DNA drugs and vaccines</li> </ul>	<b>8</b>
<b>III</b>	<b>Enzyme Technology</b> <ul style="list-style-type: none"> <li>• Microbial culture</li> <li>• Methods of enzyme production</li> <li>• Immobilization of enzymes</li> </ul>	<b>6</b>
<b>IV</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>• Application of DNA fingerprinting</li> <li>• Concept of pharmacogenomics and pharmacogenetics</li> </ul>	<b>6</b>
<b>V</b>	<b>Biostatistics I</b> <ul style="list-style-type: none"> <li>• Calculations of mean, median, mode</li> <li>• Variance, Standard Deviation</li> <li>• Concepts of Coefficient of variation</li> </ul>	<b>8</b>

<b>VI</b>	<b>Biostatistics II</b> <ul style="list-style-type: none"> <li>• Data summarizing: frequency distribution, graphical presentation—bar, pie diagram, histogram</li> <li>• Test of significance: t-test and Chi-square test</li> </ul>	<b>7</b>
<b>VII</b>	<b>Basics of Computers</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, Use of different search engines</li> </ul>	<b>7</b>
<b>VIII</b>	<b>Bioinformatics</b> <ul style="list-style-type: none"> <li>• Databases: nucleic acids, genomes, protein sequences and structures, Bibliography</li> <li>• Sequence analysis (homology): pairwise and multiple sequence alignments-BLAST, CLUSTALW</li> </ul>	<b>8</b>
<p><b>Suggested Readings:</b></p> <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. Snecdecor and W. G. Cochran, Willey 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> <p style="text-align: center;"><b>Course Books published in Hindi must be prescribed by the Universities and Colleges</b></p>		
<p>This course can be opted as an elective by the students.</p> <p>The eligibility for this paper is 10+2 with Biology as one of the subject</p>		
<p>Suggested Continuous Evaluation Methods:</p> <p><b>House Examination/Test: 10 Marks</b></p> <p><b>Written Assignment/Presentation /Research Orientation / Term Papers/Seminar: 10 Marks</b></p> <p><b>Class performance/Participation: 5 Marks</b></p>		
<p>Further Suggestions: None</p>		

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

<b>Year: Second</b>		<b>Semester: Fourth</b>
<b>Subject: ZOOLOGY</b>		
<b>Course Code: B050402P</b>	<b>Course Title: Genetic Engineering Lab, Genetic Counselling &amp; Telemedicine</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 principles of genetic engineering with hands-on experiments in mutation detection, testing of infectious diseases like Covid19.</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: 2</b>	<b>Core: Compulsory</b>	
<b>Max. Marks: 25</b>	<b>Min. Passing Marks: as per rules</b>	
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/ Teaching Hours (60)</b>
<b>I</b>	1. Measure the pre and post clitellar lengths of earthworms and calculate mean, median, mode, standard deviation etc. 2. Measure the height and weight of all students in the class and apply statistical measures.	<b>10</b>
<b>II</b>	1. To perform bacterial culture and calculate generation time of bacteria. 2. To study Restriction enzyme digestion using teaching kits. 3. To study Polymerase Chain Reaction (PCR) using teaching kits. 4. Demonstration of agarose gel electrophoresis for detection of DNA. 5. Demonstration of Polyacrylamide Gel Electrophoresis (PAGE) for detection of proteins. 6. To calculate molecular weight of unknown DNA and protein fragments from gel pictures.	<b>20</b>

<b>III</b>	<ol style="list-style-type: none"> <li>1. To learn the basics of computer applications</li> <li>2. To learn sequence analysis using BLAST</li> <li>3. To learn Multiple sequence alignment using CLUSTALW</li> <li>4. To learn about Phylogenetic analysis using the programme PHYLIP.</li> <li>5. To learn how to perform Primer designing for PCR using available softwares etc</li> </ol>	<b>15</b>
------------	--	-----------

<b>IV</b>	<p><b>Virtual Labs</b></p> <ol style="list-style-type: none"> <li>1. Gel Documentation System- <a href="https://youtu.be/WPpt3-FanNE">https://youtu.be/WPpt3-FanNE</a></li> <li>2. Colorimeter- <a href="https://youtu.be/v4aK6G0bGuU">https://youtu.be/v4aK6G0bGuU</a></li> <li>3. PCR Part 1- <a href="https://youtu.be/CpGX1UFSI4A">https://youtu.be/CpGX1UFSI4A</a></li> <li>4. PCR Part 2- <a href="https://youtu.be/6lcHAYPTAEw">https://youtu.be/6lcHAYPTAEw</a></li> <li>5. DNA isolation Part 1- <a href="https://youtu.be/QE7UI0JnY9A">https://youtu.be/QE7UI0JnY9A</a></li> <li>6. DNA isolation part 2- <a href="https://youtu.be/-efr_HFeHxM">https://youtu.be/-efr_HFeHxM</a></li> <li>7. DNA curve- <a href="https://youtu.be/ubL8QxTeuG4">https://youtu.be/ubL8QxTeuG4</a></li> <li>8. Spectrophotometer- <a href="https://youtu.be/ubL8QxTeuG4">https://youtu.be/ubL8QxTeuG4</a></li> <li>9. Agarose Part 1- <a href="https://youtu.be/7gvHPFww--g">https://youtu.be/7gvHPFww--g</a></li> <li>10. Agarose part 2- <a href="https://youtu.be/j_BOZCHNsSg">https://youtu.be/j_BOZCHNsSg</a></li> </ol>	<b>15</b>
-----------	---	-----------

**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).

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

This course can be opted as an elective by the students.

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

Suggested Continuous Evaluation Methods:

**House Examination/Test:** 10 Marks

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

**Class performance/Participation:** 5 Marks

Further Suggestions: None

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

.....



<b>Year: Third</b>		<b>Semester: Fifth</b>
<b>Subject: ZOOLOGY</b>		
<b>Course Code: B050501T</b>	<b>Course Title: Diversity of Non-Chordates and Economic Zoology</b>	
<b>Course outcomes:</b> The student at the completion of the course will be able to: 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: 4</b>	<b>Core: Compulsory</b>	
<b>Max. Marks: 25+50</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>Topic</b>	<b>Total No. of Lectures/ Teaching Hors (60)</b>
<b>I</b>	<b>Protozoa to Coelenterate</b> <ul style="list-style-type: none"> <li>• Protozoa – <i>Euglena</i> – Nutrition</li> <li>• <i>Paramecium</i> - Morphology and Reproduction</li> <li>• Porifera – <i>Sycon</i> - Canal System</li> <li>• Coelenterata – <i>Obelia</i> - Morphology and Life cycle</li> </ul>	<b>7</b>
<b>II</b>	<b>Ctenophora to Nematelminthes</b> <ul style="list-style-type: none"> <li>• Ctenophora - Salient features</li> <li>• Platyhelminthes - <i>Fasciola</i> (Liver fluke) – Morphology and Life cycle</li> <li>• Nematelminthes – <i>Ancylostoma</i> (Hook worm) - Morphology</li> </ul>	<b>7</b>
<b>III</b>	<b>Annelida to Arthropoda</b> <ul style="list-style-type: none"> <li>• Annelida – <i>Nereis</i> - Morphology and Reproductive System</li> <li>• <i>Hirudinaria</i> (Leech)- Morphology and Haemocoelomic system</li> </ul> <b>Arthropoda</b> <ul style="list-style-type: none"> <li>• Arthropoda – <i>Palaemon</i> (Prawn) – Morphology and Appendages</li> </ul>	<b>8</b>

<b>IV</b>	<b>Mollusca to Echinodermata</b> <ul style="list-style-type: none"> <li>• Mollusca <i>Pila</i> - Morphology and Nervous System <i>Unio</i> – Morphology and Life cycle</li> <li>Echinodermata –<i>Pentaceros</i> - Morphology and Water Vascular System</li> </ul>	<b>8</b>
<b>V</b>	<b>Parasitology</b> <ul style="list-style-type: none"> <li>• Structure, life cycle, pathogenicity including diseases, causes, symptoms and control of the following parasites of domestic animals and humans: Trypanosoma, Giardia and Wuchereria</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, Rodent (rat). Termites and Mosquitoes and their control	<b>8</b>
<b>VII</b>	<b>Economic Zoology-1</b> Animal breeding and culture: Aquaculture (Pisciculture), Poultry	<b>7</b>
<b>VIII</b>	<b>Economic Zoology- 2</b> Economic importance of Sericulture, Apiculture, Lac-culture, Vermiculture	<b>7</b>

**Suggested Readings:**

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

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 / Term Papers/Seminar:** 10 Marks

**Class performance/Participation:** 5 Marks

Further Suggestions: None

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

<b>Year: Third</b>		<b>Semester: Fifth</b>	
<b>Subject: ZOOLOGY</b>			
<b>Course Code: B050502T</b>		<b>Course Title: Diversity of Chordates and Comparative Anatomy</b>	
<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:4</b>		<b>Core Compulsory/Elective</b>	
<b>Max. Marks: 25+50</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>Topic</b>		<b>Total No. of Lectures/ Teaching Hours (60)</b>
<b>I</b>	<b>Origin of Chordates &amp; Hemichordata</b> Origin of Chordates, Classification of Phylum Chordata up to the class. Hemichordata: General characteristics, classification and detailed study of <i>Balanoglossus</i> (Habit and Habitat, Morphology, Salient features and affinities).		<b>6</b>
<b>II</b>	<b>Cephalochordata and Urochordata</b> <b>Cephalochordata</b> : General characteristics, classification and detailed study of <i>Branchiostoma (Amphioxus)</i> (Habit and Habitat, Morphology, Anatomy and Physiology of Digestive system). <b>Urochordata</b> : General characteristics, classification and detailed study of <i>Herdmania</i> (Habit and Habitat, Morphology, Anatomy and Physiology of Excretory system).		<b>6</b>
<b>III</b>	<b>Classification and General Characteristics of Vertebrates</b> 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		<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> Succession of kidney, Evolution of urinogenital ducts, Types of mammalian uteri	<b>8</b>
<b>VIII</b>	<b>Nervous System :</b> Comparative account of Brain, 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>
<p><b>Suggested Readings:</b></p> <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>		
<p>This course can be opted as an elective by the students.</p> <p>The eligibility for this paper is 10+2 with Biology as one of the subject</p>		
<p>Suggested Continuous Evaluation Methods:</p> <p><b>House Examination/Test:</b> 10 Marks</p> <p><b>Written Assignment/Presentation / Term Papers/Seminar:</b> 10 Marks</p> <p><b>Classperformance/Participation:</b> 5 Marks</p>		
Further Suggestions: None		

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

.....

<b>Year: Third</b>		<b>Semester: Fifth</b>
<b>Subject: ZOOLOGY</b>		
<b>Course Code: B050503P</b>	<b>Course Title: Lab on Non-chordate Virtual Dissection, Anatomy, Economic Zoology and Parasitology</b>	
<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- chordates diversity</li> <li>• explain structural and functional diversity of non- chordates</li> <li>• explain evolutionary relationship amongst different classes of the non- chordates</li> <li>• Generate self-employment</li> <li>• Enable students to take up research in biological sciences.</li> </ul>		
<b>Credits: 2</b>	<b>Core: Compulsory</b>	
<b>Max. Marks: 25</b>	<b>Min. Passing Marks: as per rules</b>	
Total No. of Lectures-Tutorials-Practical (in hours per week): <b>L-T-P: 0-0-4</b>		
<b>U nit</b>	<b>Topic</b>	<b>Total No. of Lectures/ Teaching Hours (60)</b>
<b>I</b>	To study of Museum specimens of various non-chordates (Protozoa Echinodermata): 1. To prepare permanent stained slide of Gemmule, Spicules, <i>Obelia</i> colony, <i>Sertularia</i> and <i>Campanularia</i> . 2. To take out the <i>Nereis</i> parapodia. 3. To take out hastate plate ( <i>Palaemon</i> ), <i>Arthropods statocyst</i> , <i>Pila- Radula</i> and <i>Osphradium/Gills</i> .	<b>15</b>
<b>II</b>	To study prepared permanent slides of:- Protozoa- <i>Euglena</i> , <i>Chlamydomonas</i> , <i>Volvox</i> , <i>Trypanosoma</i> , <i>Leishmania</i> , <i>Amoeba</i> , <i>Entamoeba histolytica</i> , <i>Paramecium</i> , <i>Paramecium</i> -Binary fission, <i>Paramecium</i> -Conjugation and <i>Plasmodium</i> . Porifera- Sycon L.S. and T.S., Spicules of sponges, Gemmule and <i>Amphiblastula</i> . Coelenterata- <i>Obelia</i> medusa and <i>Obelia</i> colony. Platyhelminthes- <i>Fasciola hepatica</i> (Entire), T.S. through testis, Uterus, Cirrus, <i>Fasciola hepatica</i> - Eggs, Miracidium larva, Sporocyst larva, Redia larva and Cercaria larva. Nemathelminthes- <i>Ancylostoma</i> . Annelida- <i>Nereis</i> - T.S. body through parapodium, without parapodia, <i>Heteronereis</i> with parapodia without parapodia and Trochophore larva of <i>Nereis</i> . <i>Hirudinaria</i> - salivary glands and nephridium. <i>Hirudinaria</i> - T.S of buccal cavity T.S. body through crop and its diverticula Arthropoda- <i>Culex</i> Male and Female- Head and Mouth parts, <i>Anopheles</i> Male and Female- Head and Mouth parts, Housefly- Head and Mouth parts, Honey bee- Mouth part legs, sting apparatus, <i>Cimex</i> (Bed bug), <i>Pediculus</i> larva, <i>Daphnia</i> , <i>Cyclops</i> , <i>Cypris larva</i> , <i>Mysis</i> , <i>Zoea</i> larva and <i>Megalopa</i> larva. Mollusca- <i>Pila</i> - L.S. of Osphradium <i>Pila</i> -Radula Unio- T.S. of gill lamina, Cross section of body, T.S. of shell and Glochidium larva. Echinodermata- T.S. of Starfish arm, Pedicellariae of starfish and Bipinnaria larva.	<b>15</b>

III	<ol style="list-style-type: none"> <li>1. Identification of pests.</li> <li>2. Life history of silkworm, honeybee and lac insect.</li> <li>3. Different types of important edible fishes of India.</li> <li>4. Model /chart making.</li> <li>5. <b>Dissections</b> : Through multimedia / Models</li> </ol>	<b>15</b>
IV	<b>Virtual Labs</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>

**Suggested Readings:**

1. Parker and Haswell: TextBook of Zoology, Vol. II (1978, ELBS)
2. Barnes et al (2009). The Invertebrates: A synthesis. Wiley Backwell 17
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. Boradale, L.A. and Potts, E.A. (1961). Invertebrates: A Manual for the use of Students. Asia Publishing Home
8. Robert Leo Smith Ecology and field biology Harper and Row publisher
9. Handbook of Practical Sericulture : Ullal, S.R. and Narasimhanna, M.N. (1987), Central Silk Board Publication, Bangalore.
10. Prost, P. J. (1962). *Apiculture*. Oxford and IBH, New Delhi.
11. Bisht. D.S., *Apiculture*, ICAR Publication.
12. Singh S., *Beekeeping in India*, Indian council of Agricultural Research, New Delhi.
13. Ullal S.R. and Narasimhanna, M.N. Handbook of Practical Sericulture: CSB, Bangalore
14. Jolly. M. S. Appropriate Sericultural Techniques; Ed., Director, CSR & TI, Mysore.
15. Handbook of Silkworm Rearing: Agriculture and Technical Manual-1, Fuzi Pub. Co.
16. Santanam, B. *et al*, A manual of freshwater aquaculture
17. Boyd. C.E. & Tucker.C.S, Pond aquaculture water quality management
18. Pedigo, L.P. (2002). *Entomology and Pest Management*, Prentice Hall.
19. Ranganathan L.S, Vermicomposting technology- soil health to human health

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

This course can be opted as an elective by the students.  
The eligibility for this paper is 10+2 from Arts/Commerce/Science

Suggested Continuous Evaluation Methods:

**House Examination/Test:** 10 Marks

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

**Class performance/Participation:** 5 Marks

Further Suggestions: None

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

.....

<b>Year: Third</b>		<b>Semester: Fifth</b>
<b>Subject: ZOOLOGY</b>		
<b>Course Code: B050504P</b>	<b>Course Title: Lab on Chordates Virtual Dissection and Anatomy</b>	
<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 different class of chordates</li> <li>• Generate self-employment</li> <li>• Enable students to take up research in biological sciences.</li> </ul>		
<b>Credits: 2</b>	<b>Core: Compulsory</b>	
<b>Max. Marks: 25</b>	<b>Min. Passing Marks: as per rules</b>	
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/ Teaching Hours (60)</b>
<b>I</b>	1. To study the museum specimen of various chordates  2. To prepare the permanent stained slide of oral hood of Amphioxus, Placoid scale, Chromatophore  3. To study the use and ethical handling of model organisms- Rat, Mice, Rabbit and Pig	<b>15</b>
<b>II</b>	1. Comparative study of Pectoral Girdle, Pelvic Girdle, Forelimb bones and Hind limb bones  2. Comparative study of histological slides of different tissue of Vertebrates	<b>15</b>
<b>III</b>	1. To study permanent stained slides Herdmania- Spicules, Pharyngeal wall Fish Scoliodon- Ampullae of Lorenzini, Placoid scale Labeo- Cycloid scale Nandus- Ctenoid scale Lepidosteus- Rhomboid scale Frog- Blood, Squamous epithelium, Ciliated epithelium, Striated or striped muscle fibres, Unstriated or unstriped muscle fibres Pigeon- Pecten, Filoplume  2. Dissection through multimedia or virtual Wallago- Afferent and Efferent branchial vessels, Cranial nerve, Weberian ossicles	<b>15</b>
<b>IV</b>	<b>Virtual Labs</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>



**Suggested Readings:**

1. Harvey et al: The Vertebrate Life (2006)
2. Colbert et al: Colbert's Evolution of the Vertebrates: A history of the backboned animals through time (5th ed 2002, Wiley - Liss)
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. Robert Leo Smith Ecology and field biology Harper and Row publisher

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

This course can be opted as an elective by the students.  
The eligibility for this paper is 10+2 from Arts/Commerce/Science

Suggested Continuous Evaluation Methods:

**House Examination/Test:** 10 Marks

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

**Class performance/Participation:** 5 Marks

Further Suggestions: None

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

.....

<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 fertilization 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+50		<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/Teaching Hours (60)</b>
I	<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>• Patterns of evolution (Divergence, Convergence, Parallel, Coevolution)</li> </ul>	8
II	<b>Population Genetics</b> <ul style="list-style-type: none"> <li>• Microevolution and Macroevolution: Hardy-Weinberg equilibrium</li> <li>• Forces of evolution: mutation, selection</li> </ul>	8
III	<b>Direct Evidences of Evolution</b> Types of fossils Dating of fossils, Phylogeny of horse	7
IV	<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> </ul>	7

	<ul style="list-style-type: none"> <li>• Mass extinction (Causes, Names of five major extinctions)</li> </ul>	
<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> </ul>	<b>6</b>
<b>VI</b>	<b>Developmental Genes</b> <ul style="list-style-type: none"> <li>• Genes and development</li> <li>• Molecular basis of development</li> </ul>	<b>8</b>
<b>VII</b>	<b>Early Vertebrate Development</b> <ul style="list-style-type: none"> <li>• Early development of mammals</li> <li>• Metamorphosis, regeneration and stem cells</li> </ul>	<b>8</b>
<b>VIII</b>	<b>Late Developmental Processes</b> <ul style="list-style-type: none"> <li>• Development of eye and limb</li> <li>• Metamorphosis in amphibians, insects</li> <li>• Regeneration: salamander limbs, Hydras</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 Hallgrimsson, 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 must 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 / Term Papers/Seminar:** 10 Marks

**Class performance/Participation:** 5 Marks

Further Suggestions: None

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

<b>Year: Third</b>		<b>Semester:</b> Six
<b>Subject: ZOOLOGY</b>		
<b>Course Code: B050602T</b>	<b>Course Title: Ecology, Ethology, Environmental Science and Wildlife</b>	
<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 behaviors in a variety of taxa.</li> <li>• The proximate and ultimate causes of various behaviors.</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: 4</b>	<b>Core: Compulsory</b>	
<b>Max. Marks: 25+50</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>Topic</b>	<b>Total No. of Lectures/ Teaching Hours (60)</b>
<b>I</b>	<b>Introduction to Ecology</b> <ul style="list-style-type: none"> <li>• 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>• Population: Density, natality, mortality, life tables, survivorship curves, age ratio, sex ratio, 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 of Carbon</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> </ul>	<b>7</b>
	<ul style="list-style-type: none"> <li>• Climate changes</li> <li>• Greenhouse gases and global warming</li> <li>• Acid rain, Ozone layer destruction</li> </ul>	
<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> <li>• Nuclear waste handling and disposal, Waste from thermal power plants</li> </ul>	<b>6</b>
<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>• Circadian 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 wild life - 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, Saunder
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. Sutherland, W.J. (2000). The Conservation Handbook: Research, Management and Policy. Blackwell Sciences
14. 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 must be prescribed by the Universities and Colleges**

This course can be opted as an elective by the students.

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 / Term Papers/Seminar:** 10 Marks

**Class Performance/Participation:** 5 Marks

Further Suggestions: None

.....

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

<b>Year:</b> Third		<b>Semester:</b> Sixth	
<b>Subject:</b> ZOOLOGY			
<b>Course Code:</b> B050603P		<b>Course Title:</b> Lab on 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>To understand the basic concepts and importance of evolutionary and developmental relationship between the organisms.</li> <li>Get employment in forest services, conservatories and evolutionary &amp; developmental organization etc.</li> <li>Enable students to take up evolutionary &amp; developmental research.</li> </ul>			
<b>Credits:</b> 2		<b>Core:</b> Compulsory	
<b>Max. Marks:</b> 25		<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/Teaching Hours (60)</b>
I	1. To study the different types of fossils 2. Study of different types of eggs on the basis of distribution of yolk		<b>15</b>
II	1. To study cleavage pattern through chart 2. To study the fate map through chart		<b>15</b>
III	1. To study the metamorphosis in frog 2. To study the regeneration in Hydra/Salamander		<b>15</b>
IV	<b>Virtual Labs</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>Developmental Biology, Scott F. Gilbert and Michael J. F. Barresi, Sinauer Associates, 2015</li> <li>Evolutionary Analysis, Jon C. Herron and Scott Freeman, Pearson, 2013</li> <li>Principles of Development, Lewis Wolpert, Cheryll Tickle, and Alfonso Martinez Arias, Oxford University Press, 2015</li> <li>Evolution, Douglas J. Futuyma, Sinauer Associates, 2017</li> <li>From DNA to Diversity: Molecular Genetics and the Evolution of Animal Design, Sean B. Carroll, Jennifer K. Grenier, and Scott D. Weatherbee, Wiley-Blackwell, 2007</li> <li>Introduction to Computational Biology: An Evolutionary Approach, Bernhard Haubold and Thomas Wiehe, Springer, 2006</li> <li>Evo-Devo: Evolutionary Developmental Biology, T. Ryan Gregory, Princeton University Press, 2005</li> <li>Evolutionary Genetics: Concepts and Case Studies, Charles W. Fox and Jason B. Wolf, Oxford University Press, 2006</li> </ol> <p><b>Course Books published in Hindi must be prescribed by the Universities and Colleges</b></p>			



This course can be opted as an elective by the students.

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

Suggested Continuous Evaluation Methods:

**House Examination/Test:** 10 Marks

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

**Class performance/Participation:** 5 Marks

Further Suggestions: None

.....

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

.....

<b>Year:</b> Third		<b>Semester:</b> Sixth
<b>Subject:</b> ZOOLOGY		
<b>Course Code:</b> B050604P	<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	<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/Teaching Hours (60)</b>
I	1. Study of life tables and plotting of survivorship curves of different types 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>
II	Report on a visit to National Park/Biodiversity Park/Wild life sanctuary	<b>4</b>
III	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 evidences 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>
IV	<b>Virtual Labs</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> 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 must be prescribed by the Universities and Colleges**

This course can be opted as an elective by the students.

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

Suggested Continuous Evaluation Methods:

**House Examination/Test:** 10 Marks

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

**Class performance/Participation:** 5 Marks

Further Suggestions: None

.....

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

.....

# SIDDHARTHA UNIVERSITY, KAPILVASTU

## SIDDHARTH NAGAR, U.P.

### Minor Course syllabus: Zoology (NEP-2020)

1. This syllabus shall come with effect from academic session 2023-24
2. This paper shall be a part of the Minor Optional Course of University Bachelor's Degree course.
3. Any student of B.A./B.Sc. Classes may opt this paper as Minor Course in Zoology
4. The students opting this paper shall be required to pass it only in 1<sup>st</sup> semester or his/her First Year and 3rd semester of Second Year of Bachelor degree course.
5. This paper shall carry 4 credits.

<i>Animal Science-I</i>		<i>Credits: 4</i>
<b>Programme/Class: / MINOR COURSE: Zoology</b>	<b>Semester: First/Second</b>	No. of Lectures <b>(60 hrs.)</b>
<b>UNIT-1 Cell structure and function</b>	Introduction of cell <ul style="list-style-type: none"><li>• Basic knowledge of cell theory</li><li>• Prokaryotic and eukaryotic cell</li><li>• Structure and functions of cell organelles (Nucleus, Mitochondria)</li><li>• Brief knowledge of cell cycle</li></ul>	15
<b>UNIT-2 Animal Diversity</b>	General characteristics of animal kingdom and their classification Difference between non-chordates and chordates. Diagnostic features of following phyla with examples : <ol style="list-style-type: none"><li>1. Protozoa</li><li>2. Porifera</li><li>3. Cnidaria</li><li>4. Platyhelminthes</li><li>5. Nematelminthes</li><li>6. Annelida</li><li>7. Arthropoda</li><li>8. Mollusca</li><li>9. Echinodermata</li></ol> Classification of chordata up to the class Diagnostic features of following classes with examples Fish, Amphibia, Reptile, Bird and Mammal	15
<b>UNIT-3 Human Physiology</b>	<ul style="list-style-type: none"><li>• Elementary knowledge of digestive system, respiratory system. Basic concept of immune system; antigen antibody , vaccine and vaccination</li></ul>	15

<b>UNIT-4</b> <b>Basics of Ecology</b>	<ul style="list-style-type: none"> <li>• Introduction of Ecology</li> <li>• Components of ecosystem- Abiotic and biotic factors</li> <li>• Food chain and food web</li> <li>• Ecological pyramids</li> <li>• Classification of Ecosystem</li> <li>• Causes of Pollution: Air, Water and Noise</li> <li>• Global warming and acid rain</li> </ul>	15
---	--	----

<i>Animal Science- II</i>		<i>Credits: 4</i>
<b>Programme/Class: /</b> <b>MINOR COURSE: Zoology</b>	<b>Semester: Third/Fourth</b>	<b>No. of Lectures (60 hrs.)</b>
<b>UNIT-I</b> <b>Biology</b>	<ul style="list-style-type: none"> <li>• Introduction to Origin of life</li> <li>• Basics of Lamarckism and Darwinism</li> <li>• Evidences of evolution from : <ol style="list-style-type: none"> <li>1. Connecting link</li> <li>2. Vestigial organs</li> </ol> </li> </ul>	15
<b>UNIT-2</b> <b>Basics of Biochemistry</b>	<ul style="list-style-type: none"> <li>• Elementary knowledge of carbohydrates, lipids, proteins</li> <li>• Vitamins: Types , sources, functions and diseases</li> <li>• Basics of endocrinology: Brief knowledge of endocrine glands (Pituitary, Pancreas and Thyroid)</li> </ul>	15
<b>UNIT-3</b> <b>Economic Zoology</b>	<ul style="list-style-type: none"> <li>• Basic knowledge of Apiculture, Sericulture.</li> <li>• Basics of Poultry farming.</li> </ul>	15
<b>UNIT-4</b> <b>Applied Zoology</b>	<ul style="list-style-type: none"> <li>• Human diseases: Common bacterial diseases (Tuberculosis, Pneumonia, Cholera)</li> <li>• Viral diseases (AIDS ,COVID -19 and Dengue Fever)</li> <li>• Protozoan diseases (Malaria, and Pyorrhoea)</li> <li>• Basic concept of Cancer</li> </ul>	15