



जननायक चन्द्रशेखर विश्वविद्यालय, बलिया  
Jananayak Chandrashekhar University, Ballia

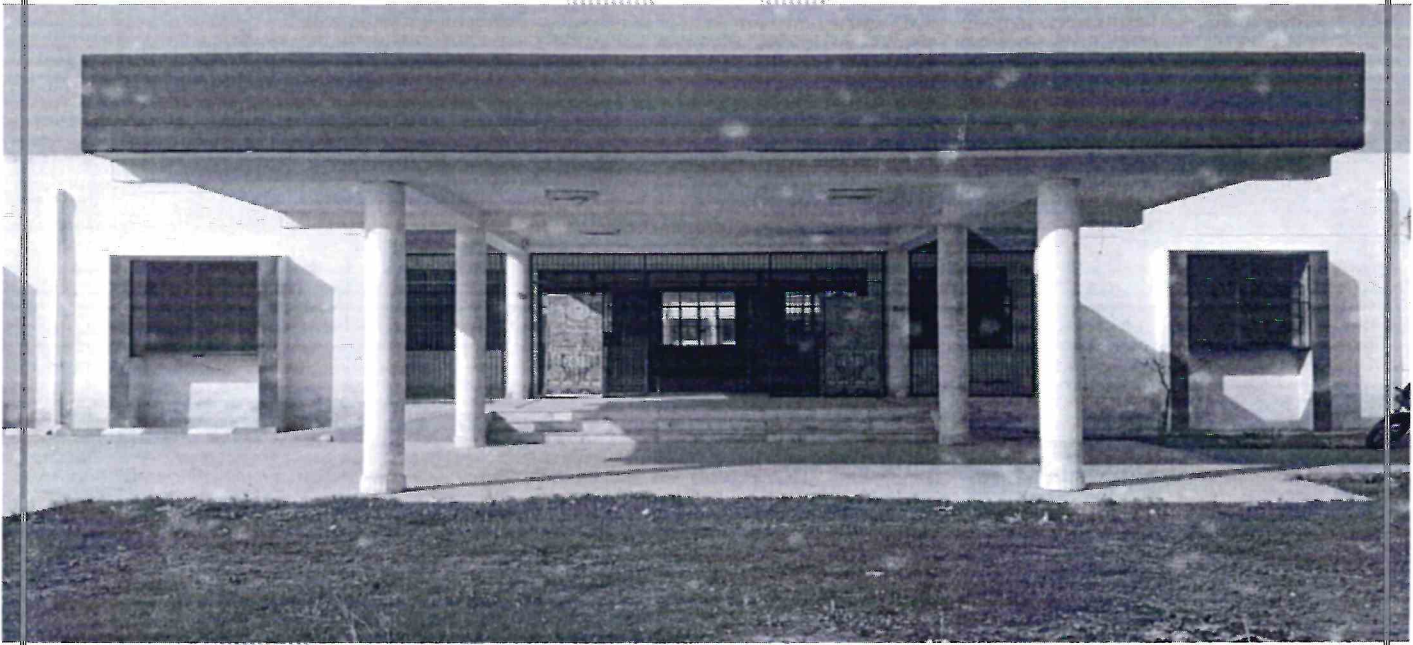
A State University established under Uttar Pradesh State University Act 1973



## Curriculum in Accordance with National Education Policy- 2020

Programme Name: B.Sc

Subject: Zoology



**Department of Zoology**  
**Jananayak Chandrashekhar University, Ballia**

*Shaheed smark, Near Surha Taal, Basantpur, Ballia- 277301, Uttar Pradesh, India*

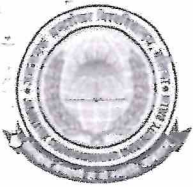
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*(Prof. Dinesh K. Sin)*



# Jananayak Chandrashekhar University, Ballia



Programme: B.Sc.  
Subject: Zoology

## Syllabus

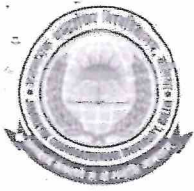
Semester	First	Year : One
Course Code	B050101T	
Course Title	Cytology, Genetics and Infectious Diseases	
Credit	4	Maximum Marks : 25 +50
<b>Course Objective:</b> 1. To learn about cells, its organelles, and functions. 2. To learn about the basic principles of genetics. 3. To know the common infectious diseases and their preventions.		
<b>Learning Outcomes:</b> After successful completion of the syllabus, learners will be able to: 1. Understand the structure and function of all the cell organelles. 2. Know about the chromatin structure and its location. 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. How one cell communicates with its neighboring cells? 5. Understand the basic principles of genetics and how genes (earlier called factors) are inherited from one generation to another. 6. Understand the Mendel's laws and the deviations from conventional patterns of inheritance. 7. Comprehend how environment plays an important role by interacting with genetic factors. 8. How to detect chromosomal aberrations in humans and study the pattern of inheritance by pedigree analysis in families		
<b>Unit</b>	<b>Course Content</b>	
I	<b>Structure and Function of Cell Organelles</b> <ul style="list-style-type: none"><li>• Structure of Cell,</li><li>• Ultrastructure and function of plasma membrane</li><li>• Cellular Junctions.</li><li>• Mitochondria, Ribosome,</li><li>• Endoplasmic Reticulum, Golgi Complex, Peroxisome, and Lysosome.</li></ul>	
II	<b>Structure of Nucleus, and Cell Division</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</li><li>• Cell division: mitosis and meiosis</li><li>• Cell cycle and its regulation</li></ul>	
III	<b>Genetics and Pattern of Inheritance</b> <ul style="list-style-type: none"><li>• Mendel's laws of Inheritance, monohybrid and dihybrid crosses, back cross test cross. Multiple alleles</li><li>• Complete and Incomplete Dominance,</li><li>• Penetrance and expressivity</li><li>• Sex-Determining Systems: Sex Determination in <i>Drosophila</i>, Environmental sex determination and sex determination in human, Dosage compensation</li><li>• Cytoplasmic Inheritance, Human Karyotype, Chromosomal aberrations</li></ul>	
IV	<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 and pathogenicity of <i>Trypanosoma</i>, <i>Giardia</i> and <i>Wuchereria</i></li></ul>	
<b>References:</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. 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 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)		

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# Jananayak Chandrashekhar University, Ballia



Programme: B.Sc.

Subject: Zoology

## Syllabus

Semester	First	Year : One
Course Code	B050102P	
Course Title	Cell Biology and Cytogenetics lab	
Credit	2	Maximum Marks: 25
<b>Course Objective:</b>		
<ol style="list-style-type: none"> <li>1. To learn about cells, its organelles, and functions.</li> <li>2. To learn about the basic principles of genetics.</li> <li>3. To know the common infectious diseases and their preventions.</li> </ol>		
<b>Learning Outcomes: Learning Outcomes:</b> After successful completion of the syllabus, learners will be able to:		
<ol style="list-style-type: none"> <li>1. Use simple and compound microscopes.</li> <li>2. Prepare slides and stain them to see the cell organelles.</li> <li>3. 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. Know about chromosomal aberrations, by preparing karyotypes.</li> <li>5. Understand How chromosomal aberrations are inherited in humans by pedigree analysis in families.</li> </ol>		
Unit	Course Content	
I	<ol style="list-style-type: none"> <li>1. To study different cell types such as buccal epithelial cells, neurons, striated muscle cells using Methylene blue.</li> <li>2. To study the different stages of Mitosis in root tip of onion.</li> <li>3. To prepare molecular models of nucleotides, amino acids, dipeptides using bead and stick method.</li> <li>4. To check the permeability of cells using salt solution of different concentrations.</li> </ol>	
II	<ol style="list-style-type: none"> <li>1. Study of parasites (eg. Protozoans, helminths etc.) from permanent slides.</li> <li>2. To learn the procedures for preparation of temporary and permanent stained/unstained slides.</li> </ol>	
III	<ol style="list-style-type: none"> <li>1. Study of mutant phenotypes of <i>Drosophila</i>.</li> <li>2. Preparation of polytene chromosomes.</li> <li>3. Study of sex chromatin (Barr bodies) in buccal smear and hair bud cells (Human).</li> <li>4. To study the human karyotype and the chromosomal aberrations with respect to number, translocation, deletion etc. from the pictures provided.</li> </ol>	
IV	<b>Virtual Labs (Suggestive sites)</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://vlab.amrita.edu">https://vlab.amrita.edu</a></li> </ol>	
<b>References:</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). Pierce B. Genetics. Freeman (2004).</li> <li>5. Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, Janis KubyKuby Immunology. W H Freeman (2007).</li> <li>6. Kesar, Saroj and Vashishta N. (2007). Experimental Physiology: Comprehensive Manual. Heritage Publishers, New Delhi</li> </ol>		

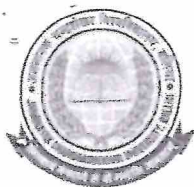
Semester	Second	Year : One
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# Jananayak Chandrashekhar University, Ballia



Programme: B.Sc.  
Subject: Zoology

## Syllabus

Course Code	B050201T	
Course Title	Biochemistry and Physiology	
Credit	4	Maximum Marks: 25 + 50
<b>Course Objective:</b>	<ol style="list-style-type: none"><li>To develop understanding of structure of biomolecules like proteins, lipids and carbohydrates</li><li>To understand the Mechanisms of energy production at cellular and molecular levels.</li><li>To understand systems biology and various functional components of an organism.</li></ol>	
<b>Learning Outcomes:</b>	After successful completion of the syllabus, learners will be able to: <ol style="list-style-type: none"><li>Students will develop understanding of structure of biomolecules like proteins, lipids and carbohydrates How simple molecules together form complex macromolecules.</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></ol>	
<b>Unit</b>	<b>Course Content</b>	
I	<b>Structure and Function of Biomolecules and Enzymes</b> <ul style="list-style-type: none"><li>Structure and Function of Biomolecules: carbohydrates, Protein and Lipids</li><li>Introduction to Enzymes; Specificity of enzyme action</li><li>Mechanism of enzyme action</li><li>Factors affecting rate of enzyme-catalysed reactions</li><li>Enzyme inhibition</li></ul>	
II	<b>Metabolism of carbohydrate, lipids and proteins</b> <ul style="list-style-type: none"><li>Metabolism of Carbohydrates: glycolysis, citric acid cycle, oxidative phosphorylation</li><li>Metabolism of Lipids: <math>\beta</math>-oxidation of fatty acids</li><li>Metabolism of amino acids: Transamination, Deamination, Urea cycle</li></ul>	
III	<b>Physiology of Digestion, Respiration, Circulation and Excretion</b> <ul style="list-style-type: none"><li>Structural organization and functions of gastrointestinal tract and associated glands,</li><li>Physiology of digestion. Absorptions of carbohydrates, lipids &amp; proteins.</li><li>Structure of lungs, Respiratory volumes, and capacities; Transport of oxygen and carbon, Mechanism of respiration,</li><li>Dissociation curves and the factors influencing it</li><li>Components of blood, blood clotting and their functions, Blood groups: Rh factor, ABO and MN</li><li>Structure of heart</li><li>Cardiac cycle; Cardiac output and its regulation,</li><li>Structure of kidney and its functional unit; Mechanism of urine formation</li></ul>	
IV	<b>Physiology of Muscular System. Nervous System and Endocrinology</b> <ul style="list-style-type: none"><li>Types of muscles; Ultra structure of skeletal muscle;</li><li>Molecular and chemical basis of muscle contraction</li><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>Endocrine glands - pineal, pituitary, thyroid, pancreas, adrenal; hormones secreted by them</li><li>Mechanism of Hormone action</li></ul>	
<b>References:</b>	<ol style="list-style-type: none"><li>Nelson &amp; Cox: Lehninger's Principles of Biochemistry: McMillan (2000)</li><li>Zubay et al: Principles of Biochemistry: WCB (1995)</li><li>Voet &amp; Voet: Biochemistry Vols 1 &amp; 2: Wiley (2004)</li><li>Murray et al: Harper's Illustrated Biochemistry: McGraw Hill (2003) Elliott and Elliott:</li><li>Guyton, A.C. &amp; Hall, J.E. Textbook of Medical Physiology. XI Edition. Harcourt 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></ol>	

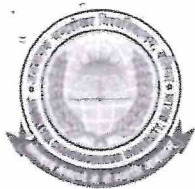
Semester	Second	Year : One
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## Syllabus

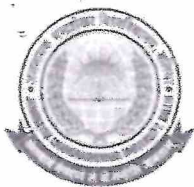
Course code	B050202P	
Course Title	Physiological, Biochemical & Hematology Lab	
Credit	2	Maximum Marks : 25
<b>Course Objective:</b> <ol style="list-style-type: none"><li>1. To Understand the structure of biomolecules like proteins, lipids and carbohydrates</li><li>2. To know how to perform basic haematological laboratory test</li><li>3. To Know normal and abnormal haematological laboratory findings to predict the diagnosis of haematological disorders and diseases</li></ol>		
<b>Course outcomes:</b> The student at the completion of the course will be able to: <ol style="list-style-type: none"><li>1. Understand the structure of biomolecules like proteins, lipids and carbohydrates</li><li>2. Perform basic haematological laboratory testing,</li><li>3. Distinguish normal and abnormal haematological laboratory findings to predict the diagnosis of haematological disorders and diseases</li></ol>		
<b>Unit</b>	<b>Course Content</b>	
I	<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. Counting of RBCs and WBCs using Haemocytometer</li><li>4. To study different mammalian blood cell types using Leishman stain.</li><li>5. Recording of blood pressure using a sphygmomanometer</li><li>6. Recording of blood glucose level by using glucometer</li></ol>	
II	Study of permanent slides of Mammalian skin, Cartilage, Bone, Spinal cord, Nerve cell, Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid	
III	<ol style="list-style-type: none"><li>1. Ninhydrin test for 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. Action of salivary amylase under optimum conditions.</li></ol>	
IV	<b>Virtual Labs (Suggestive sites)</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://vlab.amrita.edu">https://vlab.amrita.edu</a></li></ol>	
<b>References:</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>		

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# Jananayak Chandrashekhar University, Ballia



Programme: B.Sc.

Subject: Zoology

## Syllabus

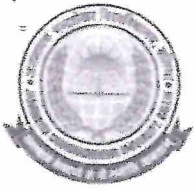
Semester	Third	Year: Two
Course Title	B050301T	
Course Title	Molecular Biology, Bioinstrumentation & Biotechniques	
Credit	4	Maximum Marks : 25 +50
<b>Course Objective:</b> To developed a conceptual understanding of molecular processes		
<ol style="list-style-type: none"><li>1. To understand how genes are expressed as proteins which are responsible for the structure and function of all organisms.</li><li>2. To Learn how four sequences (3 letter codons) generate the transcripts of life and determine the phenotypes of organisms.</li><li>3. To know genes are regulated differently at different time and place in prokaryotes and eukaryotes.</li><li>4. To familiarized with tool and techniques used in biological science</li></ol>		
<b>Learning Outcomes:</b> After successful completion of the syllabus, learners will be able to:		
<ol style="list-style-type: none"><li>1. A detailed and conceptual understanding of molecular processes viz. DNA to trait.</li><li>2. A clear understanding of the processes of central dogma viz. transcription, translation etc. underlying survival and propagation of life at molecular level.</li><li>3. Understanding of how genes are ultimately expressed as proteins which are responsible for the</li><li>4. structure and function of all organisms.</li><li>5. Learn how four sequences (3 letter codons) generate the transcripts of life and determine the phenotypes of organisms.</li><li>6. How genes are regulated differently at different time and place in prokaryotes and eukaryotes.</li><li>7. Familiarized with tool and techniques used in biological science</li></ol>		
Unit	Course Content	
I	<b>Process of Transcription and translation</b> <ul style="list-style-type: none"><li>• Structure of gene</li><li>• RNA polymerases</li><li>• Transcription factors and machinery</li><li>• Initiation, elongation and termination of transcription in prokaryotes and eukaryotes</li><li>• The Genetic code Aminoacylation of tRNA.</li><li>• Initiation, elongation, and termination of translation in prokaryotes and eukaryotes</li></ul>	
II	<b>Regulation of gene expression</b> <ul style="list-style-type: none"><li>• Regulation of gene expression in prokaryotes: lac and trp operons in <i>E. coli</i></li><li>• Post-transcriptional modifications: Capping, Splicing, Polyadenylation</li><li>• Regulation at translational level, protein folding,</li><li>• Gene silencing, RNA interference (RNAi)</li></ul>	
III	<b>Principles and types of Microscopy, Centrifugation and Chromatography</b> <ul style="list-style-type: none"><li>• Principle of Microscopy and Applications</li><li>• Types of Microscopes: light microscopy, dark field microscopy,</li><li>• Electron microscopy</li><li>• Principle of Centrifugation</li><li>• Types of Centrifuges: high speed and ultracentrifuge</li><li>• Principle and Types of Chromatography: paper, affinity &amp; gel filtration</li></ul>	
IV	<b>Spectrophotometry, Biochemical and Molecular Techniques</b> <ul style="list-style-type: none"><li>• pH Meter</li><li>• Principle of Colorimetry/Spectrophotometry: Beer-Lambert Law</li><li>• Detection of nucleic acid by gel electrophoresis (Agarose gel electrophoresis)</li><li>• DNA sequencing (Sanger Method), RFLP, DNA fingerprinting,</li><li>• Polymerase Chain Reaction (PCR), Enzyme Linked Immunosorbent Assay (ELISA)</li></ul>	
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# Jananayak Chandrashekhar University, Ballia



Programme: B.Sc.  
Subject: Zoology

## Syllabus

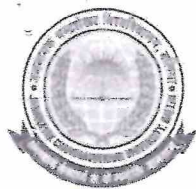
1. Lodish et al: Molecular Cell Biology: Freeman & Co, USA (2004).
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3. Cooper: Cell: A Molecular Approach: ASM Press (2000).
4. Karp: Cell and Molecular Biology: Wiley (2002).
5. Watson et al. Molecular Biology of the Gene. Pearson (2004).
6. Lewin. Genes VIII. Pearson (2004).
7. Pierce B. Genetics. Freeman (2004).
8. Sambrook et al. Molecular Cloning Vols I, II, III. CSHL (2001).
9. Primrose. Molecular Biotechnology. Panima (2001).
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# Jananayak Chandrashekhar University, Ballia



Programme: B.Sc.

Subject: Zoology

## Syllabus

<b>Semester</b>	Third	Year: Two
<b>Course Code</b>	B050302P	
<b>Course Title</b>	Bioinstrumentation & Molecular Biology Lab	
<b>Credit</b>	2	Maximum Marks: 25
<b>Course Objective:</b> <ol style="list-style-type: none"><li>1. To understand the basic principles of microscopy and working of different types of microscopes</li><li>2. To understand the basic techniques of centrifugation and chromatography.</li><li>3. To learn about advance DNA testing methods</li><li>4. To understand the principle of colorimeter and spectrophotometer and its use</li></ol>		
<b>Learning Outcomes:</b> After successful completion of the syllabus, learners will be able to: <ol style="list-style-type: none"><li>1. Understand the basic principles of microscopy, working of different types of microscopes</li><li>2. Understand the basic techniques of centrifugation and chromatography for studying cells and separation of biomolecules</li><li>3. understand the principle of colorimeter and spectrophotometer and its use.</li><li>4. Learn about the commonly used advance DNA testing methods.</li></ol>		
<b>Unit</b>	<b>Course Content</b>	
I	<ol style="list-style-type: none"><li>1. To study the working principle and Simple, Compound and Binocular microscopes.</li><li>2. To study the working principle of various lab equipment's such as pH Meter, Electronic balance, use of glass and micropipettes, Laminar flow, Incubator, Water bath, Centrifuge, Chromatography apparatus, etc</li></ol>	
II	<ol style="list-style-type: none"><li>1. To prepare solutions and buffers.</li><li>2. To measure absorbance in Colorimeter or Spectrophotometer</li><li>3. Demonstration of differential centrifugation to fractionate different components in a mixture</li></ol>	
III	<ol style="list-style-type: none"><li>1. To prepare dilutions of Riboflavin and verify the principle of spectrophotometry.</li><li>2. To identify different amino acids in a mixture using paper chromatography.</li><li>3. Demonstration of DNA extraction from blood or tissue samples.</li><li>4. To estimate amount of DNA using spectrophotometer.</li></ol>	
IV	<b>Virtual Labs (Suggestive sites)</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://vlab.amrita.edu">https://vlab.amrita.edu</a></li></ol>	
<b>References:</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 et al. 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>		

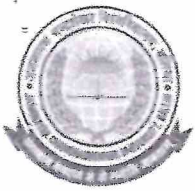
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# Jananayak Chandrashekhar University, Ballia



Programme: B.Sc.  
Subject: Zoology

## Syllabus

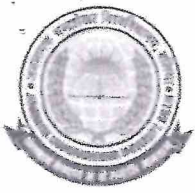
Semester	Fourth	Year: Two
Course Code	B050401T	
Course Title	Gene Technology, Immunology and Computational Biology	
Credit	4	Maximum Marks : 25 +50
<b>Course Objective:</b> <ol style="list-style-type: none"><li>1. To understand the principles of genetic engineering, how genes can be cloned.</li><li>2. To know the applications of biotechnology in various fields like agriculture, industry and human health.</li><li>3. To have an in depth understanding about Immune System &amp; its mechanisms.</li><li>4. To know DNA testing and utility of genetic engineering in forensic sciences.</li><li>5. To get familiar with use of computer and use of bioinformatics tools.</li></ol>		
<b>Learning Outcomes:</b> After successful completion of the syllabus, learners will be able to: <ol style="list-style-type: none"><li>1. Understand about the genetic engineering, to understand various technologies involved in it.</li><li>2. Know the applications of biotechnology in various fields like agriculture, industry, and human health.</li><li>3. To have an in depth understanding about Immune System &amp; its mechanisms.</li><li>4. Get introduced to DNA testing and utility of genetic engineering in forensic sciences.</li><li>5. Get introduced to computers and use of bioinformatics tools.</li></ol>		
Unit	Course Content	
I	<b>Principles of Gene Manipulation and its application</b> <ul style="list-style-type: none"><li>• Recombinant DNA Technology</li><li>• Restriction Enzymes, DNA modifying enzymes, Cloning Vectors, Ligation</li><li>• Gene transfer techniques, Gene therapy</li><li>• development of transgenics animals</li><li>• Development of DNA drugs and vaccines</li></ul>	
II	<b>DNA Diagnostics techniques and Immunology</b> <ul style="list-style-type: none"><li>• Genetic analysis of human diseases,</li><li>• detection of known and unknown mutations</li><li>• Immune System and its Components</li><li>• Historical perspective of Immunology, Innate and Adaptive Immunity,</li><li>• Structure and functions of different classes of immunoglobulins,</li><li>• Humoral immunity and cell mediated immunity</li></ul>	
III	<b>Biostatistics</b> <ul style="list-style-type: none"><li>• Calculations of mean, median, mode, variance, standard Deviation</li><li>• Data summarizing: frequency distribution, graphical presentation—bar, pie diagram, histogram</li></ul>	
IV	<b>Basics of Computers and Bioinformatics</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><li>• Databases: nucleic acids, genomes, and protein sequences</li><li>• Sequence analysis (homology): pairwise and multiple sequence alignments-BLAST</li></ul>	
<b>References:</b> <ol style="list-style-type: none"><li>1. Primrose &amp; Twyman. Principles of Genome Analysis and Genomics. Blackwell (2003).</li><li>2. Sambrook <i>et al.</i> Molecular Cloning Vols I, II, III. CSHL (2001).</li><li>3. Primrose. Molecular Biotechnology. Panima (2001).</li><li>4. Wilson. Clinical Genetics-A Short Course, Wiley (2000).</li><li>5. Pasternak. An Introduction to Molecular Human Genetics. Fitzgerald (2000).</li><li>6. Biostatistical Analysis (Fourth Edition) by Jerrold H. Zarr, Pearson Education Inc., Delhi.</li><li>7. Westhead <i>et al</i> Bioinformatics: Instant Notes. Viva Books (2003).</li></ol>		

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# Jananayak Chandrashekhar University, Ballia



Programme: B.Sc.

Subject: Zoology

## Syllabus

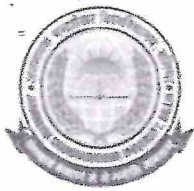
<b>Semester</b>	Fourth	Year: Two
<b>Course Code</b>	B050402P	
<b>Course Title</b>	Genetic Engineering and Counselling Lab	
<b>Credit</b>	2	Maximum Marks : 25
<b>Course Objective:</b> <ol style="list-style-type: none"><li>1. To understand the principles of genetic engineering.</li><li>2. To introduced DNA testing and utility of genetic engineering</li><li>3. To apply the knowledge and awareness of the basic principles and concepts of biology, computer science and existing software effectively to extract information from large databases and to use this information in computer modeling.</li></ol>		
<b>Learning Outcomes:</b> After successful completion of the syllabus, learners will be able to: <ol style="list-style-type: none"><li>1. Understand the principles of genetic engineering with hands-on experiments in mutation detection, testing of infectious diseases like Covid 19.</li><li>2. Get introduced to DNA testing and utility of genetic engineering in forensic sciences.</li><li>3. Apply knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics</li><li>4. Existing software effectively to extract information from large databases and to use this information in computer modelling.</li></ol>		
<b>Unit</b>	<b>Course Content</b>	
I	<ol style="list-style-type: none"><li>1. Measure the pre and post clitellar lengths of earthworms and calculate mean, median, mode, standard deviation etc.</li><li>2. Measure the height and weight of all students in the class and apply statistical measures.</li></ol>	
II	<ol style="list-style-type: none"><li>1. Determination of ABO Blood group</li><li>2. To perform bacterial culture and calculate generation time of bacteria.</li><li>3. To study Restriction enzyme digestion using teaching kits.</li><li>4. To detect genetic mutations by Polymerase Chain Reaction (PCR) using teaching kits.</li><li>5. Demonstration of agarose gel electrophoresis for detection of DNA.</li></ol>	
III	<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 how to perform Primer designing for PCR</li></ol>	
IV	<b>Virtual Labs (Suggestive sites)</b> <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/6IcHAYPTAEw">https://youtu.be/6IcHAYPTAEw</a></li><li>5. DNA curve- <a href="https://youtu.be/ubL8QxTeuG4">https://youtu.be/ubL8QxTeuG4</a></li></ol>	
<b>References:</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 et al. Molecular Cloning Vols I, II, III. CSHL (2001).</li><li>4. Primrose. Molecular Biotechnology. Panima (2001).</li></ol>		

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# Jananayak Chandrashekhar University, Ballia



Programme: B.Sc.  
Subject: Zoology

## Syllabus

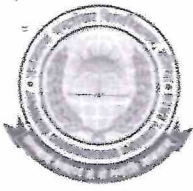
<b>Semester</b>	<b>Fifth</b>	<b>Year: Three</b>
<b>Course Code</b>	<b>B050501T</b>	
<b>Course Title</b>	<b>Diversity of Non-Chordates and Economic Zoology</b>	
<b>Credit</b>	4	Maximum Marks : 25 +50
<b>Course Objective:</b> <ol style="list-style-type: none"><li>To identify non-chordate diversity</li><li>To develop understanding about structural and functional diversity of non-chordates</li><li>To know about the economic importance of animals</li></ol>		
<b>Learning Outcomes:</b> After successful completion of the syllabus, learners will be able to: <ol 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>Learn about the Pisciculture, Sericulture, Apiculture</li></ol>		
<b>Unit</b>	<b>Course Content</b>	
I	<b>Protozoa to Nematoda</b> <ul style="list-style-type: none"><li>Protozoa – Paramecium (Morphology and Reproduction)</li><li>Porifera – Sycon (Canal System)</li><li>Coelenterata – Obelia (Morphology and Reproduction)</li><li>Ctenophora - Salient features</li><li>Platyhelminthes – Taenia (Tape worm) (Morphology and Reproduction)</li><li>Nematoda –Ascaris lumbricoides (Morphology and Reproduction)</li></ul>	
II	<b>Annelida To Arthropoda</b> <ul style="list-style-type: none"><li>Annelida –Hirudinaria (Leech) (Morphology and Reproduction)</li><li>Arthropoda – Palaemon (Prawn) (Morphology, Appendages, and Reproduction)</li></ul>	
III	<b>Mollusca, Hemichordata</b> <ul style="list-style-type: none"><li>Mollusca – Pila (Morphology and Reproduction)</li><li>Echinodermata –Pentaceros (Morphology and Water Vascular System)</li></ul>	
IV	<b>Economic Zoology</b> <ul style="list-style-type: none"><li>Life cycle and control of Gundhi bug, Sugarcane leafhopper</li><li>Pisciculture, Sericulture, Apiculture</li></ul>	
<b>References:</b> <ol style="list-style-type: none"><li>Barnes et al (2009). The Invertebrates: A synthesis. Wiley Backwell 17</li><li>Moore: An Introduction to the Invertebrates (2001, Cambridge University Press)</li><li>Brusca and Brusca (2016) Invertebrates. Sinauer</li><li>Jan Pechenik (2014) Biology of the invertebrates. McGraw Hill</li><li>Parasitology- Chatterjee</li><li>Parasitology- Chakraborty</li><li>Thomos C. Chung. General Parasitology. Hardcourt Brace and Co. Ltd. Asia, New Delhi.</li><li>Bisht. D.S., Apiculture, ICAR Publication.</li><li>Singh S., Beekeeping in India, Indian council of Agricultural Research, New Delhi.</li><li>Jhingran. V.G. Fish and fisheries in India.,</li><li>Khanna. S.S, An introduction to fishes</li><li>Boyd. C.E. &amp; Tucker. C.S, Pond aquaculture water quality management,</li><li>Stevenson, Biology of Earthworms</li><li>C. L. Metcalf, Destructive and Useful Insects by</li><li>Hanumappa, Sericulture for Rural Development : (1978), Himalaya Publication,</li><li>Sarkar, D.C, Sericulture in India. (1988), CSB, Bangalore.</li></ol>		

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# Jananayak Chandrashekhar University, Ballia



Programme: B.Sc.

Subject: Zoology

## Syllabus

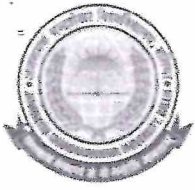
Semester	Fifth	Year: Three
Course Code	B050502T	
Course Title	Diversity of Chordates and Comparative Anatomy	
Credit	4	Maximum Marks : 25 +50
<b>Course Objective:</b> <ol style="list-style-type: none"><li>To develop ability to demonstrate comprehensive identification abilities of chordate diversity</li><li>To explain structural and functional diversity of chordates</li><li>To explain evolutionary relationship amongst chordates</li></ol>		
<b>Learning Outcomes:</b> After successful completion of the syllabus, learners will be able to: <ol 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></ol>		
Unit	Course Content	
I	<b>Chordata : Urochordata and Cephalochordata</b> <ul style="list-style-type: none"><li>Fundamental characters and classification of phylum Chordata (upto classes)</li><li>Urochordata: General characteristics, classification of Urochordata, study of Herdmania (Habit and Habitat, Morphology, and Development )</li><li>Cephalochordata: General characteristics, classification of Cephalochordata, study of Branchiostoma (Amphioxus) (Habit and Habitat, Morphology and Development)</li></ul>	
II	<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></ul>	
III	<b>Comparative study of Skeletal System and Respiratory System</b> <ul style="list-style-type: none"><li>Overview of axial and appendicular skeleton, Jaw suspensorium</li><li>Visceral arches Skin, gills, lungs and air sacs; Accessory respiratory organs</li></ul>	
IV	<b>Comparative Anatomy of Circulatory and Urinogenital System</b> <ul style="list-style-type: none"><li>General plan of circulation, evolution of heart and aortic arches</li><li>Succession of kidney, Evolution of urinogenital ducts</li></ul>	
<b>References:</b> <ol style="list-style-type: none"><li>Harvey et al: The Vertebrate Life (2006)</li><li>Colbert et al: Colbert's Evolution of the Vertebrates: A history of the backboned animals through time (5th ed 2002, Wiley - Liss)</li><li>Hildebrand: Analysis of Vertebrate Structure (4th ed 1995, John Wiley)</li><li>Kenneth V. Kardong (2015) Vertebrates: Comparative Anatomy, Function, Evolution McGraw Hill</li><li>McFarland et al: Vertebrate Life(1979, Macmillan Publishing)</li><li>Parker and Haswell: TextBook of Zoology, Vol. II (1978, ELBS)</li><li>Romer and Parsons: The Vertebrate Body (6th ed 1986, CBS Publishing Japan)</li><li>Young: The Life of vertebrates (3rd ed 2006, ELBS/Oxford)</li><li>Weichert C.K and William Presch (1970). Elements of Chordate Anatomy, Tata McGraw Hills</li></ol>		

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# Jananayak Chandrashekhar University, Ballia



Programme: B.Sc.  
Subject: Zoology

## Syllabus

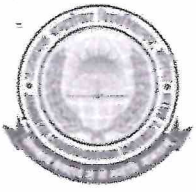
Semester	Fifth	Year: Three
Course Code	B050503P	
Course Title	Lab on Virtual Dissection, Anatomy, Economic Zoology and Parasitology	
Credit	2	Maximum Marks: 50
<b>Course Objective:</b> <ol style="list-style-type: none"><li>To demonstrate comprehensive identification abilities of chordate and non- chordates diversity</li><li>To explain structural and functional diversity of chordates and non- chordates</li><li>To explain evolutionary relationship amongst chordates and non- chordates</li></ol>		
<b>Learning Outcomes: Learning Outcomes:</b> After successful completion of the syllabus, learners will be able to: <ol style="list-style-type: none"><li>The student at the completion of the course will be able to:</li><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></ol>		
<b>Syllabus</b>		
<b>Unit</b>	<b>Course Content</b>	
I	Study of animal specimens of various animal phyla. <ol style="list-style-type: none"><li>To prepare permanent stained slide of septal nephridia of earthworm.</li><li>To take out the nerve ring of earthworm.</li><li>To take out hastate plate from <i>Palaeomon</i>.</li></ol>	
II	<ol style="list-style-type: none"><li>Study of animal specimens of various animal phyla</li><li>To prepare stained/unstained slide of placoid scales.</li><li>Comparative study of bones of different vertebrates.</li></ol>	
III	<ol style="list-style-type: none"><li>Permanent Preparation of: <i>Euglena, Paramecium</i></li><li>Study of prepared slides/specimens of <i>Entamoeba, Giardia, Leishmania, Trypanosoma, Taenia, Schistosoma, Ascaris and Ancylostoma</i></li><li>Larval stages of helminths and arthropods.</li><li>Permanent mount of wings, mouth parts and developmental stages of mosquito and house fly.</li><li>Life history of silkworm, honey bee.</li><li>Different types of important edible fishes of India</li><li>Study of an aquatic ecosystem, its biotic components and food chain.</li><li><b>Dissections:</b> through multimedia / models</li><li><b>Cockroach:</b> Central nervous system</li><li><b>16. Wallago:</b> Afferent and efferent branchial</li></ol>	
IV	<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="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="https://vlab.amrita.edu">https://vlab.amrita.edu</a>	
<b>References:</b> <ol style="list-style-type: none"><li>Colbert et al: Colbert's Evolution of the Vertebrates: A history of the backbone animals through time (5th ed 2002, Wiley - Liss)</li><li>Kenneth V. Kardong (2015) Vertebrates: Comparative Anatomy, Function, Evolution McGraw Hill</li><li>Romer and Parsons: The Vertebrate Body (6th ed 1986, CBS Publishing Japan)</li><li>Young: The Life of vertebrates (3rd ed 2006, ELBS/Oxford)</li><li>Barnes et al (2009). The Invertebrates: A synthesis. Wiley Backwell 17</li><li>Brusca and Brusca (2016) Invertebrates. Sinauer</li><li>Jan Pechenik (2014) Biology of the invertebrates. McGraw Hill</li><li>Robert Leo Smith Ecology and field biology Harper and Row publisher</li><li>Handbook of Practical Sericulture :Ullal, S.R. and Narasimhanna, M.N. (1987), Central Silk Board Publication, Bangalore.</li><li>Bisht. D.S., <i>Apiculture</i>, ICAR Publication.</li><li>Singh S., <i>Beekeeping in India</i>, Indian council of Agricultural Research, New Delhi.</li></ol>		

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# Jananayak Chandrashekhar University, Ballia



Programme: B.Sc.  
Subject: Zoology

## Syllabus

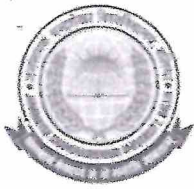
12. Ullal S.R. and Narasimhanna, M.N. Handbook of Practical Sericulture: CSB, Bangalore
13. Jolly. M. S. Appropriate Sericultural Techniques; Ed., Director, CSR & TI, Mysore.
14. Handbook of Silkworm Rearing: Agriculture and Technical Manual-1, Fuzi Pub. Co.
15. Boyd. C.E. & Tucker. C.S, Pond aquaculture water quality management
16. Pedigo, L.P. (2002). *Entomology and Pest Management*, Prentice Hall
17. S.S. Lal Practical Zoology- Volume 1
18. S.S. Lal Practical Zoology- Volume 2
19. S.S. Lal Practical Zoology- Volume 3

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# Jananayak Chandrashekhar University, Ballia



Programme: B.Sc.  
Subject: Zoology

## Syllabus

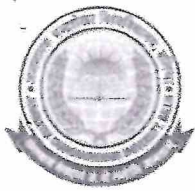
Semester	Sixth	Year: Three
Course Code	B050601T	
Course Title	Evolutionary and Developmental Biology	
Credit	4	Maximum Marks: 25 +50
<b>Course Objective:</b> <ol style="list-style-type: none"><li>To understand biological evolution</li><li>To learn about natural selection.</li><li>To understand embryonic development.</li></ol>		
<b>Learning Outcomes:</b> After successful completion of the syllabus, learners will be able to: <ol 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>Understand a variety of interacting processes, which generate an organism's heterogeneous shapes, size, and structural features.</li></ol>		
<b>Unit</b>	<b>Course Content</b>	
I	<b>Theories of Evolution</b> <ul style="list-style-type: none"><li>Origin of Life</li><li>Darwinism (Natural, Sexual and Artificial selection)</li><li>Modern synthetic theory of evolution</li></ul>	
II	<b>Direct Evidences of evolution and Species concept</b> <ul style="list-style-type: none"><li>Types of fossils, Incompleteness of fossil record,</li><li>Dating of fossils</li><li>Biological species concept (Advantages and Limitations); Modes of speciation (Allopatric, Sympatric)</li></ul>	
III	<b>Gamete Fertilization, Early Development and Developmental Genes</b> <ul style="list-style-type: none"><li>Gametogenesis, Fertilization</li><li>Cleavage pattern</li><li>Gastrulation</li><li>Differential gene expression</li></ul>	
IV	<b>Early and Late Vertebrate Development Processes</b> <ul style="list-style-type: none"><li>Early development of Birds</li><li>Development of brain (Frog)</li><li>Metamorphosis: the hormonal reactivation of</li><li>Development in amphibians, insects</li></ul>	
<b>References:</b> <ol style="list-style-type: none"><li>Ridley, M. (2004). <i>Evolution</i>. III Edition. Blackwell Publishing</li><li>Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). <i>Evolution</i>. Cold Spring, Harbour Laboratory Press.</li><li>Hall, B. K. and Hallgrímsson, B. (2008). <i>Evolution</i>. IV Edition. Jones and Bartlett Publishers</li><li>Douglas, J. Futuyma (1997). <i>Evolutionary Biology</i>. Sinauer Associates.</li><li>Essential Developmental Biology: Jonathan M. W. Slack, (3rd ed.), Wiley-Blackwell. (2012).</li><li>Current Topics in Developmental Biology: Roger A. Pedersen, Gerald P. Schatten, Elsevier. (1998).</li><li>Developmental biology: Werner A. Müller, Springer Science &amp; Business Media. (2012).</li><li>Developmental Biology: Michael J. F. Barresi, Scott F. Gilbert, Oxford University Press. (2019).</li></ol>		

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# Jananayak Chandrashekhar University, Ballia



Programme: B.Sc.  
Subject: Zoology

## Syllabus

Semester	Sixth	Year: Three
Course Code	B050602T	
Course Title	Ecology, Ethology, Environmental Science and Wildlife	
Credit	4	Maximum Marks: 25 +50
<b>Course Objective:</b> <ol style="list-style-type: none"><li>1. To understand the complexities and interconnectedness of various environmental levels and their functioning.</li><li>2. To understand the global environmental issues, their causes, consequences, and amelioration.</li><li>3. To understand and identify behaviours in a variety of taxa.</li><li>4. To learn about proximate and ultimate causes of various behaviours.</li><li>5. To conceptualize how species profitably inhabit in the temporal environment and space out their activities at different times of the day and seasons.</li><li>6. To understand the importance of wildlife conservation.</li></ol>		
<b>Learning Outcomes:</b> After successful completion of the syllabus, learners will be able to: <ol style="list-style-type: none"><li>1. Complexities and interconnectedness of various environmental levels and their functioning.</li><li>2. Global environmental issues, their causes, consequences and amelioration.</li><li>3. To understand and identify behaviours in a variety of taxa.</li><li>4. The proximate and ultimate causes of various behaviours.</li><li>5. Conceptualizing how species profitably inhabit in the temporal environment and space out their activities at different times of the day and seasons.</li><li>6. To understand the importance of wildlife conservation.</li></ol>		
<b>Unit</b>	<b>Course Content</b>	
I	<b>Ecology and Ecosystem</b> <ul style="list-style-type: none"><li>• Levels of organization, Laws of limiting factors</li><li>• Study of physical factors,</li><li>• Population: Density, natality, mortality, life tables, fecundity tables, survivorship curves, age ratio, sex ratio, dispersal, and dispersion</li><li>• Exponential and logistic growth,</li><li>• Types of ecosystems with one example in detail,</li><li>• Food chain: Detritus and grazing food chains,</li><li>• Food web, Energy flow through the ecosystem,</li><li>• Ecological pyramid and biogeochemical cycle with one example of nitrogen</li></ul>	
II	<b>Community Ecology and Environmental Hazards</b> Community characteristics: species richness, dominance, Diversity Ecological succession hydrosere Climate changes Greenhouse gases and global warming Acid rain, Ozone layer destruction, Bhopal gas tragedy, Chernobyl disaster	
III	<b>Behavioural Ecology and Chronobiology</b> Instinct vs. Learnt Behaviour Associative learning, classical and operant conditioning, Habituation, Imprinting, Circadian rhythms; Tidal rhythms and Lunar rhythms	
IV	<b>Wild Life and Protected Areas</b> Introduction to wild life and Conservation; Causes of depletion; World conservation strategies National parks & sanctuaries, Community reserve Important features of protected areas in India	
<b>References:</b> <ol style="list-style-type: none"><li>1. Ecology: Theories &amp; Applications. Peter D. Stiling, 2001, Prentice Hall.</li></ol>		

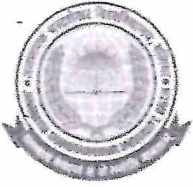
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# Jananayak Chandrashekhar University, Ballia



Programme: B.Sc.  
Subject: Zoology

## Syllabus

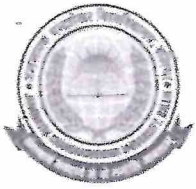
2. Ecological Modeling. 2008. Grant, W.E. and Swannack, T.M., Blackwell.
3. Ecology: The Experimental Analysis of Distribution and Abundance. Charles J. Krebs, 2016, Pearson Education Inc.
4. Elements of Ecology. T.M. Smith and R.L. Smith, 2014, Pearson Education Inc.
5. Environmental Chemistry. 2010. 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.
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# Jananayak Chandrashekhar University, Ballia



Programme: B.Sc.  
Subject: Zoology

## Syllabus

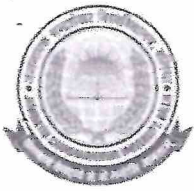
Semester	Sixth	Year: Three
Course Code	B050603P	
Course Title	Lab on Ecology, Environmental Science, Behavioral Ecology & wildlife	
Credit	2	Maximum Marks : 50
<b>Course Objective:</b> <ol style="list-style-type: none"><li>1. To understand the basic concepts, importance, status and interaction between organisms and environment</li><li>2. To understand the animal behaviour</li><li>3. To know the strategies to protect wild life</li></ol>		
<b>Learning Outcomes:</b> After successful completion of the syllabus, learners will be able to: To understand the basic concepts, importance, status and interaction between organisms and environment. Get employment in forest services, sanctuaries, conservatories etc. Enable students to take up research in wildlife.		
<b>Unit</b>	<b>Course Content</b>	
I	<ol style="list-style-type: none"><li>1. Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided.</li><li>2. Study of population dynamics through numerical problems.</li><li>3. Study of circadian functions in humans (daily eating, sleep and temperature patterns).</li></ol>	
II	<ol style="list-style-type: none"><li>1. Report on a visit to National Park/Biodiversity Park/Wild life sanctuary</li></ol>	
III	<ol style="list-style-type: none"><li>1. Demonstration of basic equipments needed in wildlife studies use, care and maintenance (Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System, Various types of Cameras and lenses)</li><li>2. Familiarization and study of animal evidences in the field; Identification of animals through pug marks, hoof marks, scats, pellet groups, nest, antlers etc.</li><li>3. Demonstration of different field techniques for flora and fauna</li></ol>	
IV	<b>Virtual Labs (Suggestive sites)</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></ol>	
<b>References:</b> <ol style="list-style-type: none"><li>1. Ecology: The Experimental Analysis of Distribution and Abundance. Charles J. Krebs, 2016, Pearson Education Inc.</li><li>2. Fundamentals of Ecology. E.P. Odum &amp; Gray. W. Barrett, 1971, Saunders.</li><li>3. Robert Leo Smith Ecology and field biology Harper and Row publisher</li><li>4. Bookhout, T.A. (1996). Research and Management Techniques for Wildlife and Habitats, 5<sup>th</sup> edition. The Wildlife Society, Allen Press.</li><li>5. Methods and Practice in biodiversity Conservation by David Hawks worth, Springer publication.</li><li>6. S.S. Lal Practical Zoology- Volume 1, Rastogi Publication</li><li>7. S.S. Lal Practical Zoology- Volume 2, Rastogi Publication</li><li>8. S.S. Lal Practical Zoology- Volume 3, Rastogi Publication</li></ol>		

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# Jananayak Chandrashekhar University, Ballia



Programme: B.Sc.  
Subject: Zoology

## Syllabus

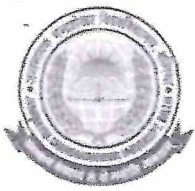
Semester	Seventh	Year: Four
Course Code	B050701T	
Course Title	Lower Non-chordates	
Credit	4	Maximum Marks: 25 +50
<b>Course Objective:</b> <ol style="list-style-type: none"><li>To know the biology of lower non-chordates</li><li>To learn about the various biological systems in lower non-chordates</li><li>To know the life cycles, pathogenicity of worms</li></ol>		
<b>Learning Outcomes:</b> After successful completion of the syllabus, learners will be able to: <ol style="list-style-type: none"><li>Know the biology of lower non-chordates</li><li>Learn about the various biological systems in lower non-chordates</li><li>Know the life cycles, pathogenicity of worms</li></ol>		
<b>Unit</b>	<b>Course Content</b>	
I	<b>Protozoa</b> <ul style="list-style-type: none"><li>Osmoregulation- Contractile and mechanism of osmoregulation,</li><li>Locomotion- Locomotor organelles and methods of locomotion</li><li>Nutrition- Holozoic, Holophytic, Saprozoic and Myxotrophic nutrition</li><li>Reproduction- Asexual and sexual</li><li>Protozoa and Diseases</li></ul>	
II	<b>Porifera</b> <ul style="list-style-type: none"><li>Cellular Organization- Pinacoderm, Choanoderm, Mesenchyme</li><li>Skeleton- Spicules and spongin</li><li>Reproduction- Asexual and Sexual</li><li>Canal System- Types and functions of canal system</li></ul>	
III	<b>Coelenterata and Ctenophora</b> <ul style="list-style-type: none"><li>Polymorphism- Basic forms and patterns</li><li>Colony formation; Metagenesis</li><li>Coral reef and its formation</li></ul>	
IV	<b>Platyhelminthes and Aschelminthes</b> <ul style="list-style-type: none"><li>Parasitism in Platyhelminthes and Aschelminthes,</li><li>Parasitic adaptations in Trematodes and Cestodes- Morphological and physiological adaptations</li><li>Larval stages of Trematodes and Cestodes</li></ul>	
<b>References:</b> <ol style="list-style-type: none"><li>Barnes et al (2009). The Invertebrates: A synthesis. Wiley Backwell 17</li><li>Moore: An Introduction to the Invertebrates (2001, Cambridge University Press)</li><li>Brusca and Brusca (2016) Invertebrates. Sinauer</li><li>Jan Pechenik (2014) Biology of the invertebrates. McGraw Hill</li><li>Parasitology- Chatterjee</li><li>Parasitology- Chakraborty</li><li>Thomos C. Chung. General Parasitology. Hardcourt Brace and Co. Ltd. Asia, New Delhi.</li></ol>		

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# Jananayak Chandrashekhar University, Ballia



Programme: B.Sc.

Subject: Zoology

## Syllabus

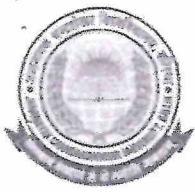
Semester	Seventh	Year: Four
Course Code	B050702T	
Course Title	Biostatistics, Biosystematics and Bioinstrumentation	
Credit	4	Maximum Marks: 25 +50
<b>Course Objective:</b> <ol style="list-style-type: none"><li>To Learn biostatistical methods and its use in biological research</li><li>To learn the various theories and mechanisms of speciation</li><li>To know the molecular techniques commonly used in biological research</li></ol>		
<b>Learning Outcomes:</b> After successful completion of the syllabus, learners will be able to: <ol style="list-style-type: none"><li>Know Biostatistical methods, use in biological research</li><li>Know the various theories and mechanisms of speciation</li><li>Familiarise with the molecular techniques, use in biological research</li></ol>		
<b>Unit</b>	<b>Course Content</b>	
I	<b>Biostatistics</b> <ul style="list-style-type: none"><li>Major central tendencies (Mean, Median, Mode),</li><li>Standard deviation/Standard error,</li><li>Analysis of Variance: ANOVA</li></ul>	
II	<b>Biosystematics</b> <ul style="list-style-type: none"><li>Theories of Biological Classification.</li><li>Speciation- Dimensions and mechanism of speciation</li><li>Species Concept- Species category and different species concept</li></ul>	
III	<b>Microscopy</b> <ul style="list-style-type: none"><li>Microscopy: Basic principle and types</li><li>Light Microscope: Dark field microscopy, Confocal, Florescent Microscope,</li><li>SEM and TEM</li><li>Sample preparation</li></ul>	
IV	<b>Molecular Techniques</b> <ul style="list-style-type: none"><li>Principle and applications of PAGE and Agarose gel electrophoresis</li><li>DNA fingerprinting, Western Blotting, and PCR,</li><li>Principles and Methodology of Spectrophotometry</li><li>Isolation and estimation of Protein, DNA, RNA</li></ul>	
<b>References:</b> <ol style="list-style-type: none"><li>Sambrook et al .Molecular Cloning Vols I, II, III. CSHL (2001).</li><li>Wilson. Clinical Genetics-A Short Course, Wiley (2000).</li><li>Biostatistical Analysis (Fourth Edition) by Jerrold H. Zarr, Pearson Education Inc., Delhi.</li><li>Westhead et al Bioinformatics: Instant Notes. Viva Books (2003).</li><li>Wilson K and Walker J, Principles and Techniques of Biochemistry and Molecular Biology</li><li>Ernst Mayr and Peter D. Ashlock. Principles of Systematic Zoology, 2nd Edition</li></ol>		

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# Jananayak Chandrashekhar University, Ballia



Programme: B.Sc.

Subject: Zoology

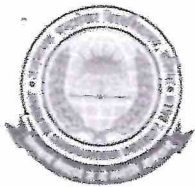
## Syllabus

Semester	Seventh	Year: Four
Course Code	B050703T	
Course Title	Environmental Biology and Bioinformatics	
Credit	4	Maximum Marks : 25 +50
<b>Course Objective:</b> <ol style="list-style-type: none"><li>To Know our environment and Ecosystem</li><li>To learn about the food chain food web and energy fellow in ecosystem</li><li>To know the various bioinformatics tool used in biological research</li></ol>		
<b>Learning Outcomes:</b> After successful completion of the syllabus, learners will be able to: <ol style="list-style-type: none"><li>Know the environment and nature</li><li>Learn about the food chain food web and energy fellow in ecosystem</li><li>Know the various bioinformatics tool used in biological research</li></ol>		
<b>Syllabus</b>		
<b>Unit</b>	<b>Course Content</b>	
I	<b>Unit 1: Ecosystem</b> <ul style="list-style-type: none"><li>Ecosystem</li><li>Production, Food webs and Energy flow through ecosystems</li><li>Biogeochemical cycles</li><li>Biomes</li></ul>	
II	<b>Unit 2: Population Ecology &amp; Community</b> <ul style="list-style-type: none"><li>Characteristics of Population</li><li>Population size and population growth</li><li>Population dynamics; r and k selection.</li><li>Ecological interactions (Mutualism, Protocooperation, Commensalism, Predation, Parasitism, Amensalism, Competition)</li></ul>	
III	<b>Unit 3: Environmental Biology</b> <ul style="list-style-type: none"><li>Environmental stresses</li><li>Global warming &amp; Climate change, Acid rain, Ozone layer depletion</li><li>Biotransformation</li><li>Bio-indicators and Biomarkers</li><li>Biodiversity- Assessment, conservation and management</li></ul>	
IV	<b>Bioinformatics</b> <ul style="list-style-type: none"><li>Computer applications: MS-Office- Word, Excel, Power point presentation, precautions and safety measures</li><li>Introduction and scope of Bioinformatics; Data archiving systems: FASTA format, Accession and GI-Number, Databases: NCBI, PDB, KEGG, and PubMed</li><li>Concept of homology: BLAST, Clustal-W and their applications</li></ul>	
<b>References:</b> <ol style="list-style-type: none"><li>Ecology: Theories &amp; Applications. Peter D. Stiling, 2001, Prentice Hall.</li><li>Ecological Modeling. 2008. Grant, W.E. and Swannack, T.M., Blackwell.</li><li>Ecology: The Experimental Analysis of Distribution and Abundance. Charles J. Krebs, 2016, Pearson Education Inc.</li><li>Elements of Ecology. T.M. Smith and R.L. Smith, 2014, Pearson Education Inc.</li><li>Environmental Chemistry. 2010. Stanley and Manahan, E. CRC, Taylor &amp; Francis. London.</li><li>Environment. Raven, Berg, Johnson, 1993, Saunders College Publishing.</li><li>Essentials of Ecology. G.T. Miller, Jr. &amp; Scott. E. Spoolman, 2014, Brooks/Cole, Cengage Learning.</li><li>Fundamental Processes in Ecology: An Earth system Approach. 2007. Wilkinson, D.M. Oxford University Press, UK.</li><li>Fundamentals of Ecology. E.P. Odum &amp; Gray. W. Barrett, 1971, Saunders</li><li>Westhead et al Bioinformatics: Instant Notes. Viva Books (2003).</li></ol>		

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# Jananayak Chandrashekhar University, Ballia



Programme: B.Sc.  
Subject: Zoology

## Syllabus

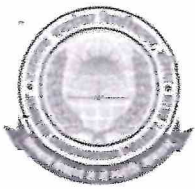
Semester	Seventh	Year: Four
Course Code	B050704T	
Course Title	Biochemistry	
Credit	4	Maximum Marks : 25 +50
<b>Course Objective:</b> <ol style="list-style-type: none"><li>1. To know the various metabolic and catabolic processes in biological system</li><li>2. To develop a deep understanding of structure of biomolecules like proteins, lipids and carbohydrates</li><li>3. To understand the mechanisms of energy production at cellular and molecular levels.</li></ol>		
<b>Learning Outcomes:</b> After successful completion of the syllabus, learners will be able to: <ol style="list-style-type: none"><li>1. Know the various metabolic and catabolic processes in biological system</li><li>2. Develop a deep understanding of structure of biomolecules like proteins, lipids and carbohydrates</li><li>3. Understand the mechanisms of energy production at cellular and molecular levels.</li></ol>		
Unit	Course Content	
I	<b>Enzymes</b> <ul style="list-style-type: none"><li>• Mechanism of enzyme action, Activation energy</li><li>• Enzyme inhibition- Competitive and non-competitive inhibitors,</li><li>• Regulation of Enzymes</li></ul>	
II	<b>Biomolecules</b> <ul style="list-style-type: none"><li>• Carbohydrates- Classification, structure, general properties and biological significance</li><li>• Lipids- Classification, structure, general properties and biological significance</li><li>• Proteins structure and function, Isoelectric point,</li><li>• Sequencing of proteins: Sanger and Edman methods</li></ul>	
III	<b>Metabolic Pathways</b> <ul style="list-style-type: none"><li>• Glycogenesis and Glycogenolysis, Gluconeogenesis,</li><li>• HMP shunt, Oxidative phosphorylation,</li><li>• Beta oxidation of fatty acids</li></ul>	
IV	<b>Vitamins. Cancer and Ageing</b> <ul style="list-style-type: none"><li>• Classification and significance of Vitamins,</li><li>• Biology of Cancer- Neoplasia, Metastasis, Phases of cancer, Oncogenes, and Carcinogens</li><li>• Biology of Ageing</li></ul>	
<b>References:</b> <ol style="list-style-type: none"><li>1. Nelson &amp; Cox: Lehninger's Principles of Biochemistry: McMillan (2000)</li><li>2. Zubayet <i>et al</i>: Principles of Biochemistry: WCB (1995)</li><li>3. Voet &amp; Voet: Biochemistry Vols 1 &amp; 2: Wiley (2004)</li><li>4. Murray <i>et al</i>: Harper's Illustrated Biochemistry: McGraw Hill (2003) Elliott and Elliott:</li><li>5. Voet &amp; Voet: Biochemistry Vols 1 &amp; 2: Wiley (2004)</li></ol>		

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# Jananayak Chandrashekhar University, Ballia



Programme: B.Sc.

Subject: Zoology

## Syllabus

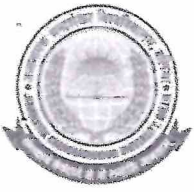
<b>Semester</b>	<b>Seventh</b>	<b>Year: Four</b>
<b>Course Code</b>	<b>B050705P</b>	
<b>Course Title</b>	<b>Lower Non-chordates , Ecology, Biostatics. Biotechnology, Biosystematics and Biochemistry Practical</b>	
<b>Credit</b>	4	<b>Maximum Marks : 100</b>
<b>Course Objective:</b> To demonstrate comprehensive identification abilities of non- chordates diversity <ol style="list-style-type: none"><li>1. To explain structural and functional diversity of non- chordates</li><li>2. To demonstrate the physiochemical factors affecting the ecosystem</li><li>3. To know the various metabolic and catabolic processes in biological system</li><li>4. To develop a deep understanding of structure of biomolecules like proteins, lipids, and carbohydrates</li></ol>		
<b>Learning Outcomes:</b> After successful completion of the syllabus, learners will be able to: <ol style="list-style-type: none"><li>1. Demonstrate comprehensive identification abilities of non- chordates diversity</li><li>2. Explain structural and functional diversity of non- chordates</li><li>3. Demonstrate the physiochemical factors affecting the ecosystem</li><li>4. Know the various metabolic and catabolic processes in biological system</li><li>5. Develop a deep understanding of structure of biomolecules like proteins, lipids and carbohydrate</li></ol>		
<b>Unit</b>	<b>Course Content</b>	
I	<b>Major Dissections:</b> Dissection of circulatory system and reproductive system of earthworm, Digestive system and Reproductive system of leech and other available lower non-chordates.	
II	<b>Preparations:</b> Slide preparation of Euglena and Paramecium, sponge gemmules, Obelia colony and other available materials from lower non-chordates.	
III	<b>Museum study:</b> General survey and classification of lower non-chordates <b>Protozoa:</b> Prepared slides of Paramecium (conjugation and binary fission), Euglena, Vorticella, Ceratium, Noctiluca. <b>Porifera:</b> Museums of Euplectella, Spongilla, Euspongia Prepared slides of T.S. Sycon, L.S. Sycon, Spicules of sponges. <b>Coelenterata-</b> Museums of Physalia, Corralium, Madrepora, Fungia, Pennatula, Metridium, Vellela, <b>Protozoa:</b> Prepared slides of Paramecium (conjugation and binary fission), Euglena, Vorticella, Ceratium, Noctiluca. <b>Porifera:</b> Museums of Euplectella, Spongilla, Euspongia Prepared slides of T.S. Sycon, L.S. Sycon, Spicules of sponges. <b>Coelenterata-</b> Museums of Physalia, Corralium, Madrepora, Fungia, Pennatula, Metridium, Vellela, <b>Prepared slides-</b> Miracidium larva, Redia larva, Cercaria larva, Scolex of Taeniasolium, Mature proglottid and gravid proglottid of T. solium, T.S of Mature proglottid and gravid proglottid of T. solium, T.S. through body of male Ascaris, T.S. through body of female Ascaris.	
IV	Comparative study of physico-chemical eco-factors in different localities: temperature, pH, Estimation of CO <sub>2</sub> , O <sub>2</sub> , carbonate in fresh water, Study of plankton in a water body Study of biological effects of certain pollutants. Biochemistry exercise: Chromatographic separation of amino acids Kinetic assay of salivary amylase and study of the effects of time and temperature on urease activity Sampling of data for frequency diagram and calculation of mean, median and mode and standard Deviation, Anova. Bioinformatics: Hands on Bioinformatics databases and tools	
<b>References:</b>		
<ol style="list-style-type: none"><li>1. Wilson K and Walker J, Principles and Techniques of Biochemistry and Molecular Biology</li><li>2. S.S. Lal Practical Zoology- Volume 1, Rastogi Publication</li><li>3. S.S. Lal Practical Zoology- Volume 2, Rastogi Publication</li><li>4. S.S. Lal Practical Zoology- Volume 3, Rastogi Publication</li></ol>		

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# Jananayak Chandrashekhar University, Ballia



Programme: B.Sc.  
Subject: Zoology

## Syllabus

5. Rodney Boyer; Experimental Biochemistry, Prentice Hall
6. S. Prasad ; Biostatics
7. Eecest Mayer; Principle of Biosystematics

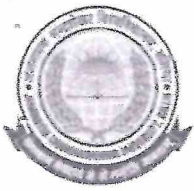
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# Jananayak Chandrashekhar University, Ballia



Programme: B.Sc.  
Subject: Zoology

## Syllabus

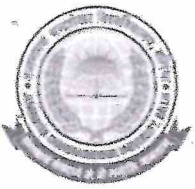
Semester	Eighth	Year: Four
Course Code	B050801T	
Course Title	Higher Non-chordates	
Credit	4	Maximum Marks : 25 +50
<b>Course Objective:</b> <ol style="list-style-type: none"><li>To know the biology of higher non-chordates</li><li>To learn about the various biological systems in higher non-chordates</li><li>To know the diversity in various forms and function in higher non-chordates</li></ol>		
<b>Learning Outcomes: Learning Outcomes:</b> After successful completion of the syllabus, learners will be able to: <ol style="list-style-type: none"><li>Know the biology of higher non-chordates</li><li>Learn about the various biological systems in higher non-chordates</li><li>Know the diversity in various forms and function in higher non-chordates</li></ol>		
<b>Unit</b>	<b>Course Content</b>	
I	<b>Annelida:</b> <ul style="list-style-type: none"><li>General characters and classification</li><li>Segmental organs, Feeding habits,</li><li>Adaptive radiation in Polychaetes,</li><li>Coelom and Metamerism.</li></ul>	
II	<b>Arthropoda:</b> <ul style="list-style-type: none"><li>General characters and classification</li><li>Larval forms of Crustacea,</li><li>Parasitism in Crustacea, Respiration in Arthropods</li></ul>	
III	<b>Mollusca:</b> <ul style="list-style-type: none"><li>General characters and classification</li><li>Respiration, Nervous system,</li><li>Foot in Mollusca, and Torsion and detorsion in Gastropods</li></ul>	
IV	<b>Echinodermata:</b> <ul style="list-style-type: none"><li>General characters and classification</li><li>Water vascular system,</li><li>Larval forms and Affinities</li></ul>	
<b>References:</b> <ol style="list-style-type: none"><li>Barnes et al (2009). The Invertebrates: A synthesis. Wiley Backwell 17</li><li>Moore: An Introduction to the Invertebrates (2001, Cambridge University Press)</li><li>Brusca and Brusca (2016) Invertebrates. Sinauer</li><li>Jan Pechenik (2014) Biology of the invertebrates. McGraw Hill</li></ol>		

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# Jananayak Chandrashekhar University, Ballia



Programme: B.Sc.  
Subject: Zoology

## Syllabus

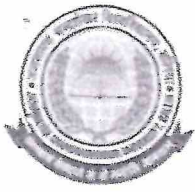
Semester	Eighth	Year: Four
Course Code	B050802T	
Course Title	Animal Physiology	
Credit	4	Maximum Marks : 25 +50
<b>Course Objective:</b> <ol style="list-style-type: none"><li>1. To understand systems biology and various functional components of an organism.</li><li>2. To know the various physiological systems of animals</li><li>3. To know the various organ system of animals</li><li>4. To explore the complex network of these functional components.</li></ol>		
<b>Learning Outcomes:</b> After successful completion of the syllabus, learners will be able to: <ol style="list-style-type: none"><li>1. Understand systems biology and various functional components of an organism.</li><li>2. Know the various physiological systems of animals</li><li>3. Know the various organ system of animals</li><li>4. Explore the complex network of these functional components.</li></ol>		
<b>Unit</b>	<b>Course Content</b>	
I	<ul style="list-style-type: none"><li>• <b>Physiology of Digestion:</b> Digestion and Absorption of Proteins, Carbohydrates and lipids.</li><li>• <b>Physiology of Respiration:</b> Gaseous exchange in terrestrial and aquatic animals, Respiratory pigments.</li></ul>	
II	<ul style="list-style-type: none"><li>• <b>Physiology of Circulation:</b> Patterns of Circulation among different animals, Physiological categories of Heart.</li><li>• <b>Physiology of Excretion:</b> Excretory products, Biosynthesis of Urea, Structure, and functional mechanism of nephron.</li></ul>	
III	<ul style="list-style-type: none"><li>• <b>Physiology of Nerve Conduction:</b> Structure of neurons, Ionic basis of resting and Action potential, Synaptic transmission at molecular levels;</li><li>• <b>Physiology of Muscle Contraction:</b> Structure of skeletal muscle, Mechanism of Muscle Contraction</li><li>• <b>Physiology of Reproduction:</b> Male and female reproductive system of mammals</li></ul>	
IV	<ul style="list-style-type: none"><li>• <b>Physiology of Defense:</b> Organs of immune system, Antigens and antibodies, their interaction, generation of antibody diversity. Complement system, MHC and antigen presentation, Vaccines: active and passive immunization, and types of vaccines.</li></ul>	
<b>References:</b>		
Guyton, A.C. & Hall, J.E. Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company. (2006).		
2. Tortora, G.J. & Grabowski, S. Principles of Anatomy & Physiology. XI Edition John Wiley & sons (2006).		
3. C C Chatterjee; Animal physiology, Nagabhushanam, Physiology and Biochemistry		

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# Jananayak Chandrashekhar University, Ballia



Programme: B.Sc.

Subject: Zoology

## Syllabus

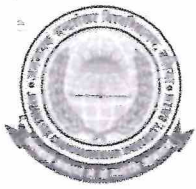
Semester	Eighth	Year: Four
Course Code	B050803T	
Course Title	Cytology, Microbiology and Genetics	
Credit	4	Maximum Marks : 25 +50
<b>Course Objective:</b> <ol style="list-style-type: none"><li>To understand the structure and function of all the cell organelles.</li><li>To Know about how cell division is regulated.</li><li>To know how cell communicates with its neighboring cells?</li><li>To understand the basic principles of genetics and how genes (earlier called factors) are inherited from one generation to another.</li><li>To understand the Mendel's laws and the deviations from conventional patterns of inheritance.</li></ol>		
<b>Learning Outcomes:</b> After successful completion of the syllabus, learners will be able to: <ol style="list-style-type: none"><li>Understand the structure and function of all the cell organelles.</li><li>Know about how cell division is regulated.</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></ol>		
Unit	Course Content	
I	<b>Cell Biology</b> <ul style="list-style-type: none"><li>Membrane transport of small molecules, and.</li><li>Cell-cell communication.</li><li>Cellular junctions and Cytoskeleton</li><li>Regulation of Cell cycle</li></ul>	
II	<b>Microbiology</b> <ul style="list-style-type: none"><li>A Brief introduction of Bacteriophages, Animal viruses, and Retroviruses,</li><li>Structure of Bacterial cell,</li><li>Gram staining</li></ul>	
III	<b>Mendelian Inheritance</b> Mendel's laws and their chromosomal basis, <ul style="list-style-type: none"><li>Genetic interaction: dominance, epistasis, pleiotropy, expressivity, and penetrance;</li><li>Linkage and Crossing over, gene mapping,</li><li>Sex-determination, Sex-linked inheritance,</li><li>Pedigree analysis and its application</li></ul>	
IV	<b>Human cytogenetics</b> <ul style="list-style-type: none"><li>Karyotype, Chromosomal aberrations, Mutation.</li><li>Population genetics: Allele and genotype frequency, Hardy-Weinberg Law, Genetic Drift, Epigenetics;</li><li>Human genetic diseases</li></ul>	
<b>References:</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></ol>		

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# Jananayak Chandrashekhar University, Ballia



Programme: B.Sc.

Subject: Zoology

## Syllabus

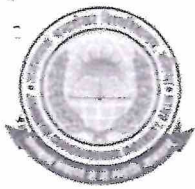
Semester	Eighth		Year: Four
Course Code	B050804T		
Course Title	Molecular Biology		
Credit	4	Maximum Marks: 25 +50	
<b>Course Objective:</b> To developed a conceptual understanding of molecular processes			
<ol style="list-style-type: none"> <li>1. To understand how genes are expressed as proteins which are responsible for the structure and function of all organisms.</li> <li>2. To Learn how four sequences (3 letter codons) generate the transcripts of life and determine the phenotypes of organisms.</li> <li>3. To know genes are regulated differently at different time and place in prokaryotes and eukaryotes.</li> </ol>			
<b>Learning Outcomes:</b> After successful completion of the syllabus, learners will be able to:			
<ol style="list-style-type: none"> <li>1. Developed a conceptual understanding of molecular processes</li> <li>2. Understand how genes are expressed as proteins which are responsible for the structure and function of all organisms.</li> <li>3. Learn how four sequences (3 letter codons) generate the transcripts of life and determine the phenotypes of organisms.</li> <li>4. Know genes are regulated differently at different time and place in prokaryotes and eukaryotes.</li> </ol>			
Unit	Course Content		
I	<b>Gene Action</b> <ul style="list-style-type: none"> <li>• Chromosomal organization of genes, Eukaryotic gene structure,</li> <li>• Non-coding genes, principal classes of DNA (A, B, and Z) DNA replication, Transcription, Genetic code.</li> <li>• Polymerase chain reaction and DNA Sequencing: Sanger Sequencing and Next Generation Sequencing</li> </ul>		
II	<b>Endomembrane system and Drug Targeting</b> <ul style="list-style-type: none"> <li>• Protein Architecture, Protein synthesis on free/bound polysomes.</li> <li>• Uptake into ER, Trafficking mechanism of proteins;</li> <li>• Regulation of intracellular transport</li> <li>• Post-translational modification of proteins</li> </ul>		
III	<b>Regulation of Gene Action</b> <ul style="list-style-type: none"> <li>• Regulation of Gene action in prokaryotes: Operon model- lac operon and Trp- operon; gene</li> <li>• Regulation in eukaryotes at transcriptional and post-transcriptional levels (Britten-Davidson model); silencers and enhancers.</li> </ul>		
IV	<b>Cell Signalling</b> <ul style="list-style-type: none"> <li>• Concept of cell signaling; Types of Cells Signaling: Paracrine, autocrine, endocrine, synaptic; Combinatorial signaling;</li> <li>• Intracellular receptors;</li> <li>• Cell surface receptors: Ion channel linked receptors, G-Protein linked receptor;</li> <li>• Mechanism of signaling through G-Protein linked receptor; Enzyme linked receptors,</li> <li>• Mechanism of action via enzyme linked receptor; Second messenger system,</li> <li>• Mechanism of action of cyclic AMP; Apoptosis.</li> </ul>		
<b>References:</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). Pierce B. Genetics. Freeman (2004).</li> <li>5. Lewin B. Genes VIII. Pearson (2004).</li> <li>6. Watson et al. Molecular Biology of the Gene. Pearson (2004).</li> </ol>			

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# Jananayak Chandrashekhar University, Ballia



Programme: B.Sc.

Subject: Zoology

## Syllabus

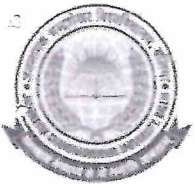
<b>Semester</b>	<b>Eighth</b>	<b>Year: Four</b>
<b>Course Code</b>	<b>B050805P</b>	
<b>Course Title</b>	<b>Non-chordates, Animal Physiology, Cytology, Microbiology and Genetics, and Molecular Biology Practical</b>	
<b>Credit</b>	<b>4</b>	<b>Maximum Marks : 10</b>
<b>Course Objective</b> To know the diversity and forms of higher invertebrates To know about the cell and its organelles To know the basic principles of inheritance To learn about the molecules and molecular events going on in cell		
<b>Learning Outcomes:</b> After successful completion of the syllabus, learners will be able to: Know the diversity and forms of higher invertebrates Know about the cell and its organelles Familiarised with the basic principles of inheritance Learn about the molecules and molecular events going on in cell		
<b>Unit</b>	<b>Course Content</b>	
<b>I</b>	<b>Major Dissection-</b> Nervous system of Pila, Unio, Sepia, and other available materials of higher non-chordates <b>Minor Dissection-</b> Nervous system of Prawn, Other minor dissections of available higher non-chordates <b>Preparation-</b> Hastate plate of prawn, parapodia of Neries, Mouth parts and salivary glands of cockroach, Mouth parts of other insects, and of other available materials.	
<b>II</b>	<b>Museum and prepared slides study-</b> General survey and classification of higher nonchordates <b>Annelida-</b> Nereies, Heteroneries, Aphrodite, Chaetopterus, Arenicola, Terebella, Pheretima, Eutyphoeus, Dero, Branchellion, Bonellia, Sipunculus and other available museums T.S. Nereies through body segments, Parapodium of Nereies, etc. <b>Arthropoda-</b> Museums and slides of major representatives of different classes of phylum Arthropoda <b>Mollusca-</b> Museums and slides of major representatives of Mollusca <b>Echinodermata-</b> Museums and slides of major representatives of Echinodermat	
<b>III</b>	<b>Physiology exercise-</b> Total counts of erythrocytes, total leucocyte counts and differential leucocyte counts of fish, frog, bird and rat. Estimation of hemoglobin content in human fish, bird and rat. Rate of Oxygen consumption of aquatic animals and effects of different stresses upon it. Study of functional properties of the cardiac muscles of frog using acetylcholine and adrenalin	
<b>IV</b>	<b>Molecular Biology exercise-</b> Isolation and colorimetric determination of protein from fat bodies of cockroach and liver Isolation and colorimetric determination of DNA from fat bodies of cockroach and liver. . <b>Cytology and Genetics exercise-</b> <b>Demonstration</b> of mitochondria in human buccal epithelium by supra vital staining <b>Study</b> of mitosis in onion root tip and meiosis in testis of grasshopper with acetocarmine squash method <b>Study</b> of salivary gland chromosomes of Drosophila and Chironomos <b>Microbiology</b> Gram staining Bacterial Culture	
<b>References:</b>		
1. Wilson K and Walker J, Principles and Techniques of Biochemistry and Molecular Biology 2. S.S. Lal Practical Zoology- Volume 1, Rastogi Publication 3. S.S. Lal Practical Zoology- Volume 2, Rastogi Publication 4. S.S. Lal Practical Zoology- Volume 3, Rastogi Publication		

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# Jananayak Chandrashekhar University, Ballia



Programme: B.Sc.  
Subject: Zoology

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5. Rodney Boyer; Experimental Biochemistry, Prentice Hall
6. S. Parasad ; Biostatics
7. Kesar, Saroj and Vashishta N. (2007). Experimental Physiology: Comprehensive Manual. Heritage Publishers, New Delhi

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