

Maa Shakumbhari University, SAHARANPUR U.P.

माँ शाकुम्भरी विश्वविद्यालय, सहारनपुर, उत्तर प्रदेश



Syllabus

of

Zoology

For First Three Years of Under-Graduate (UG) Programme

(As per guidelines of U.P. Government according to National Education Policy-2020 w.e.f. the session 2023-2024)

Members, Board of Studies (Zoology)

S. No.	Name	Designation	College/University	Signature
1.	Prof. Sandhya Jain	Convener	D.A.V. (P.G). College, Muzaffarnagar	
2.	Prof. Anju Panwar	Member	D.A.V.(P.G.) College, Muzaffarnagar	
3.	Dr. Yogendra Singh	Member	Vijay Singh Pathik Govt. P. G. College, Kairana, Shamli	
4.	Dr. Om Dutt	Member	M.S. College, Saharanpur	
5.	Prof. D. S. Malik	External expert	Gurukul Kangri University, Haridwar	
6.	Prof. Dinesh Kumar Sharma	External expert	Km. Mayawati Govt. Girls (PG)College, Badalpur , Goutam Budhnagar	
7.	Prof. A. K. Verma	External expert	Govt. College, Saidabad, PRG	

Proposed Year wise Structure of UG Program in Zoology

Programme/Year	Semester	Paper Code	Course Codes	Paper Title	Credits	Teaching Hours
1 Certificate Course in Medical Diagnostics & Public Health	I	0120501	B050101T	Cytology, Genetics and Infectious Diseases	04	60
		0120580	B050102P	Cell Biology & Cytogenetics Lab	02	60
	II	0220501	B050201T	Biochemistry and Physiology	04	60
		0220580	B050202P/R	Physiological, Biochemical & Hematology Lab	02	60
2 Diploma in Molecular Diagnostics and Genetic Counselling	III	0320501	B050301T	Molecular Biology, Bioinstrumentation & Biotechniques	04	60
		0320580	B050302P	Bioinstrumentation & Molecular Biology Lab	02	60
	IV	0420501	B050401T	Gene Technology, Immunology and Computational Biology	04	60
		0420580	B050402P/R	Genetic Engineering and Counselling Lab	02	60
3 Degree in Bachelor of Science	V	0520501	B050501T	Diversity of Non-Chordates, Parasitology and Economic Zoology	04	60
		0520502	B050502T	Diversity of Chordates and Comparative Anatomy	04	60
		0520580	B050503P	Lab on Virtual Dissection, Anatomy, Economic Zoology and Parasitology	02	60
	VI	0620501	B050601T	Evolutionary and Developmental Biology	04	60
		0620502	B050602T	Ecology, Ethology, Environmental Science and Wildlife	04	60
		0620580	B050603P	Lab on Environmental Science, Behavioral Ecology, Developmental Biology, Wildlife, Ethology	02	60

Subject prerequisite

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

Programme Objectives (POs)

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

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

PSO1	This course introduces System Biology and various functional components of an organism. Emphasis will be on physiological understanding abnormalities and anomalies associated with white blood cells and red blood cells. The course emphasizes cell identification, cell differentiation and cell morphology evaluation procedures. This will enhance hematology analytical skills along with skill of using many instruments.
PSO 2	The students will learn the basic principles of genetics and how to prepare karyotypes to study the chromosomes.
PSO 3	How chromosomal aberrations are inherited in humans by pedigree analysis in families.
PSO 4	The students will have hands-on training in the techniques like microscopy, centrifugation and chromatography, and various biochemical techniques, preparation of slides which will help them in getting employment in pathology labs and contribute to health care system.
PSO 5	The Certificate courses will enable students to apply for technical positions in government and private labs/institutes.

Diploma in Molecular Diagnostics and Genetic Counselling	
B.Sc II Programme Specific Outcomes (PSOs)	
PSO1	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.
PSO 2	The students will be able to understand and apply the principles and techniques of molecular biology which prepares students for further career in molecular biology. Independently execute a laboratory experiment using the standard methods and techniques.
PSO 3	The principles of genetic engineering, gene cloning, immunology and related technologies will enable students to play an important role in applications of biotechnology in various fields like agriculture, forensic sciences, industry and human health and make a career out of it. Students can have their own start-ups as well.
PSO 4	The basic tools of bioinformatics will enable students to analyze large amount of genomic data and its application to evolutionary biology. Apply knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics existing software effectively to extract information from large databases and to use this information in computer modeling.
PSO 5	The Diploma courses will ensure employability in Hospitals/Diagnostics and Pathology labs with good hands-on training. It will also enable students to take up higher studies and Research as their career and work in renowned labs in the country and abroad.

Degree in Bachelor of Science	
B.Sc III Programme Specific Outcomes (PSOs)	
PSO1	<ul style="list-style-type: none"> ● This programme aims to introduce students to animal diversity of invertebrates and vertebrates. The students will be taught about invertebrates and vertebrates using observational strategies, museum specimens and field reports.
PSO 2	<ul style="list-style-type: none"> ● A variety of interacting processes generate an organism's heterogeneous shapes, size, and structural features.
PSO 3	<ul style="list-style-type: none"> ● Inclusion of ecology and environmental sciences will enrich students with our world which is crucial for human well being and prosperity. This section will provide new knowledge of the interdependence between people and nature that is vital for food production, maintaining clean air and water, and sustaining biodiversity in a changing climate.
PSO 4	<ul style="list-style-type: none"> ● Students will also come to know about the basic principle of life, how a cell divides leading to the growth of an organism and also reproduces to form new organisms.
PSO 5	<ul style="list-style-type: none"> ● The basic concepts of biosystematics, evolutionary biology and biodiversity will enable students to solve the biological problems related to environment.
PSO 6	<ul style="list-style-type: none"> ● At the end of the course the students will be capable enough to comprehend the reason behind such a huge diversity of animals and reason out why two animals are grouped together or remain separate due to similarities and differences which exist at many levels along with ecological, environmental and cellular inputs.
PSO 7	<ul style="list-style-type: none"> ● The Degree courses will enable students to go for higher studies like Masters and Ph.D in Zoology and Allied subjects.

Programme/Class: Certificate	Year: First	Semester: First
Subject: ZOOLOGY		
Course Code: B050101T	Course Title: Cytology, Genetics and Infectious Diseases	
Paper Code: 0120501		
Course outcomes: The student at the completion of the course will be able to:		
<ul style="list-style-type: none"> ● Understand the structure and function of all the cell organelles. ● Know about the chromatin structure and its location. ● To be familiar with the basic principle of life, how a cell divides leading to the growth of an organism and also reproduces to form new organisms. ● How one cell communicates with its neighboring cells? ● Understand the basic principles of genetics and how genes (earlier called factors) are inherited from one generation to another. ● Understand the Mendel's laws and the deviations from conventional patterns of inheritance. ● Comprehend how environment plays an important role by interacting with genetic factors. ● How to detect chromosomal aberrations in humans and study the pattern of inheritance by pedigree analysis in families. 		
Credits: 4	Core: Compulsory	
Max. Marks: 25+75	Min. Passing Marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:4-0-0		
Unit	Topics	Total No. of Lectures (60)
I	Structure and Function of Cell Organelles I <ul style="list-style-type: none"> ● Plasma membrane: chemical structure—lipids and proteins ● Cell-cell interaction: cell adhesion molecules, cellular junctions ● Endomembrane system: protein targeting and sorting, endocytosis, exocytosis <p>Introduction to all national and international Biologists (Zoologists) who have contributed/contributing to Zoological and Life Sciences as a mark of tribute to ancient and modern biology will be included as part of the Continuous Internal Evaluation (CIE) Susruta, Charak, Patanjali, Varahamihira, Prof.H.G.Khurana, Prof.G.N.Ramachandran, Prof. Salim Ali, Prof.JP Thapliyal, Prof.Lalji Singh, Prof. MK Chandrashekharan, Prof. R Mishra-to be discussed with the topics being dealt.</p>	6
II	Structure and Function of Cell Organelles II <ul style="list-style-type: none"> ☐ Cytoskeleton: microtubules, microfilaments, intermediate filaments ☐ Mitochondria: Structure, oxidative phosphorylation, electron transport system ☐ Peroxisome and ribosome: structure and function 	6

III	Nucleus and Chromatin Structure <ul style="list-style-type: none"><li>☐ Structure and function of nucleus in eukaryotes<li>☐ Chemical structure and base composition of DNA and RNA<li>☐ DNA supercoiling, chromatin organization, structure of chromosomes<li>☐ Types of DNA and RNA	8
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IV	Cell cycle, Cell Division and Cell Signaling <ul style="list-style-type: none"> ☐ Cell division: mitosis and meiosis ☐ Introduction to Cell cycle and its regulation, apoptosis ☐ Signal transduction: intracellular signaling and cell surface receptors, via G-protein linked receptors ☐ Cell-cell interaction: cell adhesion molecules, cellular junctions 	8
V	Mendelism and Sex Determination <ul style="list-style-type: none"> ☐ Basic principles of heredity: Mendel's laws, monohybrid and dihybrid crosses ☐ Complete and Incomplete Dominance ☐ Clinical expressions: Penetrance and expressivity ☐ Genic Sex-Determining Systems, Environmental Sex Determination, Sex Determination in <i>Drosophila</i> ☐ Sex-linked characteristics and Dosage compensation 	8
VI	Extensions of Mendelism, Genes and Environment <ul style="list-style-type: none"> ☐ Extensions of Mendelism: Multiple Alleles, Gene Interaction ☐ The Interaction Between Sex and Heredity: Sex-Influenced and Sex-Limited Characteristics ☐ Cytoplasmic Inheritance, Genetic Maternal Effects ☐ Genomic Imprinting, Anticipation ☐ Interaction Between Genes and Environment: Environmental Effects on Gene Expression, Inheritance of Continuous Characteristics 	8
VII	Human Chromosomes and Patterns of Inheritance <ul style="list-style-type: none"> ☐ Human karyotype ☐ Chromosomal anomalies: Structural and numerical aberrations with examples ☐ Pedigree analysis ☐ Patterns of inheritance: autosomal dominant, autosomal recessive, X-linked recessive, X-linked dominant 	8
VIII	Infectious Diseases <ul style="list-style-type: none"> ● Introduction to pathogenic organisms: viruses, bacteria, fungi, protozoa, and worms. ● Structure, life cycle, pathogenicity, including diseases, causes, symptoms and control of common parasites: <i>Trypanosoma</i>, <i>Giardia</i> and <i>Wuchereria</i> 	8

Suggested Readings:

1. Lodish et al: Molecular Cell Biology: Freeman & Co, USA (2004).
2. Alberts et al: Molecular Biology of the Cell: Garland (2002).
3. Cooper: Cell: A Molecular Approach: ASM Press (2000).
4. Karp: Cell and Molecular Biology: Wiley (2002). Pierce B. Genetics. Freeman (2004).
5. Lewin B. Genes VIII. Pearson (2004).
6. Watson et al. Molecular Biology of the Gene. Pearson (2004).
7. Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, Janis KubyKuby Immunology. W H Freeman (2007).
8. Delves Peter J., Martin Seamus J., Burton Dennis R., Roitt Ivan M. Roitt's Essential Immunology, 13th Edition. Wiley Blackwell (2017).
9. Shetty Nandini Immunology Introductory Textbook. New Age International. (2005)

Course Books published in Hindi may be prescribed by the Universities and Colleges
Course prerequisites: To study this course, a student must have had the subject biology in class/12 th
Suggested Continuous Evaluation Methods:
Total Marks: 25
House Examination/Test: 10 Marks
Written Assignment/Presentation/Project / Term Papers/Seminar: 10 Marks
Class performance/Participation: 5 Marks
Further Suggestions: None

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

Programme/Class: Certificate	Year: First	Semester: First
Subject: ZOOLOGY		
Course Code: B050102P	Course Title: Cell Biology & Cytogenetics Lab	
Paper Code: 0120580		
Course outcomes: At the completion of the course students will learn Hands-on: <ol style="list-style-type: none"> To use simple and compound microscopes. To prepare slides and stain them to see the cell organelles. 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. The chromosomal aberrations by preparing karyotypes. How chromosomal aberrations are inherited in humans by pedigree analysis in families. The antigen-antibody reaction. 		
Credits: 2	Core: Compulsory	
Max. Marks: 25+75	Min. Passing Marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:0-0-4		
Unit	Topics	Total No. of Lectures (60)
I	<ol style="list-style-type: none"> Understanding of simple and compound microscope. To study different cell types such as buccal epithelial cells, neurons, striated muscle cells using Methylene blue(Virtual /slaughtered tissue) To study the different stages of Mitosis in root tip of onion. To study the different stages of Meiosis in testis (virtual). To check the permeability of cells using salt solution of different concentrations. 	15
II	<ol style="list-style-type: none"> Study of parasites (eg. Protozoans, helminths <i>etc.</i>) from permanent slides. To learn the procedures for preparation of temporary (root tip of onion) and permanent stained/unstained slides, with available mounting material. 	15
III	<ol style="list-style-type: none"> Study of mutant phenotypes of <i>Drosophila</i>. Preparation of polytene chromosomes. Preparation of human karyotype and study the chromosomal aberrations with respect to number, translocation, deletion <i>etc.</i> from the pictures provided.(Virtual / optional) To prepare family pedigrees. 	15

IV	Virtual Labs (Suggestive sites) https://www.vlab.co.in https://zoologysan.blogspot.com www.vlab.iitb.ac.in/vlab www.onlinelabs.in www.powershow.com https://vlab.amrita.edu https://sites.dartmouth.edu	15
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Suggested Readings:

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

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

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

Suggested Continuous Evaluation Methods:

Total Marks: 25

House Examination/Test: 10 Marks

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

Class performance/Participation: 5 Marks

Further Suggestions: None

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

Programme/Class: Certificate	Year: First	Semester: Second
Subject: ZOOLOGY		
Course Code: B050201T	Course Title: Biochemistry and Physiology	
Paper Code: 0220501		
Course outcomes:		
The student at the completion of the course will learn:		
<ul style="list-style-type: none"> ● To develop a deep understanding of structure of biomolecules like proteins, lipids and carbohydrates ● How simple molecules together form complex macromolecules. ● To understand the thermodynamics of enzyme catalyzed reactions. ● Mechanisms of energy production at cellular and molecular levels. ● To understand systems biology and various functional components of an organism. ● To explore the complex network of these functional components. ● To comprehend the regulatory mechanisms for maintenance of function in the body. 		
Credits: 4	Core: Compulsory	
Max. Marks: 25+75	Min. Passing Marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:4-0-0		
Unit	Topics	Total No. of Lectures (60)
I	Structure and Function of Biomolecules <ul style="list-style-type: none"> ☐ Structure and Biological importance of carbohydrates (Monosaccharides, Disaccharides, Polysaccharides and Glycoconjugates) ☐ Lipids (saturated and unsaturated fatty acids, Tri-acylglycerols, Phospholipids, Glycolipids, Steroids) ☐ Structure, Classification and General properties of α-amino acids; Essential and non-essential α-amino acids, Levels of organization in proteins; Simple and conjugate proteins. 	8
II	Enzyme Action and Regulation <ul style="list-style-type: none"> ● Nomenclature and classification of enzymes; Cofactors; Specificity of enzyme action ● Isozymes; Mechanism of enzyme action ● Enzyme kinetics; Factors affecting rate of enzyme-catalyzed reactions; Derivation of Michaelis-Menten equation, Concept of K_m and V_{max}, Enzyme inhibition ● Allosteric enzymes and their kinetics; Regulation of enzyme action 	8
III	Metabolism of Carbohydrates and Lipids <ul style="list-style-type: none"> ● Metabolism of Carbohydrates: glycolysis, citric acid cycle, gluconeogenesis, phosphate pentose pathway ● Glycogenolysis and Glycogenesis ● Lipids --- Biosynthesis of palmitic acid; Ketogenesis, 	8

	<ul style="list-style-type: none"> • β-oxidation and omega -oxidation of saturated fatty acids with even and odd number of carbon atoms 	
IV	Metabolism of Proteins and Nucleotides <ul style="list-style-type: none"> • Catabolism of amino acids: Transamination, Deamination, Urea cycle • Nucleotides and vitamins • Peptide linkages 	6
V	Digestion and Respiration <ul style="list-style-type: none"> ☐ Structural organization and functions of gastrointestinal tract and associated glands ☐ Mechanical and chemical digestion of food; Absorptions of carbohydrates, lipids, proteins, water, minerals and vitamins; Histology of trachea and lung ☐ Mechanism of respiration, Pulmonary ventilation; Respiratory volumes and capacities; Transport of oxygen and carbon dioxide in blood Respiratory pigments, Dissociation curves and the factors influencing it; Control of respiration 	7
VI	Circulation and Excretion <ul style="list-style-type: none"> ☐ Components of blood and their functions; haemopoiesis ☐ Blood clotting: Blood clotting system, Blood groups: Rh factor, ABO and MN ☐ Structure of mammalian heart ☐ Cardiac cycle; Cardiac output and its regulation, Electrocardiogram, Blood pressure and its regulation ☐ Structure of kidney and its functional unit; Mechanism of urine formation 	8
VII	Nervous System and Endocrinology in humans <ul style="list-style-type: none"> ☐ Structure of neuron, resting membrane potential ☐ Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibers ☐ Types of synapse ☐ Endocrine glands - pineal, pituitary, thyroid, parathyroid, pancreas, adrenal; hormones secreted by them ☐ Classification of hormones; Mechanism of Hormone action 	8
VIII	Muscular System in humans <p>Histology of different types of muscle; Ultra structure of skeletal muscle; Molecular and chemical basis of muscle contraction; Characteristics of muscle twitch; Motor unit, summation and tetanus</p>	7
Suggested Readings: <ol style="list-style-type: none"> 1. Nelson & Cox: Lehninger's Principles of Biochemistry: McMillan (2000) 2. Zubayet <i>al</i>: Principles of Biochemistry: WCB (1995) 3. Voet&Voet: Biochemistry Vols 1 & 2: Wiley (2004) 4. Murray <i>et al</i>: 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. Herculart Asia PTE Ltd. /W.B. Saunders Company. (2006).
6. Tortora, G.J. & Grabowski, S. Principles of Anatomy & Physiology. XI Edition John Wiley & sons (2006).
7. Christopher D. Moyes, Patricia M. Schulte. Principles of Animal Physiology. 3rd Edition, Pearson Education (2016).
8. Hill, Richard W., et al. Animal physiology. Vol. 2. Sunderland, MA: Sinauer Associates, (2004).
9. Chatterjee C C Human Physiology Volume 1 & 2. 11th edition. CBS Publishers(2016).

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

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

Suggested Continuous Evaluation Methods:

Total Marks: 25

House Examination/Test: 10 Marks

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

Class performance/Participation: 5 Marks

Further Suggestions: None

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

Programme/Class: Certificate	Year: First	Semester: Second
Subject: ZOOLOGY		
Course Code: B050202P/R	Course Title: Physiological, Biochemical & Hematology Lab	
Paper Code: 0220580		
Course outcomes: The student at the completion of the course will be able to: <ul style="list-style-type: none"> ● Understand the structure of biomolecules like proteins, lipids and carbohydrates ● Perform basic hematological laboratory testing, ● Distinguish normal and abnormal hematological laboratory findings to predict the diagnosis of hematological disorders and diseases. 		
Credits: 2	Core: Compulsory	
Max. Marks: 25+75	Min. Passing Marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:0-0-4		
Unit	Topics	Total No. of Lectures (60)
I	<ol style="list-style-type: none"> 1. Estimation of haemoglobin using Sahli's haemoglobinometer 2. Preparation of haemin and haemochromogen crystals 3. Counting of RBCs and WBCs using Haemocytometer 4. To study different mammalian blood cell types using Leishman stain. 5. Recording of blood pressure using a sphygmomanometer 6. Recording of blood glucose level by using glucometer 	20
II	<ol style="list-style-type: none"> 1. Study of permanent slides of Mammalian skin, Cartilage, Bone, Spinal cord, Nerve cell, Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid 2. Recording of simple muscle twitch with electrical stimulation (or Virtual) 3. Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee jerk reflex) 	15
III	<ol style="list-style-type: none"> 1. To prepare molecular models of nucleotides, amino acids, dipeptides using bead and stick method. 2. Ninhydrin test for α-amino acids. 3. Benedict's test for reducing sugar and iodine test for starch. 4. Test for sugar and acetone in urine. 5. Qualitative tests of functional groups in carbohydrates, proteins and lipids. 6. Action of salivary amylase under optimum conditions. 	10

IV	Virtual Labs (Suggestive sites) <ol style="list-style-type: none">1. https://www.vlab.co.in2. https://zoologysan.blogspot.com3. www.vlab.iitb.ac.in/vlab4. www.onlinelabs.in5. www.powershow.com6. https://vlab.amrita.edu7. https://sites.dartmouth.edu	15
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Suggested Readings:		
<ol style="list-style-type: none"> 1. Cox, M.M and Nelson, D.L. (2008). Lehninger’s Principles of Biochemistry, V Edition, W.H. Freeman and Co., New York. 2. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2007). Biochemistry, VI Edition, W.H. Freeman and Co., New York. 3. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company. 4. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons 5. Victor P. Eroschenko. (2008). diFiore’s Atlas of Histology with Functional correlations. XII Edition. Lippincott W. & Wilkins. 6. Arey, L.B. (1974). Human Histology. IV Edition. W.B. Saunders. 7. Kesar, Saroj and Vashishta N. (2007). Experimental Physiology: Comprehensive Manual. Heritage Publishers, New Delhi 		
Course Books published in Hindi may be prescribed by the Universities and Colleges		
Course prerequisites: To study this course, a student must have had the subject biology in class/12 th The eligibility for this paper is 10+2 from Arts/ Commerce/ Science		
Suggested Continuous Evaluation Methods:		
Total Marks: 25		
House Examination/Test: 10 Marks		
Written Assignment/Presentation/Project / Term Papers/Seminar: 10 Marks		
Class performance/Participation: 5 Marks		
Further Suggestions: None		

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

Programme/Class: Diploma	Year: Second	Semester: Third
Subject: ZOOLOGY		
Course Code: B050301T	Course Title: Molecular Biology, Bioinstrumentation & Biotechniques	
Paper Code: 0320501		
Course outcomes: The student at the completion of the course will be able to have: <ul style="list-style-type: none"> ● A detailed and conceptual understanding of molecular processes viz. DNA to trait. ● A clear understanding of the processes of central dogma viz. transcription, translation etc. underlying survival and propagation of life at molecular level. ● Understanding of how genes are ultimately expressed as proteins which are responsible for the structure and function of all organisms. ● Learn how four sequences (3 letter codons) generate the transcripts of life and determine the phenotypes of organisms. ● How genes are regulated differently at different time and place in prokaryotes and eukaryotes. 		
Credits: 4	Core: Compulsory	
Max. Marks: 25+75	Min. Passing Marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:4-0-0		
Unit	Topic	Total No. of Lectures (60)
I	Protein synthesis I: Process of Transcription <ul style="list-style-type: none"> ● Fine structure of gene ● RNA polymerases ● Transcription factors and machinery ● Formation of initiation complex ● Initiation, elongation and termination of transcription in prokaryotes and eukaryotes 	7
II	Process of Translation <ul style="list-style-type: none"> ● The Genetic code ● Ribosome ● Factors involved in translation ● Aminoacylation of tRNA, tRNA-identity, aminoacyl-tRNA-synthetase ● Initiation, elongation and termination of translation in prokaryotes and eukaryotes 	7
III	Regulation of Gene Expression I <ul style="list-style-type: none"> ☐ Regulation of gene expression in prokaryotes: <i>lac</i> and <i>Trp</i> operons in <i>E. coli</i> ☐ Regulation of gene expression in eukaryotes: Role of chromatin in gene expression ☐ Regulation at transcriptional level, Post-transcriptional 	8

	modifications: Capping, Splicing, Polyadenylation <ul style="list-style-type: none"> ● RNA editing. 	
IV	Regulation of Gene Expression II <ul style="list-style-type: none"> ● Regulation of gene expression in eukaryotes: ● Regulation at translational level, Post-translational modifications etc. ● Intracellular protein degradation ● Gene silencing, RNA interference (RNAi) 	8
V	Principle and Types of Microscopes <ul style="list-style-type: none"> ● Principle of Microscopy and Applications ● Types of Microscopes: light microscopy, dark field microscopy, phase-contrast microscopy, ● Fluorescence microscopy, confocal microscopy, electron microscopy 	6
VI	Centrifugation and Chromatography <ul style="list-style-type: none"> ● Principle of Centrifugation ● Types of Centrifuges: high speed and ultracentrifuge ● Types of rotors: Vertical, Swing-out, Fixed-angle etc. ● Principle and Types of Chromatography: paper, ion-exchange, gel filtration, HPLC, affinity 	8
VII	Spectrophotometry and Biochemical Techniques <ul style="list-style-type: none"> ● Biochemical techniques: Measurement of pH, Preparation of buffers and solutions ● Principle of Colorimetry/Spectrophotometry: Beer-Lambert law ● Measurement, applications and safety measures of radio-tracer techniques 	8
VIII	Molecular Techniques <ul style="list-style-type: none"> ● Detection of nucleic acid by gel electrophoresis ● DNA sequencing DNA fingerprinting, RFLP ● Polymerase Chain Reaction (PCR) ● Detection of proteins, PAGE, ELISA, Western blotting 	8

Suggested Readings:

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

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

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

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

Suggested Continuous Evaluation Methods:

House Examination/Test: 10 Marks

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

Class performance/Participation: 5 Marks

Further Suggestions: None

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

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Programme/Class: Diploma	Year: Second	Semester: Third
Subject: ZOOLOGY		
Course Code: B050302P	Course Title: Bioinstrumentation & Molecular Biology Lab	
Paper Code: 0320580		
Course outcomes: The student at the completion of the course will be able to <ul style="list-style-type: none"> ● Understand the basic principles of microscopy, working of different types of microscopes ● Understand the basic techniques of centrifugation and chromatography for studying cells and separation of biomolecules ● Understand the principle of measuring the concentrations of macromolecules in solutions by colorimeter and spectrophotometer and use them in Biochemistry. ● Learn about some of the commonly used advance DNA testing methods. 		
Credits: 2		Core: Compulsory
Max. Marks: 25+75		Min. Passing Marks: as per rules
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4		
Unit	Topic	Total No. of Lectures (60)
I	1. To study the working principle and Simple, Compound and Binocular microscopes. 2. To study the working principle of various lab equipment such as pH Meter, Electronic balance, use of glass and micropipettes, Laminar flow, Incubator, Waterbath, Centrifuge, Chromatography apparatus, etc.(Any three)	15
II	1. To prepare solutions and buffers. 2. To measure absorbance in Colorimeter or Spectrophotometer. 3. Demonstration of differential centrifugation to fractionate different components in a mixture (Optional).	15
III	1. To identify different amino acids in a mixture using paper chromatography. 2. Demonstration of DNA extraction from blood or tissue samples. 3. To estimate amount of DNA using spectrophotometer.	15

IV	Virtual Labs (Suggestive sites) www.labinapp.com www.uwlax.edu www.labster.com www.onlinelabs.in www.powershow.in https://vlab.amrita.edu	15
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	info@premiereducationaltechnologyies.com https://li.wsu.edu	
<p>Suggested Readings:</p> <ol style="list-style-type: none"> 1. Sambrook <i>et al</i> .Molecular Cloning Vols I, II, III. CSHL (2001). 2. Primrose. Molecular Biotechnology. Panima (2001). 3. Clark & Switzer. Experimental Biochemistry. Freeman (2000) <p style="text-align: center;">Course Books published in Hindi may be prescribed by the Universities and Colleges</p>		
<p>This course can be opted as an elective by the students of following subjects:</p> <p style="text-align: center;">The eligibility for this paper is 10+2 from Arts/Commerce/Science</p>		
<p>Suggested Continuous Evaluation Methods:</p> <p>House Examination/Test: 10 Marks</p> <p>Written Assignment/Presentation/Project / Term Papers/Seminar: 10 Marks</p> <p>Class performance/Participation: 5 Marks</p>		
Further Suggestions: None		

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

Programme/Class: Diploma	Year: Second	Semester: Fourth
Subject: ZOOLOGY		
Course Code: B050401T	Course Title: Gene Technology, Immunology and Computational Biology	
Paper Code: 0420501		
Course outcomes: The student at the completion of the course will be able to: <ul style="list-style-type: none"> • Understand the principles of genetic engineering, how genes can be cloned in bacteria and the various technologies involved in it. • Know the applications of biotechnology in various fields like agriculture, industry and human health. • To have an in depth understanding about Immune System & its mechanisms. • Get introduced to DNA testing and utility of genetic engineering in forensic sciences. • Get introduced to computers and use of bioinformatics tools. • Enable students to get employment in pathology/Hospital. • Take up research in biological sciences. 		
Credits: 4		Core: Compulsory
Max. Marks: 25+75		Min. Passing Marks: as per rules
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0		
Unit	Topic	Total No. of Lectures (60)
I	Principles of Gene Manipulation <ul style="list-style-type: none"> • Recombinant DNA Technology • Selection and identification of recombinant cells • Restriction Enzymes, DNA modifying enzymes, Cloning Vectors, Ligation • Gene transfer techniques, Gene therapy 	10
II	Applications of Genetic Engineering <ul style="list-style-type: none"> • Single cell proteins • Biosensors, Biochips • Crop and live stock improvement, development of transgenics • Development of DNA drugs and vaccines 	8
III	DNA Diagnostics <ul style="list-style-type: none"> • Genetic analysis of human diseases, detection of known and unknown mutations • Concept of pharmacogenomics and pharmacogenetics 	4
IV	Immune System and its Components <ul style="list-style-type: none"> • Historical perspective of Immunology, Innate and Adaptive Immunity, clonal selection, complement system • Structure and functions of different classes of immunoglobulins, Hypersensitivity • Humoral immunity and cell mediated immunity • Suitable examples of Autoimmunity, immune deficiency, transplantation rejection 	10

V	Biostatistics I <ul style="list-style-type: none">• Calculations of mean, median, mode, variance, standard deviation• Concepts of coefficient of variation, Skewness, Kurtosis• Elementary idea of probability and application	7
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VI	Biostatistics II <ul style="list-style-type: none"> ● Data summarizing: frequency distribution, graphical presentation pie diagram, histogram ● Tests of significance: one and two sample tests, t-test and Chi-square test 	7
VII	Basics of Computers <ul style="list-style-type: none"> ● Basics (CPU, I/O units) and operating systems ● Concept of homepages and websites, World Wide Web, URLs, using search engines 	6
VIII	Bioinformatics <ul style="list-style-type: none"> ● Databases: nucleic acids, genomes, protein sequences and structures, FASTA format, Bibliography ● Sequence analysis (homology): pairwise and multiple sequence alignments-BLAST 	8
Suggested Readings: <ol style="list-style-type: none"> 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 <i>et al.</i> Molecular Cloning Vols I, II, III. CSHL (2001). 4. Primrose. Molecular Biotechnology. Panima (2001). 5. Clark & Switzer. Experimental Biochemistry. Freeman (2000) 6. Sudbery. Human Molecular Genetics. Prentice-Hall (2002). 7. Wilson. Clinical Genetics-A Short Course, Wiley (2000). 8. Pasternak. An Introduction to Molecular Human Genetics. Fitzgerald (2000). 9. Biostatistical Analysis (Fourth Edition) by Jerrold H. Zarr, Pearson Education Inc., Delhi. 10. Statistical Methods (Eighth Edition) by G. W. Snedecor and W. G. Cochran, Willey Blackwell 11. Biostatistics (Tenth Edition) by W.W. Daniel and C. L. Cross, Wiley 12. Introductory Biological Statistics (Fourth Edition) by John E. Havel, Raymond E. Hampton and Scott J. Meiners 13. Westhead <i>et al</i> Bioinformatics: Instant Notes. Viva Books (2003). <p style="text-align: center;">Course Books published in Hindi may be prescribed by the Universities and Colleges</p>		
This course can be opted as an elective by the students of following subjects: The eligibility for this paper is 10+2 with Biology as one of the subject		
Suggested Continuous Evaluation Methods: <p>House Examination/Test: 10 Marks</p> <p>Written Assignment/Presentation/Project / Term Papers/Seminar: 10 Marks</p> <p>Class performance/Participation: 5 Marks</p>		
Further Suggestions: None		

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

Programme/Class: Degree	Year: Second	Semester: Fourth
Subject: ZOOLOGY		
Course Code: B050402P/R	Course Title: Genetic Engineering and Counselling Lab	
Paper Code: 0420580		
Course outcomes: The student at the completion of the course will be able to: <ul style="list-style-type: none"> ● Understand the principles of genetic engineering with hands-on experiments in mutation detection, testing of infectious diseases like Covid 19. ● Get introduced to DNA testing and utility of genetic engineering in forensic sciences. ● 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. ● Use bioinformatics tools to find out evolutionary/phylogenetic relationship of organisms using gene sequences. ● Get employment in Hospitals/Diagnostic and forensic labs/Counsel families with genetic disorders. ● Enable students to take up research in biological sciences. 		
Credits: 2	Core: Compulsory	
Max. Marks: 25+75	Min. Passing Marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:0-0-4		
Unit	Topic	Total No. of Lectures (60)
I	1. Calculate mean, median, mode, standard deviation etc. With suitable biological examples. 2. Measure the height and weight of all students in the class and apply statistical measures of central and variability tendencies.	10
II	1. Determination of ABO Blood group 2. To perform bacterial culture and calculate generation time of bacteria. 3. To study Restriction enzyme digestion using teaching kits. 4. To detect genetic mutations by Polymerase Chain Reaction (PCR) using teaching kits. 5. Demonstration of agarose gel electrophoresis for detection of DNA. 6. Demonstration of Polyacrylamide Gel Electrophoresis (PAGE) for detection of proteins. 7. To calculate molecular weight of unknown DNA and protein fragments from gel pictures.	20

III	<ol style="list-style-type: none">1. To learn the basics of computer applications2. To learn sequence analysis using BLAST(NCBI)3. To learn how to perform Primer designing for PCR using available softwares etc.	15
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IV	Virtual Labs (Suggestive sites) <ol style="list-style-type: none"> 1. Gel Documentation System- https://youtu.be/WPpt3-FanNE 2. Colorimeter- https://youtu.be/v4aK6G0bGuU 3. PCR Part 1- https://youtu.be/CpGX1UFSI4A 4. PCR Part 2- https://youtu.be/6lCHAYPTAEw 5. DNA isolation Part 1- https://youtu.be/QE7UI0JnY9 6. DNA isolation part 2- https://youtu.be/-efr_HFeHxM 7. DNA curve- https://youtu.be/ubL8QxTeuG4 8. Spectrophotometer- https://youtu.be/ubL8QxTeuG4 9. Agarose Part 1- https://youtu.be/7gvHPFww--g 10. Agarose part 2- https://youtu.be/j_bOZCHNsSg 11. Use softwares like Primer3, NEB cutter 12. NCBI, BLAST, CLUSTAL W, PHYLP 	15
Suggested Readings: <ol style="list-style-type: none"> 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 <i>et al.</i> Molecular Cloning Vols I, II, III. CSHL (2001). 4. Primrose. Molecular Biotechnology. Panima (2001). <p style="text-align: center;">Course Books published in Hindi may be prescribed by the Universities and Colleges</p>		
This course can be opted as an elective by the students of following subjects: <p style="text-align: center;">The eligibility for this paper is 10+2 from Arts/Commerce/Science</p>		
Suggested Continuous Evaluation Methods: House Examination/Test: 10 Marks Written Assignment/Presentation/Project / Term Papers/Seminar: 10 Marks Class performance/Participation: 5 Marks		
Further Suggestions: None		

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

Programme/Class: Degree	Year: Third	Semester: Fifth
Subject: ZOOLOGY		
Course Code: B050501T	Course Title: Diversity of Non-Chordates and Economic Zoology	
Paper Code: 0520501		
Course outcomes: The student at the completion of the course will be able to: The student at the completion of the course will be able to: <ul style="list-style-type: none"> ● demonstrate comprehensive identification abilities of non-chordate diversity ● explain structural and functional diversity of non-chordate ● explain evolutionary relationship amongst non-chordate groups ● Get employment in different applied sectors ● Students can start their own business i.e. self employments. ● Enable students to take up research in Biological Science 		
Credits: 4		Core: Compulsory
Max. Marks: 25+75		Min. Passing Marks: as per rules
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0		
Unit	Topic	Total No. of Lectures (60)
I	Protozoa to Coelenterate – Salient features and outline classification included <ul style="list-style-type: none"> ☐ Protozoa – <i>Paramecium</i> (Morphology and Reproduction) ☐ Porifera – <i>Sycon</i>(Canal System) ☐ Coelenterata – <i>Obelia</i> (Morphology and Reproduction) 	7
II	Ctenophora to Nematelminthes -Salient features and outline classification included <ul style="list-style-type: none"> ☐ Ctenophora - Salient features ☐ Platyhelminthes - <i>Taenia</i> (Tape worm) (Morphology and Reproduction) ☐ Nematelminthes –<i>Ascaris lumbricoides</i> (Morphology and Reproduction) 	7
III	Annelida-Salient features and outline classification included <ul style="list-style-type: none"> ● Annelida –<i>Hirudinaria</i> (Leech) (Morphology and Reproduction) 	8
IV	Arthropoda- Salient features and outline classification included <ul style="list-style-type: none"> ● Arthropoda – <i>Palaemon</i> (Prawn) (Morphology, Appendages, Nervous System and Reproduction) 	8

V	<p>Mollusca to Hemichordata- Salient features and outline classification included</p> <ul style="list-style-type: none"> ☐ Mollusca – <i>Pila</i>(Morphology, Shell, Respiration, Nervous System and Reproduction) ☐ Echinodermata –<i>Pentaceros</i> (Morphology and Water Vascular System) 	8
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VI	Vectors and pests Life cycle and their control of following pests: Gundhi bug, Sugarcane leafhopper, Rodents. Termites and Mosquitoes and their control	8
VII	Economic Zoology-1 Animal breeding and culture: Pisciculture	7
VIII	Economic Zoology- 2 Sericulture, Apiculture, Lac-culture, Vermiculture	7
<p>Suggested Readings:</p> <ol style="list-style-type: none"> 1. Barnes et al (2009). The Invertebrates: A synthesis. Wiley Backwell 17 2. Hunter: Life of Invertebrates (1979, Collier Macmillan) 3. Marshall: Parker & Haswell Text Book of Zoology, Vol. I (7th ed 1972, Macmillan) 4. Moore: An Introduction to the Invertebrates (2001, Cambridge University Press) 5. Brusca and Brusca (2016) Invertebrates. Sinauer 6. Jan Pechenik (2014) Biology of the invertebrates. McGraw Hill 7. Neilsen (2012). Animal Evolution: Interrelationships amongst living Phyla. Oxford 8. Parasitology- Chatterjee 9. Parasitology- Chakraborty 10. Thoms C. Chung. General Parasitology. Hardcourt Brace and Co. Ltd. Asia, New Delhi. 11. Gerard D. Schmidt and Larry S Roberts. Foundations of Parasitology. McGraw Hill. 12. Bisht. D.S., <i>Apiculture</i>, ICAR Publication. 13. Singh S., <i>Beekeeping in India</i>, Indian council of Agricultural Research, New Delhi. 14. Jhingran. V.G. Fish and fisheries in India., 15. Khanna. S.S, An introduction to fishes 16. Boyd. C.E. & Tucker. C.S, Pond aquaculture water quality management, 17. Biswas.K.P, Fish and prawn diseases, 18. Pedigo, L.P. (2002). <i>Entomology and Pest Management</i>, Prentice Hall. 19. Lee, Earthworm Ecology 20. Stevenson, Biology of Earthworms 21. Destructive and Useful Insects by C. L. Metcalf 22. Sericulture for Rural Development : Hanumappa (1978), Himalaya Publication, 23. Sericulture in India Sarkar, D.C. (1988), CSB, Bangalore. <p style="text-align: center;">Course Books published in Hindi may be prescribed by the Universities and Colleges</p>		
<p>This course can be opted as an elective by the students of following subjects:</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>House Examination/Test: 10 Marks</p> <p>Written Assignment/Presentation/Project / Term Papers/Seminar: 10 Marks</p> <p>Class performance/Participation: 5 Marks</p>		
Further Suggestions: None		

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

Programme/Class: Degree	Year: Third	Semester: Fifth
Subject: ZOOLOGY		
Course Code: B050502T	Course Title: Diversity of Chordates and Comparative	
Paper Code: 0520502	Anatomy	
Course outcomes: The student at the completion of the course will be able to: <ul style="list-style-type: none"> ● Demonstrate comprehensive identification abilities of chordate diversity ● Explain structural and functional diversity of chordates ● Explain evolutionary relationship amongst chordates ● Take up research in biological sciences. 		
Credits: 4	Core Compulsory/Elective	
Max. Marks: 25+75	Min. Passing Marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0		
Unit	Topic	Total No. of Lectures (60)
I	Origin of Chordates & Hemichordata- Salient features and outline classification included <ul style="list-style-type: none"> ● Origin of Chordates. Classification of Phylum Chordata upto the class. ● Hemichordata: General characteristics, classification and detailed study of <i>Balanoglossus</i>(Habit and Habitat, Morphology, Anatomy, Physiology and Development). 	6
II	Cephalochordata and Urochordata--Salient features and outline classification included <ul style="list-style-type: none"> ● (ii)Urochordata : General characteristics, classification and detailed study of <i>Herdmania</i>(Habit and Habitat, Morphology, Anatomy, Physiology and Post Embryonic Development ● Cephalochordata : General characteristics, classification and detailed study of <i>Branchiostoma (Amphioxus)</i> (Habit and Habitat, Morphology, Anatomy, Physiology). 	6
III	Classification and General Characteristics of Vertebrates <ul style="list-style-type: none"> ● 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 	8

IV	Comparative Anatomy and Physiology of Vertebrates Integumentary System Structure, functions and derivatives of integument Skeletal System Overview of axial and appendicular skeleton, Jaw suspensorium, Visceral arches	8
V	Digestive System Alimentary canal and associated glands, dentition	

		8
VI	Respiratory System Skin, gills, lungs and air sacs; Accessory respiratory organs	8
VII	Circulatory System General plan of circulation, evolution of heart and aortic arches Urinogenital System Succession of kidney, Evolution of urinogenital ducts, Types of mammalian uteri	8
VIII	Nervous System Comparative account of brain, structure and evolution of brain in vertebrates Autonomic nervous system, Spinal cord, Cranial nerves in mammals Sense Organs Classification of receptors Brief account of visual and auditory receptors in man	8
Suggested Readings:		
<ol style="list-style-type: none"> 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. Weichert C.K and William Presch (1970). Elements of Chordate Anatomy, Tata McGraw Hills 		
Course Books published in Hindi may be prescribed by the Universities and Colleges		
This course can be opted as an elective by the students of following subjects:		
The eligibility for this paper is 10+2 with Biology as one of the subject		
Suggested Continuous Evaluation Methods:		
House Examination/Test: 10 Marks		
Written Assignment/Presentation/Project / Term Papers/Seminar: 10 Marks		
Class performance/Participation: 5 Marks		
Further Suggestions: None		

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

Programme/Class: Degree	Year: Third	Semester: Fifth
Subject: ZOOLOGY		
Course Code: B050503P	Course Title: Lab on Virtual Dissection, Anatomy, Economic Zoology and Parasitology	
Paper Code: 0520580		
Course outcomes: The student at the completion of the course will be able to: <ul style="list-style-type: none"> ● demonstrate comprehensive identification abilities of chordate and non- chordates diversity ● explain structural and functional diversity of chordates and non- chordates ● explain evolutionary relationship amongst chordates and non- chordates ● Generate self employment ● Enable students to take up research in biological sciences. 		
Credits: 2	Core: Compulsory	
Max. Marks: 25+75	Min. Passing Marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4		
Unit	Topic	Total No. of Lectures (60)
I	Study of animal specimens of various animal phyla. 1.To prepare permanent stained slide of septal nephridia of earthworm. 2.To take out the nerve ring of earthworm. 3.To study statocyst, appendages and hastate plate from <i>Palaemon</i> .(Demo/online allowed)	15
II	1.Study of animal specimens of various animal phyla 2. Study on use and ethical handling of model organisms (Mice, rats, rabbit and pig). 3. To prepare stained/unstained slide of placoid scales. 1. Comparative study of bones of different vertebrates. 2. Comparative study of histological slides of different tissues of vertebrates.	15

<p style="text-align: center;">III</p>	<ol style="list-style-type: none"> 1. Permanent Preparation of: <i>Euglena, Paramecium</i> 2. Study of prepared slides/specimens of <i>Entamoeba, Giardia, Leishmania, Trypanosoma, Plasmodium, Fasciola, Taenia, Polystoma Schistosoma, Echinococcus, Enterobius, Ascaris and Ancylostoma</i> 3. Permanent Preparation of <i>Cimex</i> (bed bug)/ <i>Pediculus</i> (Louse), <i>Haematopinus</i> (cattle louse), fresh water annelids, arthropods; and soil arthropods as per availability. Manual microtomy has been proposed subject to consideration of members (Demo system allowable) 4. Larval stages of helminths and arthropods. 5. Permanent mount of wings, mouth parts and developmental stages of mosquito and house fly. Permanent preparation of ticks/ mites, abdominal gills of aquatic insects viz. Chironomus larva, dragonfly and mayfly nymphs, preparation of antenna of housefly. 6. Identification of pests. 7. Life history of silkworm, honeybee and lac insect. 8. Different types of important edible fishes of India. 	<p style="text-align: center;">15</p>
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	<p>9. Study of an aquatic ecosystem, its biotic components and food chain.</p> <p>10. Project Report/ model chart making.</p> <p>11. Dissections : through multimedia / models</p> <p>12. Cockroach : Central nervous system</p> <p>13. Wallago: Afferent and efferent branchial vessels, Cranial nerves, Weberian ossicles.</p>	
IV	<p>Virtual Labs (Suggestive sites)</p> <p>https://www.vlab.co.in</p> <p>https://zoologysan.blogspot.com</p> <p>www.vlab.iitb.ac.in/vlab</p> <p>https://www.vlab.co.in</p> <p>https://zoologysan.blogspot.com</p> <p>www.vlab.iitb.ac.in/vlab</p> <p>www.onlinelabs.in</p> <p>www.powershow.com</p> <p>https://vlab.amrita.edu</p> <p>https://sites.dartmouth.edu</p>	15

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. Barnes et al (2009). The Invertebrates: A synthesis. Wiley Backwell 17
10. Marshall: Parker & Haswell Text Book of Zoology, Vol. I (7th ed 1972, Macmillan)
11. Moore: An Introduction to the Invertebrates (2001, Cambridge University Press)
12. Brusca and Brusca (2016) Invertebrates. Sinauer
13. Jan Pechenik (2014) Biology of the invertebrates. McGraw Hill
14. Boradale, L.A. and Potts, E.A. (1961). Invertebrates: A Manual for the use of Students. Asia Publishing Home
15. Robert Leo Smith Ecology and field biology Harper and Row publisher
16. Handbook of Practical Sericulture :Ullal, S.R. and Narasimhanna, M.N. (1987), Central Silk Board Publication, Bangalore.
17. Prost, P. J. (1962). *Apiculture*. Oxford and IBH, New Delhi.
18. Bisht. D.S., *Apiculture*, ICAR Publication.
19. Singh S., *Beekeeping in India*, Indian council of Agricultural Research, New Delhi.
20. Ullal S.R. and Narasimhanna, M.N. Handbook of Practical Sericulture: CSB, Bangalore
21. Jolly. M. S. Appropriate Sericultural Techniques; Ed., Director, CSR & TI, Mysore.
22. Handbook of Silkworm Rearing: Agriculture and Technical Manual-1, Fuzi Pub. Co.
23. Santanam, B. *et al*, A manual of freshwater aquaculture
24. Boyd. C.E. & Tucker. C.S, Pond aquaculture water quality management
25. Pedigo, L.P. (2002). *Entomology and Pest Management*, Prentice Hall.
26. Ranganathan L.S, Vermicomposting technology- soil health to human health

Course Books published in Hindi may be prescribed by the Universities and Colleges
<p>This course can be opted as an elective by the students of following subjects:</p> <p>The eligibility for this paper is 10+2 from Arts/Commerce/Science</p>
<p>Suggested Continuous Evaluation Methods:</p> <p>House Examination/Test: 10 Marks Written Assignment/Presentation/Project / Term Papers/Seminar: 10 Marks Class performance/Participation: 5 Marks</p>
Further Suggestions: None

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

Programme/Class: Degree	Year: Third	Semester: Sixth
Subject: ZOOLOGY		
Course Code: B050601T	Course Title: Evolutionary and Developmental Biology	
Paper Code: 0620501		
Course outcomes: The student at the completion of the course will be able to:		
<ul style="list-style-type: none"> • Understand that by biological evolution we mean that many of the organisms that inhabit the earth today are different from those that inhabited it in the past. • Understand that natural selection is one of several processes that can bring about evolution, although it can also promote stability rather than change. • Understand how the single cell formed at fertilisation forms an embryo and then a full adult organism. • Integrate genetics, molecular biology, biochemistry, cell biology, anatomy and physiology during embryonic development. • Understand a variety of interacting processes, which generate an organism's heterogeneous shapes, size, and structural features. • Understand how a cell behaves in response to an autonomous determinant or an external signal, and the scientific reasoning exhibited in experimental life science. 		
Credits: 4	Core: Compulsory	
Max. Marks: 25+75	Min. Passing Marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0		
Unit	Topic	Total No. of Lectures (60)
I	Theories of Evolution <ul style="list-style-type: none"> • Origin of Life • Historical review of evolutionary concept: Lamarckism, Darwinism (Natural, Sexual and Artificial selection) • Modern synthetic theory of evolution • Patterns of evolution (Divergence, Convergence, Parallel, Coevolution) 	8
II	Population Genetics <ul style="list-style-type: none"> • Microevolution and Macroevolution: allele frequencies, genotype frequencies, Hardy-Weinberg equilibrium and conditions for its maintenance • Forces of evolution: mutation, selection, genetic drift 	8
III	Direct Evidences of Evolution Types of fossils, Incompleteness of fossil record, Dating of fossils, Phylogeny of horse	7
IV	Species Concept and Extinction <ul style="list-style-type: none"> • Biological species concept (Advantages and Limitations); Modes of speciation (Allopatric, Sympatric) 	7

	<ul style="list-style-type: none"> ● Mass extinction (Causes, Names of five major extinctions) 	
V	Gamete Fertilization and Early Development <ul style="list-style-type: none"> ● Gametogenesis, Fertilization ● Cleavage pattern ● Gastrulation, fate maps ● Morphogenesis 	6
VI	Developmental Genes <ul style="list-style-type: none"> ● General concepts of organogenesis ● Introduction to genetic basis of embryonic development ● Developmental control genes (Homeobox genes) 	8
VII	Early Vertebrate Development <ul style="list-style-type: none"> ● Early development of vertebrates (fish, birds & mammals) ● Metamorphosis, regeneration ● Environmental regulation of development 	8
VIII	Late Developmental Processes <ul style="list-style-type: none"> ● Development of eye, kidney, limb in amphibian ● Mammalian female reproductive cycles estrous cycle and menstruation ● Aging: the biology of senescence 	8

Suggested Readings:

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

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

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

Suggested Continuous Evaluation Methods:

House Examination/Test: 10 Marks

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

Class performance/Participation:5 Marks

Further Suggestions: None

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

Programme/Class: Degree	Year: Third	Semester: Six
Subject: ZOOLOGY		
Course Code: B050602T	Course Title: Ecology, Ethology, Environmental Science and Wildlife	
Paper Code: 0620502		
Course outcomes: The student at the completion of the course will learn: <ul style="list-style-type: none"> • Complexities and interconnectedness of various environmental levels and their functioning. • Global environmental issues, their causes, consequences and amelioration. • To understand and identify behaviours in a variety of taxa. • The proximate and ultimate causes of various behaviours. • About the molecules, cells, and systems of biological timing systems. • Conceptualizing how species profitably inhabit in the temporal environment and space out their activities at different times of the day and seasons. • To interpret the cause and effect of lifestyle disorders contributing to public understanding of biological timing. • To understand the importance of wildlife conservation. 		
Credits: 4	Core: Compulsory	
Max. Marks: 25+75	Min. Passing Marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0		
Unit	Topic	Total No. of Lectures (60)
I	Introduction to Ecology <ul style="list-style-type: none"> • History of ecology, Autecology and synecology, Levels of organization, Laws of limiting factors, Study of physical factors 	4
II	Organization of Ecosystem <ul style="list-style-type: none"> • Levels of organization, Laws of limiting factors, Study of physical factors, • Population: Density, natality, mortality, life tables, fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion ,Exponential and logistic growth, • Types of ecosystems with one example in detail, Food chain: Detritus and grazing food chains, , Food web, Energy flow through the ecosystem, • Ecological pyramids and Ecological efficiencies, Nutrient and biogeochemical cycle with one example of Carbon cycle 	12
III	Community Ecology Community characteristics: species richness, dominance, diversity, abundance, Ecological succession with one example	7

IV	Environmental Hazards <ul style="list-style-type: none"> ● Sources of Environmental hazards ● Climate changes. Basics of environmental impact assessment ● Greenhouse gases and global warming ● Acid rain, Ozone layer destruction 	7
V	Effects of Climate Change <ul style="list-style-type: none"> ● Effect of climate change on public health ● Sources of waste, types and characteristics, Sewage disposal and its management, Solid waste disposal, Biomedical waste handling and disposal, ● Nuclear waste handling and disposal, Waste from thermal power plants, ● Case histories on Bhopal gas tragedy, Chernobyl disaster and their aftermath. 	6
VI	Behavioural Ecology and Chronobiology <ul style="list-style-type: none"> ● Origin and history of Ethology, ● Instinct vs. Learnt Behaviour ● Associative learning, classical and operant conditioning, Habituation, Imprinting, ● Biological clocks, Circadian rhythms; Tidal rhythms and Lunar rhythms, circannual rhythms ● Chronomedicine 	8
VII	Introduction to Wild Life <ul style="list-style-type: none"> ● Values of wild life - positive and negative; Conservation ethics; Importance of conservation; Causes of depletion; World conservation strategies. 	8
VIII	Protected areas <ul style="list-style-type: none"> ● National parks & sanctuaries, Community reserve; Important features of protected areas in India; Tiger conservation - Tiger reserves in India; Management challenges in Tiger reserve 	8

Suggested Readings:

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

University Press, UK.

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

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

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

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

Suggested Continuous Evaluation Methods:

House Examination/Test: 10 Marks

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

Class Performance/Participation: 5 Marks

Further Suggestions: None

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

Programme/Class: Degree	Year: Third	Semester: Sixth
Subject: ZOOLOGY		
Course Code: B050603P	Course Title: Lab on Ecology, Environmental Science, Behavioral Ecology & wildlife	
Paper Code: 0620580		
Course outcomes: The student at the completion of the course will be able to: <ul style="list-style-type: none"> ● 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. 		
Credits: 2	Core: Compulsory	
Max. Marks: 25+75	Min. Passing Marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4		
Unit	Topic	Total No. of Lectures (60)
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).	26
II	Report on a visit to National Park/Biodiversity Park/Wild life sanctuary	4
III	<ol style="list-style-type: none"> 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) 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 	15
IV	Virtual Labs (Suggestive sites) https://www.vlab.co.in https://zoologysan.blogspot.com www.vlab.iitb.ac.in/vlab	15



Suggested Readings:

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

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

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

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

Suggested Continuous Evaluation Methods:

House Examination/Test: 10 Marks

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

Class performance/Participation: 5 Marks

Further Suggestions: None

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

Programme/Class: Certificate	Year: First	Semester: First
Subject: ZOOLOGY (Skill course)		
Course Code:	Course Title: Basic Clinical Techniques- Part-I	
Course outcomes:		
The student at the completion of the course will be able to:		
<ul style="list-style-type: none"> ● adjust to protocols and guidelines relevant to the assistant role in clinical practice ● recognize the boundary of the clinical assistant responsibility ● exhibit managing potential to risks to the quality and patient safety. ● be aware of relevant legislation, standards, policies, and procedures followed in the clinics ● engage and supervise other providers in order to maintain quality continued care. ● PRACTICAL AND INTERNSHIP ON ALL UNITS WITH SKILL PARTNERS 		
Credits: 3		Core: Skill
Max. Marks: 25+75		Min. Passing Marks: as per rules
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 1-0-2		
Unit	Topics	Total No. of Lectures (15T+60P)
I	Health and Healthcare <ul style="list-style-type: none"> • Basic structure and functioning of the human body and healthcare in India; Biomedical terminology and abbreviation • IEC document and safety, Record keeping and report 	5T+6P
II	Laboratory Safety System <ul style="list-style-type: none"> ● Good laboratory practices, ● Autoclave- Working principle, parts. ● Deep freezers, Hot Air Oven ● Biomedical waste disposal- Theory and Practice, waste 	2T+12P
III	Collection of blood for various tests <ul style="list-style-type: none"> ● Collection of blood and other samples for analysis ● Preparation of blood smears, Antigen testing, ● PH meter- working and applications, Clinical relevance of blood PH ● Labelling, Storage and Sample transportation 	2T+12P
	Introduction to 24X7 Patient car <ul style="list-style-type: none"> ● Ambulatory blood pressure monitoring; Clinical Laboratory Improvement amendments ● Point-of-Care testing (Glucometer), oximeter, continuous glucose monitoring; maintaining data for sleep ● Diabetes care understanding of hypoglycaemia, its consequence 	3T+24P
	Care of Elderly <ul style="list-style-type: none"> ● Anatomy of ear and hearing function. ● Types of audiometers - Pure tone audiometer and speech audiometer, parts and operation of hearing aids. ● Walking support, wheelchair, ● National Programme for Health Care of the Elderly (NPHCE) 	
Suggested Readings:		
1. Text book of medical laboratory technology, Prafut Godkar; Bhalani Bhalani Publishing House 2. Manual of FIRST AID: Management of General injuries, Sports injuries and <u>Common Ailments</u> <u>LC Gupta, Abhitabh Gupta Jaypce</u>		

<p>3. Health Education and Community Pharmacy for First Year Diploma in Pharmacy 3EdV.N. Raje, CBS</p> <p>4. Textbook of Community Health Nursing 1, S.D. Manivannan CBS Nursing</p> <p>Course Books published in Hindi may be prescribed by the Universities and Colleges</p>
<p>Course prerequisites: To study this course, a student must have had the subject biology in class12th</p>
<p>Suggested Continuous Evaluation Methods:</p> <p style="text-align: center;">Total Marks: 25</p> <p>House Examination/Test: 10 Marks</p> <p>WrittenAssignment/Presentation/Project/Term Papers/Seminar:10Marks</p> <p>Class performance/Participation: 5 Marks</p>
<p>Further Suggestions: None</p>

Programme/Class: Certificate	Year: First	Semester: First
Subject: ZOOLOGY (Skill course)		
Course Code:	Course Title: Basic Clinical Techniques- Part-II	
Course outcomes:		
The student at the completion of the course will be able to:		
<ul style="list-style-type: none"> ● adjust to protocols and guidelines relevant to the assistant role in clinical practice ● recognize the boundary of the clinical assistant responsibility ● exhibit managing potential to risks to the quality and patient safety. ● be aware of relevant legislation, standards, policies, and procedures followed in the clinics ● engage and supervise other providers in order to maintain quality continued care. ● PRACTICAL AND INTERNSHIP ON ALL UNITS WITH SKILL PARTNERS 		
Credits: 3	Core: Skill	
Max. Marks: 25+75	Min. Passing Marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 1-0-2		
Unit	Topics	Total No. of Lectures (15T+60P)
I	Laboratory Instruments- I <ul style="list-style-type: none"> ● Microscopy - introduction , different types of microscopes, parts magnification, adjustments, compound microscope ● photoelectric colorimeter - working principle, block diagram, applications ● Centrifuge- parts, working, maintenance of tabletop centrifuge 	3T+1813
II	Laboratory Instruments- II <ul style="list-style-type: none"> ● Introduction to dialysis - Importance of dialysis, Types of dialysis - peritoneal dialysis and hemo dialysis, Hemodialysis ● Idea about liquid oxygen supply, defibrillators. ● First aid to pulmonary exacerbation 	2T+12P
III	Laboratory Instruments- III <ul style="list-style-type: none"> ● Fundamentals of Eletrolyte analyser, Blood gas analyser, incubator and waterbath , ● Familiarise Automatic Hetnoanalysers and blood cell counters, ● name and uses of Blood batik equipments-Blood bank refrigerators, cryo centrifuge,cry bath, Apheresis machines, donor couch, blood bag sealer, platelet agitator, blood shaker 	2T+12P
IV	Patient-Home and Hospital care <ul style="list-style-type: none"> ● sleep and sleep Hygeine ● Handling of pre-and post-disease anxiety ● Pre-and post- operative therapies ● <u>Rehabilitation</u> 	3T+24P
Suggested Readings:		
<ol style="list-style-type: none"> 1. Text book of medical laboratory technology, Prafut Godkar; Bhalani Bhalani Publishing House 2. Manual of FIRST AID: Management of General injuries, Sports injuries and <u>Common Ailments LC Gupta, Abhitabh Gupta Jaypce</u> 3. Health Education and Community Pharmacy for First Year Diploma in Pharmacy 3EdV.N. Raje, CBS 4. Textbook of Community Health Nursing 1, S.D. Manivannan CBS Nursing 		
Course Books published in Hindi may be prescribed by the Universities and Colleges		

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

Suggested Continuous Evaluation Methods:

Total Marks: 25

House Examination/Test: 10 Marks

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

Class performance/Participation: 5 Marks

Further Suggestions: None

Programme/Class: Certificate		Year: First	Semester: First
Subject: ZOOLOGY			
Course Code:		Course Title: Environment and Public Health challenges	
<p>Course outcomes: The student at the completion of the course will be able to:</p> <ul style="list-style-type: none"> ● contribute to capacity building to limit greenhouse gases and carbon footprint. ● understand importance of biodiversity and wildlife sustainability. ● take up green jobs contributing to preserve the environment, eco-sensitization programmes, emerging green sectors like renewable energy etc. ● append lifestyle correction to prevent diseases- like daily rhythm correction, yoga and meditation ● work in programmes addressing challenges of health and sanitation, epidemiology of communicable & non-Communicable diseases ● assist in strategizing for control of diseases of important public health problems. 			
Credits: 4		Core: Elective	
Max. Marks: 25+75		Min. Passing Marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0			
Unit	Topics	Total No. of Lectures (60)	
I	<p>Biological inputs to a low-carbon economy Introducing low-carbon economies for ecosystem resilience Biological impacts of global warming, rising sea levels, extremities of storms and cyclones Current trends of Climate change and its mitigation in India CPCB central pollution control board</p>	8	
II	<p>Sustainable wildlife protection Government legislations and bodies CPCSEA, MoEFW, AWB, BLAHS, WWF rationalizing protected area boundaries: man animal conflict in modern India</p>	4	
III	<p>India: A bioreserve hub Project tiger wildlife sanctuaries and national parks special reference to Hastinapur sanctuary endangered wild species in India</p>	8	
IV	<p>Methods to promote environmental skills Recycling / New skilled waste treatment use of modern biotechnology for Energy efficiency; green transport knowledge of renewable energy, Solar energy, wind power energy, biofuel usage sustainable construction techniques with Energy Performance, legislation, resource management</p>	8	

	Food Nutrition and Health balanced diet: Mediterranean diet time of eating; intermittent fasting calorie and food timings health consequences of empty calorie diets in young adults	8
	Lifestyle and Indian methods to improve health Circadian rhythms fur better life Ayurveda Clock Exercise Yoga Meditation	8
	Sleep disorders in 24X Society ASPS; DSPS; Sleep Apnea Role of morning sunlight Shift work and occupational health challenges sleep and mental health	8
	Non-communicable diseases as lifestyle disorders Cancer; Hypertension PCOS Diabetes; obesity	8
Suggested Readings: <ol style="list-style-type: none"> 1. Sanjay Upadhyay et al; Environmental Laws in India (Vol -I, II, III.) Butterworth: New Delhi:2004 2. Raj Punjwani, Wildlife Conservation in India, Natraj; Dehradun;2000 3. M. Zafar Mahfooz Normani, Natural resources, Law and Policy, Uppal: New Delhi-2004 4. Health Education and Community Pharmacy for First Year Diploma in Pharmacy 3rd ed. V.N. Raje, CBS 5. Textbook of Community Health Nursing 1, S.D. Manivannan CBS Nursing Course Books published in Hindi may be prescribed by the Universities and Colleges		
Course prerequisites: To study this course, a student must have had the subject biology in class 12th		
Suggested Continuous Evaluation Methods: Total Marks: 25 House Examination/Test: 10 Marks Written Assignment/Presentation/Project/Term Papers/Seminar: 10 Marks Class performance/Participation: 5 Marks		
Further Suggestions: None		

Scientific Progress and Environmental Awareness in India
Minor (4 Credits)

Couse Outcomes: The course aims to make freshers aware about the scientific aptitude and the progresses made by leading Indian research laboratories working in the field of:

- Agriculture, Cattle biotechnology, Oceanography, Food technology, Pollution abatement, Molecular Biology, Remote sensing, Fundamental Scientific Researches, Communicable diseases and Fish and Fisheries etc.
- It also encompasses Wildlife and environmental rules, Endangered species and various NGOs working in the field of Environmental awareness and wildlife conservation.
- One unit makes them aware about the important environmental movements in India and helps them in becoming a responsible citizen of India.
- Introduction to Scientific terminology will help students from various disciplines to understand the ongoing efforts in environmental planning and awareness. This understanding and appreciation will help them learn the interdisciplinary nature of such courses.

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Max. Marks: 25+75

Min Marks: As per rules

Total No. of Lectures-Tutorials-Practicals (In hours per week): L-T-P: 4-0-0
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Unit I: India Biodiversity Portal

Total No. of Lectures= 60

Major Environmental Laws of India
Wildlife Protection Act (1972)

Endangered wildlife species of India

Unit II: Important Science Institutes in India and their

Research Contributions: (e.g., IARI, NDRI, CDRI, NIO, CFIRI, NEE RI, CCMB, TIFR NICD, IVRI and CIFE).

Major environmental movements in India: (Bishnoi movement, Chipko, Silent valley Movement, Appiko, NBA, and Tehri Dam Conflict).

Unit III : Important Government bodies/ NGOs in India working in the field of

Environment, Climate change and Wildlife Conservation:

(e.g., CPCB, TERI, WWF-India, CSE, BNHS, WTI etc.).

Unit IV: Scientific terms used in Environmental Science:

Algal blooms, Alternative Energy Sources, Biodegradable waste,

Carbon Credits, Carbon footprint, CFCs, Climate change, Ecotourism, Flora & Fauna, ISO certification, Sustainable development and Zero emissions. **12**

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Suggested Continuous Evaluation Methods: Total Marks: 25 internal Examination/Test: 10 Marks

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

Class performance/Participation: 5 Marks

Course eligibility/ prerequisite

Course can be opted by Arts/ Science/ Commerce students seeking admission in First Semester 13.Se. (to be run by Dept of Zoology of all aided, govt and affiliated colleges of CCS University, Meerut).

Suggested Reading:

1. Ecology and Environmental Science, 11 R Singh and Neeraj Kumar, 2018. Vishal Publishing Co. Jalandhar, Punjab, /New Delhi.
2. [https:// www.icar.gov.in](https://www.icar.gov.in)
3. <https://www.iari.res.in/>
4. [https:// www.ccmb.res.in/](https://www.ccmb.res.in/)
5. [https:// www.iirs.gov.in/](https://www.iirs.gov.in/)
6. [https:// cpcb.nic.in/](https://cpcb.nic.in/)
7. [https:// www.neeri.res.in/](https://www.neeri.res.in/)
8. [https:// www.cife.edu.in/](https://www.cife.edu.in/)
9. [https:// www.ivri.nic.in/](https://www.ivri.nic.in/)
10. [https:// wii.gov.in/](https://wii.gov.in/)
11. <https://fridu.gov.in/>
12. <https://moef.gov.in/>
13. [https:// www.cseindia.org/](https://www.cseindia.org/)
14. [https:// www.bnhs.org/](https://www.bnhs.org/)
15. [https:// www.teriin.org/](https://www.teriin.org/)
16. [https:// www.wwfindia.org/](https://www.wwfindia.org/)
17. [https:// www.nicd.ac.za/](https://www.nicd.ac.za/)
18. <https://nbaindia.org/>

Submitted by

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