

**Undergraduate Programme
B. Sc. Zoology (Honours)
4- year Degree Course**

**Dr. BHIM RAO AMBEDKAR UNIVERSITY,
AGRA
(Formerly: Agra University, Agra)**

SUBJECT: ZOOLOGY

Members, Experts and Convenor

Convenor

**Prof. J Andrew,
Department of Zoology,
St. John's College, Agra**

Members

**1- Prof. Rajvir Singh,
Department of Zoology, R.B.S. College, Agra.**

**2- Prof. Vinod Kumar Khandelwal,
Department of Zoology, K.R.P.G. College, Mathura.**

**3- Prof. Ravi Kumar Yadav,
Department of Zoology, Narain College, Shikohabad.**

**4- Prof. Suman Kapoor,
Department of Zoology, Agra College, Agra**

**5- Prof. Vishwakant,
Department of Zoology, Agra College, Agra**

**6- Prof. Dharmendra Pratap Singh,
Department of Zoology, Agra College, Agra.**

EXPERTS

**1. Prof. Alok Kumar Panday,
Department of Zoology, DAV (PG) College, Kanpur**

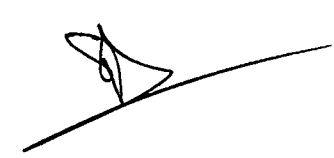
**2. Prof. Ravikant Upadhyay,
Department of Zoology, Gorakhpur University, Gorakhpur**

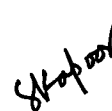
Undergraduate Programme: B. Sc. Zoology (Honours) 4- year Degree Course

Year	Course	Semester	Paper Title	Course Code	Theory/Practical/Project	Credits	Teaching Hours
1	Certificate Course in Medical Diagnostics & Public Health	I	Cytology, Genetics, and Infectious Diseases	B050101T	Theory	4	60
			Cell Biology and Cytogenetics Lab	B050102P	Practical	2	60
		II	Biochemistry and Physiology	B050201T	Theory	4	60
			Physiological, Biochemical & Haematology Lab	B050202P	Practical	2	60
2	Diploma in Molecular Diagnostics and Genetic Counselling.	III	Molecular Biology, Bioinstrumentation & Biotechniques	B050301T	Theory	4	60
			Bioinstrumentation & Molecular Biology Lab	B050302P	Practical	2	60
			Project work/ Dissertation	Research Project: Methodology			60
		IV	Gene Technology, Immunology and Computational Biology	B050401T	Theory	4	60
			Genetic Engineering and Counselling Lab	B050402P	Practical	2	60
			Project work/ Dissertation	B050403R	Research Project	4	60
3	B.Sc. Degree of Bachelor of Science in Zoology	V	Diversity of Non-Chordates, Parasitology and Economic Zoology	B050501T	Theory	4	60
			Protochordata, Diversity of Chordates and Comparative Anatomy	B050502T	Theory	4	60
			Lab on Virtual Dissection, Anatomy, Economic Zoology and Parasitology	B050503P	Practical	2	60
		VI	Evolution and Developmental Biology	B050601T	Theory	4	60
			Ecology, Ethology, Environmental Science and Wildlife	B050602T	Theory	4	60
			Lab on Environmental Science, Behavioural Ecology, Developmental Biology, Wildlife and Ethology	B050603P	Practical	2	60

Year	Course	Semester	Paper Title	Course Code	Theory/Practical/Project	Credits	Teaching Hours
4	B.Sc. (Hons.) Degree of Bachelor of Science with Honours in Zoology	VII	Systematics, Structure and Function of invertebrates	B050701T	Theory	4	60
			Molecular and Cell Biology	B050702T	Theory	4	60
			Biological Techniques and Instrumentation	B050703T	Theory	4	60
			Micro Biology and Immunology	B050704T	Theory	4	60
			Practical	B050705P	Practical	4	60
		VIII	Chordate Anatomy	B050801T	Theory	4	60
			Genetics and Biotechnology	B050802T	Theory	4	60
			Animal Physiology and Biochemistry	B050803T	Theory	4	60
			Developmental Biology	B050804T	Theory	4	60
			Practical	B050805P	Practical	4	60
4	B.Sc. (Hons.) Degree of Bachelor of Science with Honours and Research in Zoology *Any 3 of the Theory papers & Research Project	VII	Systematics, Structure and Function of invertebrates*	B050701T	Theory	4	60
			Molecular and Cell Biology*	B050702T	Theory	4	60
			Biological Techniques and Instrumentation*	B050703T	Theory	4	60
			Micro Biology and Immunology*	B050704T	Theory	4	60
			Practical	B050705P	Practical	4	60
			Research Project	Research Project: Methodology			60
		VIII	Chordate Anatomy*	B050801T	Theory	4	60
			Genetics and Biotechnology*	B050802T	Theory	4	60
			Animal Physiology and Biochemistry*	B050803T	Theory	4	60
			Developmental Biology*	B050804T	Theory	4	60
			Practical	B050805P	Practical	4	60
			Research Project	B050806R	Research Project	8	60







**Certificate Course in Medical Diagnostics & Public
Health**

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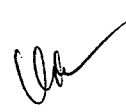
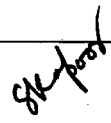
SEMESTER- I

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Programme /Class: B.Sc. / Certificate	Course B.Sc. Subject: ZOOLOGY Year: First Semester: I	Course code
	Course Title: Cytology, Genetics, and Infectious Diseases	B050101T
Credits: 4	Marks: 25 Internal+75 External=100	Lectures/ week: 4
Unit	Topics Total Number of Lectures (60)	Lectures
I	Contribution of the following scientists as introduction and part of the Continuous Internal Evaluation-(CIE) - Sir C.V. Raman in Spectroscopy and biomolecules - Har Govind Khorana in Genetics - M.S. Swaminathan in Green Revolution - Verghese Kurien in White revolution - Venkatraman Ramakrishnan in Atomic structure of Ribosome - Sir. Salim Ali in Ornithology - Sir. J.N Tata- Modernising silk industry in India	6
	Structure and Function of Cell Organelles I - Plasma membrane: chemical structure—lipids and proteins - Cell-cell interaction: cell adhesion molecules, cellular junctions - Endomembrane system: protein targeting and sorting, endocytosis, exocytosis.	
II	Structure and Function of Cell Organelles II - Cytoskeleton: microtubules, microfilaments, intermediate filaments - Mitochondria: Structure, oxidative phosphorylation - Peroxisome and ribosome: structure and function	6
III	Nucleus and Chromatin Structure - Structure and function of nucleus in eukaryotes - Chemical structure and base composition of DNA and RNA - DNA supercoiling, chromatin organization, structure of chromosomes - Types of DNA and RNA	8
IV	Cell cycle, Cell Division and Cell Signalling - Cell division: mitosis and meiosis - Cell cycle and its regulation, apoptosis - Signal transduction: intracellular signalling and cell surface receptors, via G-protein linked receptors, JAK-STAT pathway	8
V	Mendelism and Sex Determination - Basic principles of heredity: Mendel's laws, monohybrid and dihybrid crosses - Complete and Incomplete Dominance	8




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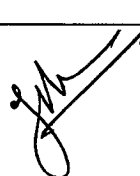
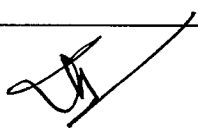
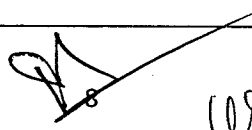
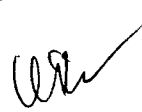
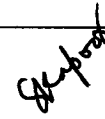
	• Penetrance and expressivity • Genic Sex-Determining Systems, Environmental Sex Determination, Sex Determination in <i>Drosophila</i>, Sex Determination in Humans • Sex-linked characteristics and Dosage compensation	
VI	Extensions of Mendelism, Genes and Environment • Extensions of Mendelism: Multiple Alleles, Gene Interaction • The Interaction Between Sex and Heredity: Sex-Influenced and Sex-Limited Characteristics • Cytoplasmic Inheritance, Genetic Maternal Effects • 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 • Human karyotype • Chromosomal anomalies: Structural and numerical aberrations with examples • Pedigree analysis • Patterns of inheritance: autosomal dominant, autosomal recessive, X-linked recessive, X-linked dominant	8
VIII	Infectious Diseases • Introduction to pathogenic organisms: viruses, bacteria, fungi, protozoa, and worms. • Structure, life cycle, pathogenicity, including diseases, causes, symptoms and control of common parasites: <i>Trypanosoma</i>, <i>Giardia</i> and <i>Wuchereria</i>	8
	Suggested Readings: 1. De Robertis: Cell and Molecular Biology, Saunders Pub. 2. Lodish et al: Molecular Cell Biology: Freeman & Co, USA (2004). 3. Alberts et al: Molecular Biology of the Cell: Garland (2002). 4. Cooper: Cell: A Molecular Approach: ASM Press (2000). 5. Karp: Cell and Molecular Biology: Wiley (2002). Pierce B. Genetics. Freeman (2004). 6. Lewin B. Genes VIII. Pearson (2004). 7. Watson et al. Molecular Biology of the Gene. Pearson (2004). 8. Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, Janis Kuby Kuby Immunology. W H Freeman (2007). 9. Delves Peter J., Martin Seamus J., Burton Dennis R., Roitt Ivan M. Roitt's Essential Immunology, 13th Edition. Wiley Blackwell (2017). 10. Shetty Nandini Immunology Introductory Textbook. New Age International. (2005)	
Certificate Course in Medical Diagnostics and Public Health		







Programme /Class: B.Sc. / Certificate	Course B.Sc. Subject: ZOOLOGY Year: First Semester: I	Course code B050102P
	Course Title: Cell Biology and Cytogenetics Lab	
Credits: 2	Marks: 100 External	Practical/ week 4
Unit	Topics Total Number of Practical Classes (60)	Practical
I	1. To study different cell types such as buccal epithelial cells, neurons, striated muscle cells using Methylene blue. 2. To study the different stages of Mitosis in root tip of onion. 3. To study the different stages of Meiosis in grasshopper testis. 4. To prepare molecular models of nucleotides, amino acids, dipeptides using bead and stick method. 5. To check the permeability of cells using salt solution of different concentrations.	15
II	1. Study of parasites (e.g. Protozoans, helminths etc.) from permanent slides. 2. To learn the procedures for preparation of temporary and permanent stained/unstained slides.	15
III	1. Study of mutant phenotypes of <i>Drosophila</i> . 2. Preparation of polytene chromosomes. 3. Study of sex chromatin (Barr bodies) in buccal smear and hair bud cells (Human). 4. Preparation of human karyotype and study the chromosomal aberrations with respect to number, translocation, deletion etc. from the pictures provided. 5. To prepare family pedigrees.	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
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		

SEMESTER-II

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Programme /Class: B.Sc. / Certificate	Course B.Sc. Subject: ZOOLOGY Year: First Semester: II	Course code
	Course Title: Biochemistry and Physiology	B050201T
Credits: 4	Maximum Marks: 25 Internal+75 External=100	Lectures/ week: 4
Unit	Topics Total Number of Lectures (60)	Lectures
I	Structure and Function of Biomolecules - Structure and Biological importance of carbohydrates (Monosaccharides, Disaccharides, Polysaccharides and Glycoconjugates) - Lipids (saturated and unsaturated fatty acids, Tri-acylglycerols, Phospholipids, Glycolipids, Steroids) - Structure, Classification and General properties of α-amino acids; Essential and non-essential α-amino acids, Levels of organization in proteins; Simple and conjugate proteins.	8
II	Enzyme Action and Regulation - Nomenclature and classification of enzymes; Cofactors; Specificity of enzyme action - Isozymes; Mechanism of enzyme action - Enzyme kinetics; Factors affecting rate of enzyme-catalysed reactions; Derivation of Michaelis-Menten equation, Concept of K_m and V_{max}, Lineweaver-Burk plot; Enzyme inhibition; - Allosteric enzymes and their kinetics; Regulation of enzyme action	8
III	Metabolism of Carbohydrates and Lipids - Metabolism of Carbohydrates: glycolysis, citric acid cycle, gluconeogenesis, phosphate pentose pathway - Glycogenolysis and Glycogenesis - Lipids --- Biosynthesis of palmitic acid; Ketogenesis β-oxidation and omega -oxidation of saturated fatty acids with even and odd number of carbon atoms	8
IV	Metabolism of Proteins and Nucleotides - Catabolism of amino acids: Transamination, Deamination, Urea cycle - Nucleotides and vitamins - Review of mitochondrial respiratory chain, Oxidative phosphorylation, and its regulation	6
V	Digestion and Respiration - Structural organization and functions of gastrointestinal tract and associated glands - Mechanical and chemical digestion of food; Absorptions of carbohydrates, lipids, proteins, water, minerals and vitamins; - Histology of trachea and lung	7

	· 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	
VI	Circulation and Excretion · Components of blood and their functions · Haemostasis: Blood clotting system, Blood groups: Rh factor, ABO and MN · Structure of mammalian heart · Cardiac cycle; Cardiac output and its regulation, Electrocardiogram, Blood pressure and its regulation · Structure of kidney and its functional unit; Mechanism of urine Formation	8
VII	Nervous System and Endocrinology · Structure of neuron, resting membrane potential · Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibers · Types of synapses · Endocrine glands - pineal, pituitary, thyroid, parathyroid, pancreas, adrenal; hormones secreted by them · Classification of hormones; Mechanism of Hormone action	8
VIII	Muscular System Histology of different types of muscle; Ultra structure of skeletal muscle; Molecular and chemical basis of muscle contraction; Characteristics of muscle twitch; Motor unit, summation and tetanus	7
1. Nelson & Cox: Lehninger's Principles of Biochemistry: McMillan (2000) 2. Zubayet <i>et 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 14 5. Guyton, A.C. & Hall, J.E. Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company. (2006). 6. Tortora, G.J. & Grabowski, S. Principles of Anatomy & Physiology. XI Edition John Wiley & sons (2006). 7. Christopher D. Moyes, Patricia M. Schulte. Principles of Animal Physiology. 3rd Edition, Pearson Education (2016). 8. Hill, Richard W., et al. Animal physiology. Vol. 2. Sunderland, MA: Sinauer Associates, (2004). 9. Chatterjee C C Human Physiology Volume 1 & 2. 11th edition. CBS Publishers(2016).		
Certificate Course in Medical Diagnostics and Public Health		

Programme /Class: B.Sc. / Certificate	Course B.Sc. Subject: ZOOLOGY Year: First Semester: II	Course code
	Course Title: Physiology, Biochemistry and Haematology Lab	B050202P
Credits: 2	Marks: 100 External	Practical/ week 4
Unit	Topics Total Number of Practical Classes (60)	Practical
I	1. Estimation of haemoglobin using Sahli's haemoglobinometer 2. Preparation of haemin and haem chromogen 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	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	1. Ninhydrin test for α -amino acids. 2. Benedict's test for reducing sugar and iodine test for starch. 3. Test for sugar and acetone in urine. 4. Qualitative tests of functional groups in carbohydrates, proteins and lipids. 5. Action of salivary amylase under optimum conditions.	10
IV	Virtual Labs (Suggestive sites) 1. https://www.vlab.co.in 2. https://zoologysan.blogspot.com 3. www.vlab.iitb.ac.in/vlab 4. www.onlinelabs.in 5. www.powershow.com 6. https://vlab.amrita.edu 7. https://sites.dartmouth.edu	15
Suggested Readings: 1. Cox, M.M and Nelson, D.L. (2008). Lehninger's Principles of Biochemistry, V Edition, W.H. Freeman and Co., New York. 2. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2007). Biochemistry, VI Edition, W.H. Freeman and Co., New York. 3. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hecourt Asia PTE Ltd. /W.B. Saunders Company. 4. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons 5. Victor P. Eroschenko. (2008). diFiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott W. & Wilkins. 6. Arey, L.B. (1974). Human Histology. IV Edition. W.B. Saunders. 7. Kesar, Saroj and Vashishta N. (2007). Experimental Physiology: Comprehensive Manual. Heritage Publishers, New Delhi		
Certificate Course in Medical Diagnostics and Public Health		

Diploma in Molecular Diagnostics and Genetic Counselling

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SEMESTER- III

Programme /Class: B.Sc. / Diploma	Course B.Sc. Subject: ZOOLOGY Year: Second Semester: III	Course code B050301T
	Course Title: Molecular Biology, Bioinstrumentation and Biotechniques	
Credits: 4	Marks: 25 Internal+75 External=100	Lectures/ week: 4
Unit	Topics Total Number of Lectures (60)	Lectures
I	Process of Transcription • Fine structure of gene • RNA polymerases • Transcription factors and machinery • Formation of initiation complex • Initiation, elongation and termination of transcription in prokaryotes and eukaryotes	7
II	Process of Translation • The Genetic code • Ribosome • Factors involved in translation • Aminoacylation of tRNA, tRNA-identity, Aminoacyl tRNA synthetase • Initiation, elongation and termination of translation in prokaryotes and eukaryotes	7
III	Regulation of Gene Expression I • Regulation of gene expression in prokaryotes: <i>lac</i> and <i>Trp</i> operons in <i>E. coli</i> • Regulation of gene expression in eukaryotes: Role of chromatin in gene expression • Regulation at transcriptional level, post-transcriptional modifications: Capping, Splicing, Polyadenylation • RNA editing.	8
IV	Regulation of Gene Expression II • Regulation of gene expression in eukaryotes: • Regulation at translational level, post-translational modifications: protein folding etc. • Intracellular protein degradation • Gene silencing, RNA interference (RNAi)	8
V	Principles and Types of Microscopes • Principle of Microscopy and Applications • Types of Microscopes: light microscopy, dark field microscopy, phase-contrast microscopy,	7

	Fluorescence microscopy, confocal microscopy, electron microscopy	
VI	Centrifugation and Chromatography - Principle of Centrifugation - Types of Centrifuges: high speed and ultracentrifuge - Types of rotors: Vertical, Swing-out, Fixed-angle etc. - Principle and Types of Chromatography: paper, ion exchange, gel filtration, HPLC, affinity	7
VII	Spectrophotometry and Biochemical Techniques - Biochemical techniques: Measurement of pH, Preparation of buffers and solutions - Principle of Colorimetry/Spectrophotometry: Beer-Lambert law - Measurement, applications and safety measures of Radio tracer techniques	8
VIII	Molecular Techniques - Detection of nucleic acid by gel electrophoresis - DNA sequencing DNA fingerprinting, RFLP - Polymerase Chain Reaction (PCR) - Detection of proteins, PAGE, ELISA, Western blotting	8
	Suggested Readings: - Lodish et al: Molecular Cell Biology: Freeman & Co, USA (2004). - Alberts et al: Molecular Biology of the Cell: Garland (2002). - Cooper: Cell: A Molecular Approach: ASM Press (2000). - Karp: Cell and Molecular Biology: Wiley (2002). - Watson et al. Molecular Biology of the Gene. Pearson (2004). - Lewin. Genes VIII. Pearson (2004). - Pierce B. Genetics. Freeman (2004). - Sambrook et al. <i>Molecular Cloning</i> Vols I, II, III. CSHL (2001). - Primrose. Molecular Biotechnology. Panima (2001). - Clark & Switzer. Experimental Biochemistry. Freeman (2000)	
Diploma in Molecular Diagnostics and Genetic Counselling.		

Programme /Class: B.Sc. / Diploma	Course B.Sc. Subject: ZOOLOGY Year: Second Semester: III	Course code B050302P
	Course Title: Bioinstrumentation and Molecular Biology Lab	
Credits: 2	Marks: 100 External	Practical/ week 4
Unit	Topics Total Number of Practical Classes (60)	Practical
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, Water bath, Centrifuge, Chromatography apparatus, etc.	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.	15
III	1. To prepare dilutions of Riboflavin and verify the principle of spectrophotometry. 2. To identify different amino acids in a mixture using paper chromatography. 3. Demonstration of DNA extraction from blood or tissue samples. 4. To estimate amount of DNA using spectrophotometer.	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 info@premiereducationaltechnologyies.com https://li.wsu.edu	15
Suggested Readings: 1. Sambrook <i>et. al.</i> <i>Molecular Cloning</i> Vols I, II, III. CSHL (2001). 2. Primrose. <i>Molecular Biotechnology</i> . Panima (2001). 3. Clark & Switzer. <i>Experimental Biochemistry</i> . Freeman (2000)		
Preparation for the Diploma in Molecular Diagnostics and Genetic Counselling.		

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SEMESTER- IV

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Programme /Class: B.Sc. / Diploma	Course B.Sc. Subject: ZOOLOGY Year: Second Semester: IV	Course code B050401T
	Course Title: Gene Technology, Immunology and Computational Biology	
Credits: 4	Maximum. Marks: 25 Internal+75 External=100	Lectures/ week: 4
Unit	Topics Total Number of Lectures (60)	Lectures
I	Principles of Gene Manipulation • Recombinant DNA Technology • Selection and identification of recombinant cells • Restriction Enzymes, DNA modifying enzymes, Cloning Vectors, Ligation • Gene transfer techniques, Gene therapy	10
II	Applications of Genetic Engineering • Single cell proteins • Biosensors, Biochips • Crop and livestock improvement, development of transgenics • Development of DNA drugs and vaccines	8
III	DNA Diagnostics • Genetic analysis of human diseases, detection of known and unknown mutations • Concept of pharmacogenomics and pharmacogenetics	4
IV	Immune System and its Components • Historical perspective of Immunology, Innate and Adaptive Immunity, clonal selection, complement system • Structure and functions of different classes of immunoglobulins, Hypersensitivity • Humoral immunity and cell mediated immunity • HLA complex: organization, class I and II HLA molecules	10
V	V Biostatistics I • Calculations of mean, median, mode, variance, standard deviation • Concepts of coefficient of variation, Skewness, Kurtosis • Elementary idea of probability and application	7
VI	Biostatistics II • Data summarizing: frequency distribution, graphical presentation—bar, pie diagram, histogram • Tests of significance: one and two sample tests, t-test and Chi-square Test	7

VII	Basics of Computers - Basics (CPU, I/O units) and operating systems - Concept of homepages and websites, World Wide Web, URLs, using search engines	6
VIII	Bioinformatics - Databases: nucleic acids, genomes, protein sequences and structures, Bibliography - Sequence analysis (homology): pairwise and multiple sequence alignments-BLAST, CLUSTALW - Phylogenetic analysis	8
	Suggested Readings: 1. Primrose & Twyman. Principles of Genome Analysis and Genomics. Blackwell (2003). 2. Hartl & Jones. Genetics: principles & Analysis of Genes & Genomes. Jones & Bartlett (1998). 3. Sambrook <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).	
Diploma in Molecular Diagnostics and Genetic Counselling.		

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Programme /Class: B.Sc. / Diploma	Course B.Sc. Subject: ZOOLOGY Year: Second Semester: IV	Course code
	Course Title: Genetic Engineering and Counselling Lab	B050402P
Credits: 2	Marks: 100 External	Practical/ week 4
Unit	Topics Total Number of Practical (60)	Practical
I	1. Measure the pre and post clitellar lengths of earthworms and calculate mean, median, mode, standard deviation etc. 2. Measure the height and weight of all students in the class and apply statistical measures.	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	1. To learn the basics of computer applications 2. To learn sequence analysis using BLAST 3. To learn Multiple sequence alignment using CLUSTALW 4. To learn about Phylogenetic analysis using the programme PHYLIP. 5. To learn how to perform Primer designing for PCR using available software etc.	15
IV	Virtual Labs (Suggestive sites) 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/QE7UI0JnY9A 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 software like Primer3, NEB cutter 12. NCBI, BLAST, CLUSTAL W, PHYLIP	15
Suggested Readings: 1. Primrose & Twyman. Principles of Genome Analysis and Genomics. Blackwell (2003). 2. Hartl & Jones. Genetics: principles & Analysis of Genes & Genomes. Jones & Bartlett (1998). 3. Sambrook <i>et al.</i> Molecular Cloning Vols I, II, III. CSHL (2001). 4. Primrose. Molecular Biotechnology. Panima (2001).		
Diploma in Molecular Diagnostics and Genetic Counselling.		

Programme /Class: B.Sc. / Diploma	Course B.Sc. (Diploma) Subject: ZOOLOGY Years: 2 Semesters: 3,4	Course code B050403R
	Course Title: Research Project: Methodology	
Credits: 4	Maximum. Marks: 25 Internal+75 External= 100	Lectures/ Practical /Week: 4
Unit	Topics Total Number of Lectures (60)	Lectures
I	Teaching Research Methodology for doing a Research Project. Learning how to identify a research work, do and Present a Research Project Report.	10
II	Learning the literature which forms the base for identifying a research problem Identifying the lacuna (Need for a study/work) available in the existing knowledge.	10
III	Formulating the methodology to do the work and identifying the tools and techniques involved in doing the research Project	10
IV	Doing the work under the guidance of the Research Supervisor and documenting the observations, results, and findings.	10
V	Collecting the observations of the Research work done in the form of data, Pictures or recordings and arranging them in the proper form of Results or observations or findings presentable as a Research Project. The data collected can be analyzed using the needful statistical analysis and expressed in the form of graphs.	10
VI	In writing the discussion, findings of the Research work should be correlated with the available literature to justify the findings. The relevant literature related to the work quoted in the Project work should be arranged in the form of References. Finally, the Research Project work can be organised and submitted in the Presentable form to the University.	10
	Diploma in Molecular Diagnostics and Genetic Counselling	

B.Sc. Degree of Bachelor of Science in Zoology

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SEMESTER- V

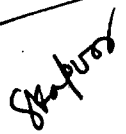
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Programme /Class: B.Sc. / Degree	Course B.Sc. Subject: ZOOLOGY Year: Third Semester: V	Course code
	Course Title: Diversity of Non- Chordates and Economic Zoology	B050501T
Credits: 4	Maximum. Marks: 25 Internal+75 External=100	Lectures/ week: 4
Unit	Topics Total Number of Lectures (60)	Lectures
I	Protozoa to Coelenterate • 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 • Ctenophora - Salient features • Platyhelminthes - <i>Taenia</i> (Tape worm) (Morphology and Reproduction) • Nematelminthes – <i>Ascaris lumbricoides</i> (Morphology and Reproduction)	7
III	Annelida • Annelida – <i>Hirudinaria</i> (Leech) (Morphology and Reproduction)	8
IV	Arthropoda • Arthropoda – <i>Palaemon</i> (Prawn) (Morphology, Appendages, Nervous System and Reproduction)	8
V	Mollusca, Echinodermata • Mollusca – <i>Pila</i> (Morphology, Shell, Respiration, Nervous System and Reproduction) • Echinodermata – Star fish (Morphology and Water Vascular System)	8
VI	Vectors and pests Life cycle and their control of following pests: Gandhi 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
	Suggested Readings: 1. Barnes et al (2009). The Invertebrates: A synthesis. Wiley Backwell 17 2. Hunter: Life of Invertebrates (1979, Collier Macmillan) 3. Marshall: Parker & Haswell Text Book of Zoology, Vol. I (7th ed 1972, Macmillan) 4. Moore: An Introduction to the Invertebrates (2001, Cambridge University Press) 5. Brusca and Brusca (2016) Invertebrates. Sinauer 6. Jan Pechenik (2014) Biology of the invertebrates. McGraw Hill	

	7. Neilsen (2012). Animal Evolution: Interrelationships amongst living Phyla. Oxford 8. Parasitology- Chatterjee 9. Parasitology- Chakraborty 10. Thomas 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. Sriculture in India Sarkar, D.C. (1988), CSB, Bangalore.	
Degree in Bachelor of Science.		







Programme /Class: B.Sc. / Degree	Course B.Sc. Subject: ZOOLOGY Year: Third Semester: V	Course code B050502T
	Course Title: Protochordata, Diversity of Chordates and Comparative Anatomy	
Credits: 4	Marks: 25 Internal+75 External=100	Lectures/ week: 4
Unit	Topics Total Number of Lectures (60)	Lectures
I	Origin of Chordates & Hemichordata • Origin of Chordates. Classification of Phylum Chordata Up to the class. • Hemichordata: General characteristics, classification and detailed study of <i>Balanoglossus</i> (Habit and Habitat, Morphology, Anatomy, Physiology and Development).	6
II	Cephalochordata and Urochordata • Cephalochordata: General characteristics, classification and detailed study of <i>Branchiostoma (Amphioxus)</i> (Habit and Habitat, Morphology, Anatomy, Physiology). • (ii) Urochordata: General characteristics, classification and detailed study of <i>Herdmania</i> (Habit and Habitat, Morphology, Anatomy, Physiology and Post Embryonic Development).	6
III	Classification and General Characteristics of Vertebrates • General characters and Classification of different classes of vertebrates (Pisces, Amphibia, Reptilia, Aves, Mammalia) up to the order with examples. • Poisonous and Non-Poisonous Snakes and biting mechanism. • Neoteny and Paedogenesis • Migration in birds • Dentition in Mammals	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 Autonomic nervous system, Spinal cord, Cranial nerves in mammals Sense Organs Classification of receptors	8

	Brief account of visual and auditory receptors in man	
	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: Text Book 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	
Degree in Bachelor of Science.		







Programme /Class: B.Sc. / Degree	Course B.Sc. Subject: ZOOLOGY Year: Third Semester: V	Course code B050503P
	Course Title: Lab on Virtual Dissection, Anatomy, Economic Zoology and Parasitology	
Credits: 2	Maximum. Marks: 100 External	Practical/ week 4
Unit	Topics Total Number of Practical classes (60)	Practical
I	Study of animal specimens of various invertebrate phyla. 1. To prepare permanent stained slide of septal nephridia of earthworm. 2. To take out the nerve ring of earthworm. 3. To take out hastate plate from <i>Palaemon</i> .	15
II	1. Study of animal specimens of various Chordate 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. 4. Comparative study of bones of different vertebrates. 5. Comparative study of histological slides of different tissues of vertebrates.	15
III	1. Permanent Preparation of: <i>Euglena</i> , <i>Paramecium</i> 2. Study of prepared slides/specimens of <i>Entamoeba</i> , <i>Giardia</i> , <i>Leishmania</i> , <i>Trypanosoma</i> , <i>Plasmodium</i> , <i>Fasciola</i> , <i>Cotugnia</i> , <i>Taenia</i> , <i>Rallietina</i> , <i>Polystoma</i> , <i>Schistosoma</i> , <i>Echinococcus</i> , <i>Enterobius</i> , <i>Ascaris</i> and <i>Ancylostoma</i> 3. Permanent Preparation of <i>Cimex</i> (bed bug)/ <i>Pediculus</i> (Louse), <i>Haematopinus</i> (cattle louse), fresh water annelids, arthropods; and soil arthropods. 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. 9. Slides of plant nematodes. 10. Study of an aquatic ecosystem, its biotic components and food chain. 11. Project Report/ model chart making. 12. Dissections: through multimedia / models 13. Cockroach: Central nervous system 14. Wallago/Scoliodon: Afferent and efferent branchial vessels, Cranial nerves, Weberian ossicles.	15
IV	Virtual Labs (Suggestive sites) https://www.vlab.co.in https://zoologysan.blogspot.com www.vlab.iitb.ac.in/vlab https://www.vlab.co.in https://zoologysan.blogspot.com www.vlab.iitb.ac.in/vlab	15

	www.onlinelabs.in www.powershow.com https://vlab.amrita.edu https://sites.dartmouth.edu	
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: Text Book 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 Blackwell 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). <i>Apiculture</i>. Oxford and IBH, New Delhi. 18. Bisht. D.S., <i>Apiculture</i>, ICAR Publication. 19. Singh S., <i>Beekeeping in India</i>, 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. <i>et al</i>, A manual of freshwater aquaculture 24. Boyd. C.E. & Tucker. C.S, Pond aquaculture water quality management 25. Pedigo, L.P. (2002). <i>Entomology and Pest Management</i>, Prentice Hall. 26. Ranganathan L.S, Vermicomposting technology- soil health to human health		
Degree in Bachelor of Science		

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SEMESTER- VI

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Programme /Class: B.Sc. / Degree	Course B.Sc. Subject: ZOOLOGY Year: Third Semester: VI	Course code B050601T
	Course Title: Evolution and Developmental Biology	
Credits: 4	Maximum. Marks: 25 Internal+75 External	Lectures/ week: 4
Unit	Topics Total Number of Lectures (60)	Lectures
I	Theories of Evolution • Origin of Life • Historical review of evolutionary concept: Lamarckism, Darwinism (Natural, Sexual and Artificial selection) • Modern synthetic theory of evolution • Patterns of evolution (Divergence, Convergence, Parallel, Coevolution)	8
II	Population Genetics • Microevolution and Macroevolution: allele frequencies, genotype frequencies, Hardy- Weinberg equilibrium and conditions for its maintenance • Forces of evolution: mutation, selection, genetic drift	8
III	Direct Evidences of Evolution Types of fossils, Incompleteness of fossil record, Dating of fossils, Phylogeny of horse	7
IV	Species Concept and Extinction • Biological species concept (Advantages and Limitations); • Modes of speciation (Allopatric, Sympatric) • Mass extinction: Causes, Names of five major Extinctions	7
V	Gametes, Fertilization and Early Development • Gametogenesis, Fertilization • Cleavage pattern • Gastrulation, fate maps • Developmental mechanics of cell specification • Morphogenesis and cell adhesion	6
VI	Developmental Genes • Genes and development • Molecular basis of development • Differential gene expression	8
VII	Early Vertebrate Development • Early development of vertebrates (fish, birds & mammals) • Metamorphosis, regeneration, and stem cells • Environmental regulation of development	8
VIII	Late Developmental Processes • The dynamics of organ development • Development of eye, kidney, limb • Metamorphosis: the hormonal reactivation of development in amphibians, insects	8

	• Regeneration: salamander limb, mammalian liver, Hydra • Aging: the biology of senescence	
	Suggested Readings: 1. Ridley, M. (2004). <i>Evolution</i>. III Edition. Blackwell Publishing 2. 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. 3. Hall, B. K. and Hallgrímsson, B. (2008). <i>Evolution</i>. IV Edition. Jones and Bartlett Publishers 4. Campbell, N. A. and Reece J. B. (2011). <i>Biology</i>. IX Edition, Pearson, Benjamin, Cummings. 5. Douglas, J. Futuyma (1997). <i>Evolutionary Biology</i>. 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).	
Degree in Bachelor of Science.		

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Programme /Class: B.Sc. / Degree	Course B.Sc. Subject: ZOOLOGY Year: Third Semester: VI	Course code B050602T
	Course Title: Ecology, Ethology, Environmental Science and Wildlife.	
Credits: 4	Maximum. Marks: 25 Internal+75 External	Lectures/ week: 4
Unit	Topics Total Number of Lectures (60)	Lectures
I	Introduction to Ecology · History of ecology, Autecology and synecology, Levels of organization, Laws of limiting factors, Study of physical factors	4
II	Organization of Ecosystem · 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 · Sources of Environmental hazards · Climate changes · Greenhouse gases and global warming · Acid rain, Ozone layer destruction	7
V	Effects of Climate Change · Effect of climate change on public health · Sources of waste, types, and characteristics, Sewage disposal and its management, Solid waste disposal, Biomedical waste handling and disposal, · Nuclear waste handling and disposal, Waste from thermal power plants. · Case histories on Bhopal gas tragedy, Chernobyl disaster, Seveso disaster and Three Mile Island accident and their aftermath.	6
VI	Behavioural Ecology and Chronobiology · Origin and history of Ethology, · Instinct vs. Learnt Behaviour · Associative learning, classical and operant conditioning, Habituation, Imprinting, · Circadian rhythms; Tidal rhythms and Lunar rhythms · Chrono medicine	8

VII	Introduction to Wild Life • Values of wild life - positive and negative; Conservation ethics; Importance of conservation; Causes of depletion; World conservation strategies.	8
VIII	Protected areas • National parks & sanctuaries, Community reserve; Important features of protected areas in India; Tiger conservation - Tiger reserves in India; Management challenges in Tiger reserves.	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	
Degree in Bachelor of Science.		

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Programme /Class: B.Sc. / Degree	Course B.Sc. Subject: ZOOLOGY Year: Third Semester: VI	Course code B050603P
	Course Title: Lab on Ecology, Developmental Biology, Behavioural Ecology and Wild Life.	
Credits: 2	Maximum. Marks: 100 External	Practical/ week 4
Unit	Topics Total Number of Practical Classes (60)	Practical
I	1. Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided. 2. Study of an Ecosystem: Pond/Grass Land 3. Study of population dynamics through numerical Problems. 4. Study of circadian functions in humans (daily eating, sleep, and temperature patterns). 5. Study of permanent slides on Embryology: Stages of cleavage, Gastrula, and Chick embryo at various stages of development:18, 24, 48, 72 hours.	26
II	Report on a visit to National Park/Biodiversity Park/Wild life Sanctuary	4
III	1. Demonstration of basic equipment needed in wildlife studies, their 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 Sith 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.		
Degree in Bachelor of Science.		

B.Sc. (Hons.)
Degree of Bachelor of Science in Zoology
(Honours)

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SEMESTER- VII

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Programme /Class: B.Sc. / Honours	Course B.Sc. (Hons.) Subject: ZOOLOGY Year: Fourth Semester: VII	Course code B050701T
	Course Title: Systematics, Structure and Function of Invertebrates.	
Credits: 4	Maximum. Marks: 25 Internal+75 External	Lectures/ week: 4
Unit	Topics Total Number of Lectures (60)	Lectures
I	Principles of animal taxonomy and the basic concepts of . biosystematics: - Species concept, International Code of Zoological Nomenclature. - Taxonomic procedures: new trends in taxonomy - Taxonomy collections, preservations, and curretting process of identification. - different kinds of taxonomy keys and their merits and demerits	10
II	Organization of Coelom: - Acoelomates - Pseudocoelomates Coelomates: Protostomia and Deuterostomia	10
III	Nutrition and Digestion: - Patterns of feeding and digestion in lower metazoan - Filter feeding in Polychaeta, Mollusca, and Echinodermata. - Parasitic mode of feeding.	10
IV	Excretion and Respiration: Structural and functional organization of excretory systems in various invertebrates (Coelomoducts, Nephridia and Malpighian tubules) and various excretory products produced within them. Osmoregulation. Structural and functional organization of respiratory organs (gills, lungs and trachea) in invertebrates.	10
V	Parasitic protozoans, helminths and Invertebrate Larvae: Larval forms of free-living Invertebrates. Strategies and evolutionary significance of larval forms. Description of protozoan and helminth parasites	10
VI	Minor Phyla in Classification: Concept and significance. Organization and general characters. Affinities of Rotifera and Hemichordata	10
Degree in Bachelor of Science (Honours) Zoology.		

Suggested Readings for **Course B.Sc. (Hons.) Subject: ZOOLOGY Year: Fourth: Paper:**
Systematic and Structure and Function of Invertebrate

1. Barnes, R. D. (1987). *Invertebrate zoology* (5th ed.). Saunders College Publishing.
2. Barrington, E. J. W. (1979). *Structure and function of invertebrates*. Thomas Nelson and Sons Ltd.
3. Hyman, L. H. (1940–1967). *The invertebrates* (Vols. 1–6). McGraw-Hill.
4. Mayr, E., & Ashlock, P. D. (1991). *Principles of systematic zoology* (2nd ed.). McGraw-Hill.

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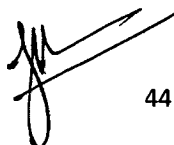
Programme /Class: B.Sc. / Honours	Course B.Sc. (Hons.) Subject: ZOOLOGY Year: Fourth Semester: VII	Course code B050702T
	Course Title: Molecular and Cell Biology	
Credits: 4	Maximum. Marks: 25 Internal+75 External	Lectures/ week: 4
Unit	Topics Total Number of Lectures (60)	Lectures
I	History and scope of molecular Biology: Structure of DNA and types of DNA DNA replication: prokaryotic and eukaryotic DNA replication, DNA damage and DNA repair Nucleosome and structure of chromatin	10
II	DNA- Transcription and Translation: - Transcription: Pro and Eukaryotic transcription, RNA polymerases - Three-dimensional structure of t-RNA, clover leaf model, L type model. - Regulation of gene expression: Prokaryotic organisms, Lac operon, Trp. operon. Role of ribosomes in protein synthesis, operon model.	10
III	Cell Biology: - Modern Concepts of Structure and functions of bio membranes. - Transport across the Plasma Membrane: Diffusion, Active transport and Pumps - Membrane Potential.	10
IV	Cell Organelles: Structural and functional organization of Cell Organelles (Mitochondria, Lysosomes, Golgi Apparatus and Endoplasmic Reticulum) Molecular structure of chromosome, Heterochromatin and Giant Chromosomes. Cilia and flagella.	10
V	Cell Cycles: Cellular differentiation and cell cycle. - Mitosis and Meiosis. - Significance of cell cycles.	10
VI	Cellular Origin of Diseases: Cellular prigin of. diseases: cancer, glycogen storage disease, lipid storage disease Inborn errors of metabolism Phenyl Ketonuria, Galactosaemia, Thalassemia, and Sickle cell anaemia	10
	Suggested Readings:	
Degree in Bachelor of Science (Honours) Zoology.		
Suggested Readings for Course B.Sc. (Hons.) Subject: ZOOLOGY Year: Fourth: Paper: Molecular and Cell Biology - Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2001). <i>Molecular biology of the cell</i> (4th ed.). Garland Science. - Freifelder, D. (1998). <i>Molecular biology</i> (2nd ed.). Jones and Bartlett Publishers. - Gardner, E. J. (1975). <i>Principles of genetics</i>. Wiley Eastern Pvt. Ltd.		

4. Giese, A. C. (1973). *Cell physiology* (5th ed.). W.B. Saunders Company.
5. Karp, G. (1996). *Cell and molecular biology: Concepts and experiments*. John Wiley & Sons.
6. Karp, G. (1999). *Cell and molecular biology: Concepts and experiments* (2nd ed.). John Wiley & Sons.
7. Kleinsmith, L. J., & Kish, V. M. (1995). *Principles of cell and molecular biology* (2nd ed.). Harper Collins College Publishers.
8. Lodish, H., Berk, A., Zipursky, S. L., Matsudaira, P., Baltimore, D., & Darnell, J. (1995). *Molecular cell biology* (3rd ed.). Scientific American Books.
9. Sinnott, E. W., Dunn, L. C., & Dobzhansky, T. (1960). *Principles of genetics* (5th ed.). McGraw-Hill.
10. Swanson, C. P. (1957). *Cytology and cytogenetics*. Macmillan & Co. Ltd.
11. Waddington, C. H. (1956). *An introduction to modern genetics*. George Allen & Unwin Ltd.
12. White, M. J. D. (1973). *Animal cytology and evolution* (3rd ed.). Cambridge University Press.

Programme /Class: B.Sc. / Honours	Course B.Sc. (Hons.) Subject: ZOOLOGY Year: Fourth Semester: VII	Course code B050703T
	Course Title: Biological Techniques and Instrumentation	
Credits: 4	Maximum. Marks: 25 Internal+75 External	Lectures/ week: 4
Unit	Topics Total Number of Lectures (60)	Lectures
I	Fixation: Principles of chemical basis of fixation. Fixation by formaldehyde, glutaraldehyde, chromium salts, mercury salts, Osmium tetroxide, alcohol, and acetone. Freeze drying, freeze fracturing and substitution techniques	10
II	Cytology and Hematology techniques: Measurement of cell size • Hematological methods: Total Leucocyte Count, Total Erythrocytes Count, Differential Leucocyte Count, Hb concentration, PCV, ESR and Red cell indices.	10
III	Chemical basis of staining for Histology and Histochemistry: Processing a tissue, Embedding, sectioning by a Microtome, and staining for observation. Special Staining Methods for Carbohydrates, Proteins, Lipids and DNA contents like PAS, Feulgen and other methods. Metachromasia.	10
IV	Tools for Histology, Cytology and Histochemistry: Various types of microscopes. Compound, Binocular and Trinocular Microscopes • Phase contrast, interference, fluorescence, and polarized microscopes. Transmission and scanning Electron microscopes.	10
V	Techniques of separation I: Types of Centrifuges and their applications. Types of Electrophoresis techniques and their applications	10
VI	Techniques of separation II: Types of Chromatography techniques and their applications. Autoradiography and its applications. X-ray diffraction method and its applications.	10
	Suggested Readings:	
Degree in Bachelor of Science (Honours) Zoology.		
Suggested Readings for Course B.Sc. (Hons.) Subject: ZOOLOGY Year: Fourth: Paper: Biological Techniques and Instrumentation		
1. Bisen, P. S., & Mathur, S. (2010). <i>Tools and techniques in life sciences</i>. CBS Publishers & Distributors. 2. Braun, R. D. (1987). <i>Introduction to instrumental analysis</i>. McGraw-Hill Book Company. 3. Brouss, R. (1982). <i>Introduction to instrumental analysis</i>. McGraw-Hill International Editions. 4. Caspersson, T. O., & Schultz, W. E. (1950). <i>Cell growth, cell function and cytochemical study</i>. W. W. Norton & Co.		

5. Cowdry, E. V. (1950). *Laboratory techniques in biology and medicine*. Williams & Wilkins Co.
6. Sluder, G., & Wolf, D. E. (Eds.). (2008). *Techniques in microscopy for biomedical applications*. Tata McGraw-Hill Education.
7. Wilson, K., & Goulding, K. H. (1986). *A biologist's guide to principles and techniques of practical biochemistry* (3rd ed.). Edward Arnold.
8. Wilson, K., & Walker, J. (2010). *Principles and techniques of biochemistry and molecular biology* (7th ed.). Cambridge University Press.



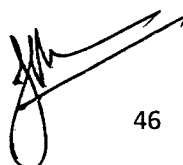




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Programme /Class: B.Sc. / Honours	Course B.Sc. (Hons.) Subject: ZOOLOGY Year: Fourth Semester: VII	Course code B050704T
	Course Title: Microbiology and Immunology	
Credits: 4	Maximum. Marks: 25 Internal+75 External	Lectures/ week: 4
Unit	Topics Total Number of Lectures (60)	Lectures
I	History and scope of Microbiology: • Recognition of microbial role in diseases. • Microbial effects on organic and inorganic matter, the composition of microbial world and scope and relevance of microbiology. Virus - Concept, general properties, cultivation, purification, Assay, structure, and structural properties	10
II	Microbial Taxonomy: Morphological, Physiological, metabolic. • Ecological and molecular characteristics. Aerobic, motile, and non-motile gram-negative bacteria, anaerobic gram negative and gram-positive bacteria.	10
III	Basic concepts of immunology: • Basic concepts of immunity, Types of immunity, Phagocytosis, Inflammation • Cells and molecules of the immune system, functions of immune response. The adaptive immune response- T cell immunity properties, cytotoxicity.	10
IV	Nature of symbiotic microbial association: • Types of interactions: Symbiosis, Commensalism, Mutualism and Host parasite relationships. • Microbiota of human body. • Microorganisms as components of environment Microorganisms in Aquatic Ecosystems .	10
V	Microbial Diseases and Immunology: Viral- Air borne, Direct contact, Food borne and water borne diseases. • Bacterial- Air borne and direct contact. • Fungal and Protozoan diseases. Deficiencies of immune system, autoimmune diseases, allergy, and hypersensitivity	10
VI	Antibodies: • Antibody production and their function. • Structure of antibody molecules and immunoglobulin genes. Antibody with specific	10

	antigens. • Antigen recognition by T lymphocyte and Antibody production by B lymphocyte.	
Degree in Bachelor of Science (Honours) Zoology		
Suggested Readings for Course B.Sc. (Hons.) Subject: ZOOLOGY Year: Fourth: Paper: Microbiology and Immunology		
1. Banwart, G. J. (1989). <i>Basic food microbiology</i> (2nd ed.). Van Nostrand Reinhold. 2. Campbell, R. (1983). <i>Microbial ecology</i>. Blackwell Scientific Publications. 3. Kuby, J. (1997). <i>Immunology</i> (3rd ed.). W.H. Freeman and Company. 4. Laskin, A. I. (Ed.). (2005). <i>Advances in applied microbiology</i> (Vol. 57). Academic Press. 5. Prescott, L. M., Harley, J. P., & Klein, D. A. (2005). <i>Microbiology</i> (6th ed.). McGraw-Hill. 6. Wistreich, G. A., & Lechtman, M. D. (1988). <i>Microbiology</i> (5th ed.). Macmillan Publishing Company.		





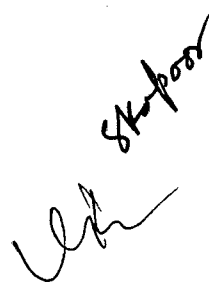
Programme /Class: B.Sc. / Honours	Course B.Sc. (Hons.) Subject: ZOOLOGY Year: Fourth Semester: VII	Course code B050705P
	Course Title: Practical	
Credits: 4	Marks: 100 External	Practical/ week 4
Unit	Topics Total Number of Practical Classes (60)	Practical
I	(I): Specimens and Slides (Invertebrates)	12
	(a) Protozoa: Entamoeba histolytica, Entamoeba gingivalis. Trypanosoma, Leishmania, Trichomonas, Plasmodium. (b) Porifera: Euplectella, Spongilla, Cliona, Euspongia. Prepared Sides: LS of Sycon, Gemmule, Amphiblastula Larva. (c) Coelenterata: Tubularia, Campanularia, Sertularia, Millipora, Physalia, Porpita, Tubipora, Alcyonium, Adamsia, Madrepora, Fungia. Medusa of Obelia, Ephyra and Scyphistoma larvae of Aurelia. (d) Platyhelminthes: Planaria, Polystoma, Schistosoma, Echinococcus Granulosus, Fasciola hepatica, Taenia solium Sporocyst, Miracidium, Redia and Cercaria larvae of F. hepatica Scolex, Gravid proglottid and Cysticercus larva of T. solium.	
II	(e) Aschelminthes: Ancylostoma, Wuchereria bancrofti, Trichinella spiralis, Trichuris, Enterobius vermicularis T.S. through the body of Ascaris Male and Female. (f) Annelida: Nereis, Heteronereis, Glycera, Chaetopterus, Arenicola, Amphitrite, Pontobdella, Hirudinaria, T. S. of Pheretima through Pharynx and Typhlosolar regions, Parapodium of Nereis and Heteronereis, Trochophore Larva of Nereis, T. S. of Hirudinaria through Crop with/without diverticula. (g) Mollusca: Snail, Chiton, Dentalium, Aplysia, Doris, Mytilus, Pinctada, Teredo, Loligo, Octopus, Nautilus	12

	Radula of Pila, TS through gill Lamina of Unio, Glochidium Larva of <i>Unio</i> .	
III	(h) Arthropoda: Balanus, Sacculina on Crab, Eupagurus, Scolopendra, Julus, Peripatus, Limulus, Lepisma, Collembola, Melanopus, Gryllotalpa, praying Mantis, Pediculus, Termite, Dragon Fly, Belostoma, Cicada, Butterfly, Moth, Xenopsylla, Head and Mouth Parts of Male and Female Anopheles and Culex. Head and mouth parts of Butterfly Mouth parts and Sting apparatus of honey bee. (i) Echinodermata: Antedon, Cucumaria, Holothuria, Asterias, Ophiothrix, Echinus, Clypeaster, Bipinnaria, Brachiolaria, Ophiopluteus and Echinopluteus larvae. (j) Hemichordata: Balanoglossus, T.S. of Balanoglossus through Proboscis and collar regions, Tonaria larva of Balanoglossus. (k) Minor Phyla: Echiura, Bonellia, Sipunculus, Bugula and Sagitta	12
IV	<u>Dissections: Major and Minor</u> 1. Pheretima posthuma (Earthworm): External Features, General Anatomy, Septal Nephridia, Ovary and Nervous System 2. Unio/Mytilus: External Features, General anatomy and Nervous System 3. Sepia/ Loligo: Nervous System 4. Pila: External Features, General Anatomy and Nervous System. 5. Palaemon: External features, Appendages and Nervous System	12

	6. Cockroach: External Features, General anatomy, Reproductive System and Nervous System SELECTED MOUNTINGS: 1. Phylum Protozoa: Amoeba, Paramecium, Euglena, Balantidium. 2. Phylum Porifera: Spicules, Spongin fibre, Gemmules 3. Phylum Coelenterata: Hydra, Obelia 4. Phylum Platyhelminthes: Planaria 5. Nematodes. 6. Phylum Annelida (a) Earthworm-Ovary, septal nephridia, Nereis: Parapodia. 7. Phylum Arthropoda: Palaemon- Hastate Plate, Statocyst Cyclops, Daphnia, and other Crustacean Larvae. Cockroach-Salivary Glands, Trachea, Mouth parts of insects. 8. Phylum Echinodermata: Tube Feet and pedicellariae of starfish	
V	(II) Molecular Biology 1. Study of polytene Chromosomes 2. Study and interpretation of Electron Micrographs or Photographs showing DNA replication and Transcription (III) Cell Biology: 1. Study of Human karyotype (normal and abnormal). 2. Study of buccal epithelial cells, neurons, striated muscles using Methylene blue. 3. Study of different stages of Mitosis using onion root tip. (IV) Techniques and Instrumentation: 1. To study the working principle of various laboratory equipment such as pH Meter, Electronic balance 2. Use of glass and micropipettes, Laminar flow, Incubator, Water bath, Centrifuge, Chromatography apparatus etc.	6
VI	(V) Microbiology: 1. To study the different phases of bacterial growth and to plot standard growth curve of Staphylococcus	<i>Staphylococcus</i>

	aureus. 2. Gram Stain Technique. Staining of Bacterial smear (VI) Immunology: 1. Determination of ABO Blood group 2. To study primary and secondary immune organs of rat 3. Histological study of spleen, thymus, and lymph nodes through slides/ photographs 4. Preparation of stained blood film to study various types of blood cells	6
Suggested Readings:		
Degree in Bachelor of Science (Honours) Zoology		



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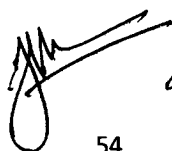
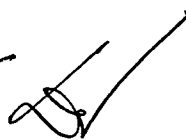
Programme /Class: B.Sc. / Honours	Course B.Sc. (Hons.) Subject: ZOOLOGY Year: Fourth Semester: VIII	Course code B050801T
	Course Title: Chordate Anatomy	
Credits: 4	Maximum. Marks: 25 Internal+75 External	Lectures/ week: 4
Unit	Topics Total Number of Lectures (60)	Lectures
I	- Outline classification of various classes of chordates - Concept of Protochordates	10
II	- General organization and affinities of Cephalochordata, Cyclostomata, Holocephali and Dipnoid - Origin, Evolution, adaptation, and parental care in amphibia	10
III	- Characters and affinities of Rhynchocephalia - Characters and affinities of Ratitae, palate in birds, migration and aerial adaptation in birds - Characters and affinities of Prototheria and Metatheria - Adaptive radiation in Mammals	10
IV	- Chordate integuments and its derivatives - Evolution of heart, aortic arches and portal systems - Comparative account of respiratory organs of Chordates	10
V	- Comparative account of jaw suspensorium, vertebral column of Chordates - Evolution of Urinogenital systems in Chordates	10
VI	- Organs of olfaction and taste - Lateral line systems, electroreception - Comparative anatomy of brain and spinal cord in relation to its functions in Chordates	10
Suggested Readings: Books Recommended: Ali Salim, 1995. The Book of Indian Birds. Bombay Nat. His. Soc. Bombay. Berrill, N. J. 1955. The Origin of Vertebrates. London Colbert E. H. 1955. Evolution of The Vertebrates. New York Goodrich E.S. 1958. Studies on the Structures and Development of Vertebrates. vol I&II. New York Hegnar R. W. & Steiles K. A. 1963. College Zoology. Oxford & IBH		
Degree in Bachelor of Science (Honours) Zoology.		

Suggested Readings for **Course B.Sc. (Hons.) Subject: ZOOLOGY Year: Fourth:**

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Programme /Class: B.Sc. / Honours	Course B.Sc. (Hons.) Subject: ZOOLOGY Year: Fourth Semester: VIII	Course code B050802T
	Course Title: Genetics and Biotechnology	
Credits: 4	Maximum. Marks: 25 Internal+75 External	Lectures/ week: 4
Unit	Topics Total Number of Lectures (60)	Lectures
I	Basics concepts and Mendelism - Genetic terms and concepts - Mendel's laws of inheritance - Limitations of Mendelism (incomplete dominance, codominance, epistasis, polygenes, lethal genes) - Linkage and crossing over	10
II	Chromosomal basis of inheritance - Gene and chromosome mapping - Variations in chromosome number and structure - Human genetic disorders - Concept of gene - Basic concepts of bacterial genetics	10
III	Molecular Basis of Inheritance - Genetic material - Experiments to support DNA as genetic material - Structures of nucleic acids - Replication of DNA - DNA repair mechanisms	10
IV	Gene Expression - Concept of modern central dogma and flow of genetic information - Genetic codes - Transcription and translation in prokaryotes and eukaryotes - Operon model and gene regulation in bacteria - Gene regulation in eukaryotes	10
V	Biotechnology and basics of DNA recombination - Scope of biotechnology - DNA Recombination Technology - PCR - Gel Electrophoresis - Southern, Northern and Western Blotting	10

	• Gene guns • Autoradiography	
VI	Biotechnology and its applications • Biotechnical waste water and sewage treatment • New medicines using biotechnical methods • Single cell proteins and bio-fortified food • Genetically modified organisms Biotechnology and environment	10
Suggested Readings: 1. Snustad and Simmons., Principals of genetics. John Wiley & Sons, Inc. 2. Robert H. Tamarin., Principals of genetics. Robert H. Tamarin, WCB Publishers. 3. D.L. Hartl, E.W. Jones., Genetics - Principles and Analysis. Bartlett Publishers, Massachusetts. 4. John E. Smith., Biotechnology. Cambridge University Press. 5. A. J. Nair., Introduction to biotechnology and genetic engineering. Infinity science press, Massachusetts New Delhi, India.		
Degree in Bachelor of Science (Honours) Zoology.		


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Programme /Class: B.Sc. / Honours	Course B.Sc. (Hons.) Subject: ZOOLOGY Year: Fourth Semester: VIII	Course code B050803T
	Course Title: Animal Physiology and Biochemistry	
Credits: 4	Maximum. Marks: 25 Internal+75 External	Lectures/ week: 4
Unit	Topics Total Number of Lectures (60)	Lectures
I	Biochemical setup - Carbohydrates- structure, and functions - Amino acids and protein structure - Fatty acids, lipids, and steroids - Nucleotides and nucleic acids	10
II	Biomolecules of physiological importance - Enzymes, classification, action mechanism, inhibition - Hormones, types, and mechanism of action - bioenergetics (Glycolysis, Kreb's cycle, Beta oxidation, Pentose Phosphate Pathway (PPP) and Electron Transport System (ETS))	10
III	Digestion and respiration - Alimentary canal and associated glands - Digestive juices, enzymes and their action - Absorption and assimilation of food - Structure of lungs and thoracic cavity - Inhalation and exhalation mechanism - Transport of gases within the body	10
IV	Neural and chemical control - Neurons, types, and impulse conduction - Synaptic transmission - Structure and functions of Brain, spinal cord and associated nerves - Reflex actions and their types - Autonomic control - Structure of eye and ear - Important endocrine glands and their secretion	10
V	Muscles, Skeleton and Excretion - Various types of muscles - Detailed structure of skeletal muscle and the mechanism of contraction - Details of human skeleton (Axial and	10

	appendicular skeleton). • Pectoral girdles in different vertebrates • Pelvic girdles in different vertebrates • Modes of excretion in different vertebrates • Mechanism of urine formation and urine concentration mechanism RAAS and hemodialysis	
VI	Cardiovascular system and reproduction • Heart in different vertebrates • Detailed structure and functioning of human heart • Blood pressure, Arteries, and veins • Human male and female reproductive system • Menstruation and pregnancy • Human and chick embryology. Foetal membranes and placenta	10
Suggested Readings: Suggested Reading - 1. Denis e R. Ferrier, Lippincott's Illustrated Reviews : Biochemistry. Lippicott Williams and Wilikins 2. David L. Nelson, Michael M. Cox. . Lehninger Principles of Biochemistry 3. Harper's Illustrated Biochemistry. Lange Medical Books 4. Guyton, Hall. Text book of Medical Physiology. Elsevier Sounders 5. Lauralee Sherwood. Human Physiology - From Cells to Systems. Brooks/Cole 6. Agrawal P. K. Simplified Biochemistry. Pragati Prakashan. Meerut 7. Ganong's Review of Medical Physiology. Lange Medical book		
Degree in Bachelor of Science (Honours) Zoology.		

Programme /Class: B.Sc. / Honours	Course B.Sc. (Hons.) Subject: ZOOLOGY Year: Fourth Semester: VIII	Course code B050804T
	Course Title: Developmental Biology	
Credits: 4	Maximum. Marks: 25 Internal+75 External	Lectures/ week: 4
Unit	Topics Total Number of Lectures (60)	Lectures
I	- Theories of Development: Preformation of Epigenesis - Gametogenesis: Spermatogenesis and Oogenesis - Fertilization: Significance of Fertilization for development, Pre and Post Fertilization and Biochemistry of Fertilization	10
II	- Biochemistry of Semen: Semen composition and formation, assessment of sperm function and sperm structure - Different types of eggs in Chordates - Different types of cleavage	10
III	- Early embryonic development: Patterns of cleavage, Blastulation and Gastrulation in Chordates (Tunicates to Mammals), fate maps, morphogenic movements, mechanics and significance of gastrulation - Casual basis of development: primitive embryonic induction, • concepts of potencies, prospective fates , progressive determination, Speman's primary organization, nature and regionally specific properties of inductor	10
IV	- Organogenesis: Brain, aortic arches, hearts, eyes in mammals - Development and physiology of extraembryonic membranes (foetal membranes) in amniotes	10
V	- Development types and physiology of mammalian placenta - Metamorphosis in amphibian: Structural and physiological changes during metamorphosis, endocrine control of metamorphosis. Environmental regulations of animal development	10
VI	- Competence, determination, differentiation, and regeneration - Regeneration: types of regeneration (physiological, reparative and compensatory, hypertrophy), - regenerative ability in Chordates morphological and histological process in amphibian limb regeneration, origin of cells for regeneration and differentiation	10

Books Recommended:

Balinsky, B.I. *Introduction To Embryology*. Saunders, Philadelphia
Berril, N. J.& Karp, G. *Development Biology*. McGraw Hill, New York

Gilbert, S. F. *Developmental Biology.* 10th Edition, Sinauer
Associated Inc., Massachusetts

Hamburger, V& Hamilton, H.L. *Handbook of Chick development
stages.* Saunders Publications

Degree in Bachelor of Science (Honours) Zoology.

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Programme /Class: B.Sc. / Honours	Course B.Sc. (Hons.) Subject: ZOOLOGY Year: Fourth	Course code B050805P
	Semester: VIII	
Credits: 4	Course Title: Practical	Practical/ week 4
	Marks: 100 External	
Unit	Topics Total Number of Practical Classes (60)	Practical
I	Study of Museum specimens and a field Visit (a) Study of various Chordate specimens from Protochordata and class Cyclostomata to class Mammalia. (b) A Field visit and study of Biodiversity of animals.	12
II	Histology, Osteology and Embryology (a) Histological slides of various organ systems from Protochordata and class Cyclostomata to class Mammalia. (b) Osteology of Vertebrates from Amphibia to Mammals. (c) Embryology slides: Blastula and Gastrula. (d) Study of Chick Embryo Development after 18, 24, 48 and 72 hours of incubation of Egg.	12
III	Dissection: Major And Minor Major dissections: 1. Afferent Branchial Arteries of (dogfish) Scoliodon. 2. Efferent Branchial Arteries of (dogfish) Scoliodon. 3. Cranial nerves of Scoliodon 4. Minor dissection: Exposure of internal ear of Scoliodon in situ. Permanent mounting: 1. Preparation of permanent slides from animal tissues like amphioxus-oral hood/wheel organ/pharyngeal wall. 12. Preparation of permanent slide of placoid scales from scoliodon.	12
IV	Genetics and Biotechnology Exercise: Genetics Exercises based on basic principles of heredity: 1. Incomplete Dominance 2. Law Of independent Assortment 3. Multiple Alleles 4. Sex-Linked Inheritance. 5. Pedigree Analysis. Biotechnological exercises (on the basis of	12

59

	availability) 1. Cell culture study 2. Primary cell line and Secondary cell line culture study 3. Vermiculture 4. Transgenic animals and their models.	
V	Physiology and Biochemistry Exercise: 1. Counting of RBC and WBC's using Hemocytometer. 2. A study of mammalian blood (cell types) by making Leishman's stain blood smear. 3. Monitoring of muscle activity by electromyography. 4. Separation of amino acids by paper chromatography and the calculation of Rf value. 5. Identification of lipids/Amino acids in a given sample by thin layer Chromatography	12
Degree in Bachelor of Science (Honours) Zoology.		

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Programme /Class: B.Sc. / Honours	Course B.Sc. (Hons.) Subject: ZOOLOGY Years: 4 Semesters: 7,8	Course code B050806R
	Course Title: Research Project: Methodology	
Credits: 8	Maximum. Marks: 25 Internal+75 External= 100	Lectures/ Practical /Week: 4
Unit	Topics Total Number of Lectures (60)	Lectures
I	Teaching Research Methodology for doing a Research Project. Learning how to identify a research work, do and Present a Research Project Report.	10
II	Learning the literature which forms the base for identifying a research problem Identifying the lacuna (Need for a study/work) available in the existing knowledge.	10
III	Formulating the methodology to do the work and identifying the tools and techniques involved in doing the research Project	10
IV	Doing the work under the guidance of the Research Supervisor and documenting the observations, results, and findings.	10
V	Collecting the observations of the Research work done in the form of data, Pictures or recordings and arranging them in the proper form of Results or observations or findings presentable as a Research Project. The data collected can be analyzed using the needful statistical analysis and expressed in the form of graphs.	10
VI	In writing the discussion, findings of the Research work should be correlated with the available literature to justify the findings. The relevant literature related to the work quoted in the Project work should be arranged in the form of References. Finally, the Research Project work can be organised and submitted in the Presentable form to the University.	10
Degree in Bachelor of Science (Honours) Zoology.		
Information for those Opting Zoology as a Minor Subject		
Any one of the Following courses of SWAYAM Portal is recommended as Minor Subject in Zoology.		
Course No: 1- NOC 25 MG 74: Applied and Economic Zoology		
Course No. 2- NOC 25 GE 14 Fundamentals of Ecology		

Postgraduate Program
M. Sc. Zoology 1- year Degree Course
Dr. BHIM RAO AMBEDKAR UNIVERSITY, AGRA
(Formerly: Agra University, Agra)

SUBJECT: ZOOLOGY

Members, Experts and Convenor

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Department of Zoology, St. John's College, Agra

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Department of Zoology, Agra College, Agra.

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Dr. Mitra Pal Singh
Department of Zoology, ~~Shikohabad~~ Shikohabad

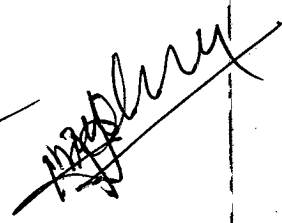
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Department of Zoology, Agra College, Agra.

Dr. Praveen Ojha,
Department of Zoology, K.R. College, Mathura

EXPERTS

Prof. Sant Prakash,
Former Professor of Zoology, DEI, Agra

Prof. P.K. Singh,
Former Professor of Zoology, DBRAU, Agra



Postgraduate Program

M. Sc. Zoology 1- year Degree Course

Dr. BHIM RAO AMBEDKAR UNIVERSITY, AGRA

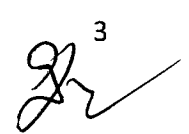
M.Sc. (ZOOLOGY)

PAPER CODING AND CREDIT DISTRIBUTION

			Title of Paper	Credit	Paper code	Page No.
3	Master of Science in Zoology	IX	Invertebrates and Vertebrates	4	B050901T	5
			Concepts in Zoology	4	B050902T	8
			Chronobiology	Choose ANY TWO	4 B050903T	12
			Genomics		4 B050904T	14
			Bioinformatics		4 B050905T	16
			Insect Pest Management		4 B050906T	18
			Human Population & Pollution		4 B050907T	21
			Vector and Vector borne Diseases		4 B050908T	23
			Fish Culture		4 B050909T	25
			Apiculture		4 B050910T	26
			Biodiversity Conservation		4 B050911T	27
			Conservation of Endangered Species		4 B050912T	30
			Aquaculture		4 B050913T	33
			Sericulture		4 B050914T	34
			Practical	4	B050915P	35
4		X	Choose ANY ONE Course (A/B/C/D)			

4	Master of Science in Zoology	X	OPTIONAL COURSE A-ENTOMOLOGY			
			Insect Morphology and anatomy	4	B051001T	38
			Insect Physiology and Development	4	B051002T	39
			Insect Systematics	4	B051003T	40
			Ecology and Applied Entomology	4	B051004T	41
			Practical	4	B051005P	44
			Research Project	8	B051006R	45
			OPTIONAL COURSE B-ICHTHYOLOGY			
			Systematics and Morphology of fishes	4	B051007T	46
			Physiology and Embryology Fishes	4	B051008T	47
			Aquaculture and fisheries	4	B051009T	48
			Pisciculture and economic importance	4	B051010T	49
			Practical	4	B051011P	51
			Research Project	8	B051012R	45
			OPTIONAL COURSE C-PARASITOLOGY			
			General Parasitology	4	B051013T	52
			Biology of Parasite	4	B051014T	54
			Parasitological Technique	4	B051015T	57
			Host Parasites Interaction	4	B051016T	59
			Practical	4	B051017P	61
			Research Project	8	B051018R	45
			OPTIONAL COURSE D-WILDLIFE AND ENVIRONMENTAL BIOLOGY			
			Wildlife Ecology	4	B051019T	63






		Wildlife Biodiversity and Conservation	4	B051020T	66
		Environmental Physiology	4	B051021T	68
		Environmental Pollution and Management	4	B051022T	71
		Practical	4	B051023P	73
		Research Project	8	B051024R	45

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IV	Classification- by Whittaker: Basic Characters used Characters of the Phylum Hemichordata and Chordata Characters of the Sub- phyla: Cephalochordata, Urochordata and Vertebrata Characters of Agnatha and Gnathostomata General characters and classification of Pisces and Tetrapoda with examples.	10
V	Classification of Anamniota and Amniota Migration in Lampreys Accessory respiratory organs in fishes Adaptations of fish in lentic and lotic habitats. General Characters and classification of Amphibians with examples Morphology and Anatomy of <i>Rana tigrina</i> Adaptive radiation in Amphibians	10

VI	General Characters and classification of reptiles with examples Morphology and Anatomy of garden lizard Hormonal control of colour change in lizards General Characters and classification of birds with examples Morphology and Anatomy of Pigeon Volant adaptations in Birds. General Characters and classification of mammals with examples Morphology and Anatomy of rat Adaptive radiation in mammals.	10
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Suggested Readings:

1. A Textbook of Invertebrate Zoology

Kotpal, R. L. (2019). A textbook of invertebrate zoology. Rastogi Publications.

2. Modern Textbook of Zoology: Vertebrates

Kotpal, R. L. (2020). Modern textbook of zoology: Vertebrates. Rastogi

Publications.

3. Invertebrate Zoology

Jordan, E. L., & Verma, P. S. (2018). Invertebrate zoology. S. Chand Publishing.

4. Chordate Zoology

Jordan, E. L., & Verma, P. S. (2017). Chordate zoology. S. Chand Publishing.

5. Biology of Animals

Gangane, S. D. (2016). Biology of animals. Himalaya Publishing House.

6. Life of Vertebrates

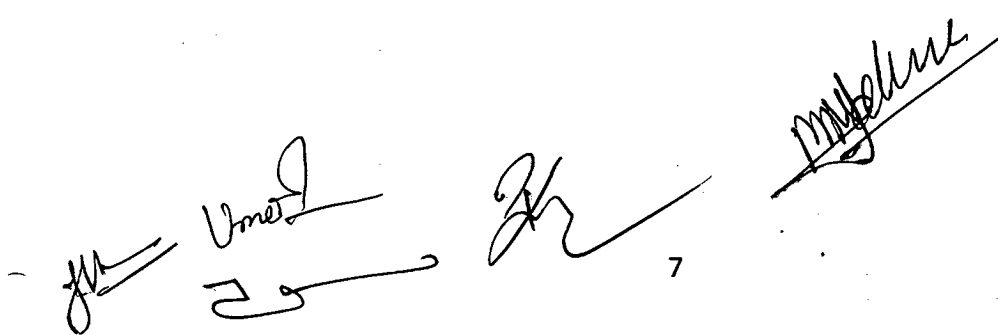
Young, J. Z. (2004). The life of vertebrates (3rd ed.). Oxford University Press.

7. Invertebrates

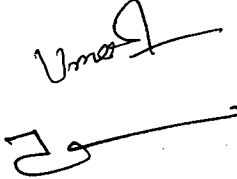
Brusca, R. C., Moore, W., & Shuster, S. M. (2016). Invertebrates (3rd ed.). Sinauer Associates.

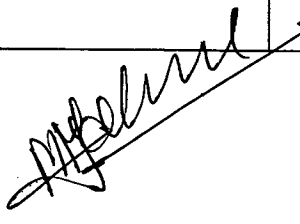
8. Integrated Principles of Zoology

Hickman, C. P., Roberts, L. S., Keen, S. L., Larson, A., & Eisenhour, D. J. (2017). Integrated principles of zoology (17th ed.). McGraw-Hill Education.

The bottom of the page features four handwritten signatures in black ink. From left to right, they are: a signature that appears to be 'JL', a signature that appears to be 'Vme', a signature that appears to be 'Z', and a signature that appears to be 'M. S. Verma'. Below the second signature is a horizontal line. To the right of the third signature is the number '7'.

Programme /Class: M.Sc. Zoology	Course M.Sc. Zoology Subject: ZOOLOGY Year: Fifth Semester: IX	Course code B050902T
	Course Title: Concepts in Zoology	
Credits: 4	Maximum. Marks: 25 Internal+75 External	Lectures/ week: 4
Unit	Topics Total Number of Lectures (60)	Lectures
I	Speciation: Factors affecting speciation Biodiversity: Threats to biodiversity Invasive species Biodiversity Indices: Shannon- Weiner Index, Dominance Index, Similarity and dissimilarity index Population genetics and Hardy-Weinberg equilibrium, polygenic inheritance Population viability analysis (PVA) Anthropogenic pressures: Land use and land-cover change; Climate change. Pollution: Land, air and water.	10
II	Host pathogen interaction: Recognition and entry processes of bacteria and viruses in to animal host cells. Alteration of host cell behaviour by pathogens Virus induced cell transformation Pathogen induced diseases in animals M.H.C. Molecules Antigen processing and presentation. Activation and differentiation of B and T Cells. B and T cell receptors. Humoral and cell mediated immune responses. Primary and secondary immune modulation.	10

8


	ELISA, RIA, western blot, immunoprecipitation, flow cytometry and immunofluorescence microscopy	
III	Regulation of water balance, electrolyte balance, acid-base balance. Blood volume, blood pressure ECG – its principle and significance Transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration. Mechanism of Hormone action Muscle metabolism Somatic sensory pathway Overview of Lymphatic system Aging and the special senses Phases of digestion.	10
IV	Isolation, separation and analysis of Proteins: Protein sequencing methods. Isolation, separation and analysis of DNA and RNA: strategies for genome sequencing and gene expression analysis. DNA sequencing methods. In-situ localisation techniques: FISH, GISH and their uses DNA Fingerprinting, DNA Barcoding and their applications.	10
V	Major Bioinformatic Resources, Molecular modelling and Dynamics: Sequence databases, gene expression data bases, 3D structural database, pattern sequence databases 3-D structure visualization and simulation, Basic concepts in molecular modelling, Molecular Mechanics, Force fields etc.	10

VI	Biosafety and Bioethics: Biological safety measures, biosafety levels, regulatory guidelines, animal ethics, research ethics, publication ethics	10
Suggested Readings: 1. Molecular Biology of the Cell Alberts, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K., & Walter, P. (2022). Molecular biology of the cell (7th ed.). Garland Science. 2. Immunobiology Murphy, K., & Weaver, C. (2022). Janeway's immunobiology (10th ed.). Garland Science. 3. Principles of Genetics Snustad, D. P., & Simmons, M. J. (2019). Principles of genetics (7th ed.). Wiley. 4. Fundamentals of Biochemistry Voet, D., Voet, J. G., & Pratt, C. W. (2018). Fundamentals of Biochemistry: Life at the molecular level (5th ed.). Wiley. 5. Lehninger Principles of Biochemistry Nelson, D. L., & Cox, M. M. (2021). Lehninger principles of biochemistry (8th ed.). W. H. Freeman. 6. Bioinformatics: Sequence and Genome Analysis Mount, D. W. (2021). Bioinformatics: Sequence and genome analysis (2nd ed.). Cold Spring Harbor Laboratory Press. 7. Essential Immunology Roitt, I. M., Brostoff, J., & Male, D. (2019). Roitt's essential immunology (14th ed.). Wiley-Blackwell.		

8. Ecology and Environment

Sharma, P. D. (2020). Ecology and environment. Rastogi Publications.

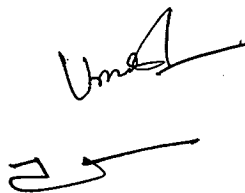
9. Principles of Anatomy and Physiology

Tortora, G. J., & Derrickson, B. (2021). Principles of anatomy and physiology (16th ed.). Wiley.

10. Bioethics and Biosafety

Sateesh, M. K. (2017). Bioethics and biosafety. I. K. International Publishing House.

Degree of Master of Science in Zoology.

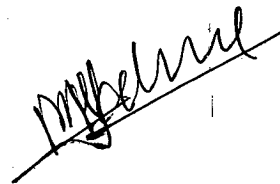


M.Sc. Zoology Semester IX (Elective Course-1)		
Paper code: B050903T		Total marks: 25+75
CHRONOBIOLOGY		
Unit	Topics	Total No. of Lecture
I	History and Adaptive significance, Introduction to biological clocks: Temporal organization. Evolution and adaptive significance; Types of biological rhythms and their properties. Circadian rhythms. Circannual rhythms. Ultradian rhythms, Tidal/Lunar rhythms. Peripheral clocks. Photoperiodism: Photoreception, phototransduction; Geophysical environment–Organisms in the cyclic environment	10
II	Properties of biological clocks: Characteristics, Phase shift, phase angle difference, Phase response curve (PRC). Masking and concept of zeitgeber. Entrainment-parametric and non-parametric entrainment.	10
III	Clock system in prokaryotes/invertebrates: Clock in bacteria with example Cyanobacteria. Circadian pacemaker system in invertebrates with <i>Drosophila</i> as example. Circadian clock in humans: Organization of clock system in humans. Central and peripheral clock.	10
IV	Vertebrate Clock System: Suprachiasmatic nucleus (SCN), Molecular biology of the circadian pacemaker system with examples from birds and mammals. Melatonin and human physiology: Bio-synthesis and regulation of melatonin, role of melatonin in regulation of diseases. Sleep and diseases in human.	10
V	Biological clocks in human welfare - Clock and Human health, Chronopharmacology, Chronomedicine and Chronotherapy. Proximate and Ultimate factors. Role of proximate factor in regulation of physiology and behavior. Disruption of clocks and diseases viz. Diabetes, Cardiovascular diseases. Ageing and sleep disorders.	10
VI	Photoperiodic time measurement; Methods for the study of rhythms in humans: Measurement of rhythms in physiology and metabolism (e.g. heartbeat), blood pressure, body temperature, liver metabolism. Clock regulation of metabolism.	10



Suggested Readings:

1. Chronobiology Biological Timekeeping: Jay. C. Dunlap, Jennifer. J. Loros, Patricia J. DeCoursey (ed). 2004, Sinauer Associates, Inc. Publishers, Sunderland, MA, USA
2. Insect Clocks. D.S. Saunders, C.G.H. Steel, X., Afopoulou (ed.) R. D. Lewis. (3rd Ed). 2002, Barends and Noble Inc. New York, USA
3. Biological Rhythms: Vinod Kumar (ed 2002) Narosa Publishing House, Delhi/ Springer-Verlag, Germany.
4. Chronobiology Biological Timekeeping: Jay. C. Dunlap, Jennifer. J. Loros, Patricia J. DeCoursey (ed). 2004, Sinauer Associates, Inc. Publishers, Sunderland, MA, USA
5. Biologic Rhythms in Clinical and Laboratory Medicine. Touitou, Yvan; Haus, Erhard (Eds.) Springer-Verlag, 1992



M.Sc. Zoology Semester IX (Elective Course-2)

Paper code: B050904T		Total Marks:25 +75
GENOMICS		
Unit	Topics	Total No. Of Lectures
I	- An Introduction of genomics and its scope. - Nucleic acids, genes and chromosome relationship - DNA as molecular database, structure and replication. DNA content in different animals. C Value paradox. DNA estimation. - RNA, structure, types and synthesis. - Basics of protein structure.	12
II	- Central dogma and genetic codes. - Transcription and translation. - Protein structure: primary, secondary and tertiary, processing, and transport. - Various approaches in prokaryotic and eukaryotic gene control.	12
III	- Genome organization in viruses, prokaryotes and eukaryotes - Organization of nuclear and organellar genomes - Repetitive DNA-satellite DNAs and interspersed repeated DNAs, transposable elements - LINES, SINES, Alu family and their application in genome mapping. - Variation at the genetic level: DNA markers -VNTR, STR, microsatellite, SNP and their detection techniques	12
IV	- Methods of DNA and protein analysis: Electrophoretic techniques, Southern and Northern blotting, Preparation of probes, Isolation and purification of DNA, RFLP analysis, DNA finger printing and its application, Native PAGE, SDS-PAGE and two-dimensional PAGE analysis of proteins, Western Blotting. - Polymerase Chain Reaction (PCR): Concept of PCR, various kinds of PCR, Real Time PCR. RT-PCR. - RAPD fingerprinting, Ligation Chain Reaction, Applications of PCR. - Construction of DNA libraries: Vectors used in the construction of cDNA versus genomic DNA libraries.	12

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V	• Genome sequencing: DNA sequencing by Sanger's method, Physical mapping, Whole genome shotgun sequencing, Preparation of BAC/YAC library, Genome annotation at different levels, Comparative genome sequencing. • Protein engineering and proteome analysis: Insertional and deletion mutagenesis, Site-directed mutagenesis, Proteome analysis, Protein arrays and their applications. • Mammalian tissue culture, cell line transfections, functional assays, Use of model organisms, methods for generation of transgenic animals, RNAi approach.	12
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Suggested Readings:

1. Concepts of Genetics	Klug W. S. and Cummings	M. R Prentice-Hall
2. Genetics-a Conceptual Approach	Pierce B. A.	Freeman
3. Genetics- Analysis of Genes and Genomes	Hartle D. L. and Jones E. W.	Jones & Bartlett
4. An Introduction to Genetic Analysis	Griffith A. F. et al	Freeman
5. Principles of Genetics	Snustad D. P. and Simmons.	John Wiley & Sons.
6. Genetics	Strickberger M. W.	Prentice-Hall
7. Essential Cell Biology	Alberts B. et al.	Garland
8. Molecular Biology of The Cell	Alberts B et al.	Garland
9. Advanced Genetic Analysis	Hawley & Walker	Blackwell
10. Genes IX	Lewin B.	Pearson
11. Molecular Cell Biology	Lodish, H. et al.	Freeman
12. Cell and Molecular Biology	De Robertis & De Robertis	Lippincott & Wilkins

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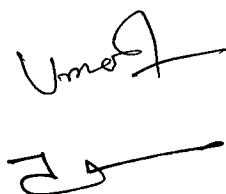
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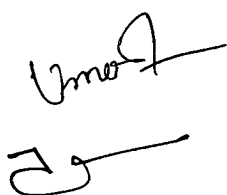
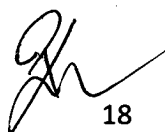
M.Sc. Zoology Semester IX (Elective Course-3)		
Paper code: B050905T		Total Marks: 25+75
BIOINFORMATICS		
Unit	Topics	Total No. of Lectures
I	Introduction to bioinformatics, computational genomics and proteomics. Genomics and proteomics databases- Nucleic acid sequence databases: GenBank, EMBL, DDBJ. Protein sequence databases: Swiss-prot, PDB, TrEMBL. Metabolic pathway database: KEGG, EcoCyc, and MetaCyc. Small molecule databases: PubChem, Drug Bank, ZINC, CSD.	12
II	BLAST, BLAST vs FASTA, file formats- FASTA GCG and ClustalW. Databank search- data mining, data management and interpretation. Multiple sequence alignment of genes and primer designing. Phylogenetic analysis with the program PHYLIP, DISTANCES, and GROWTREE. Basics of designing a microarray, image analysis and normalization, annotations.	12
III	Basic components of computer- hardware (CPU, input, output, storage devices), Software (operating systems), Application software. Introduction to MSEXCEL- use of worksheet to enter data, edit data, copy data, move data. Use of in- built statistical functions for computations of mean, S. D. correlation, regression coefficients etc. Use of bar diagram, histogram, scatter plots, etc., Graphical tools in EXCEL for presentation of data. Introduction to MS- WORD, word processor- editing, copying, moving, formatting, table insertion, drawing flow charts. Introduction to Power Point, image and data handling and software like Endnote.	12
	Biostatistics- population, sample, variable, parameter, primary and secondary data, screening and representation of data, frequency distribution, tabulation, bar diagram, histograms, piedigram, mean, median, mode, quartiles and percentiles, variance, standard	

IV	deviation, coefficient of variation; Probability and distributions- definition of probability (frequency approach), independent events. Addition and multiplication rules, conditional probability, examples- binomial, Poisson and normal distributions; Chi-square test, Z test, t-Test P- value of the statistic, confidence limits. Introduction to one-way and two- way analysis of variance.	12
V	Proteins, secondary structure and folding, RNA secondary structures, protein prediction tools- protein secondary structure, molecular modelling, identification and characterization of protein mass fingerprint, world- wide biological databases. Protein modelling, protein structure analysis, docking, ligplot interactions. Introduction to the latest modern softwares and technologies.	12



M.Sc. Semester IX (Elective Course-4)		
Paper code: B050906T		Total Marks: 25+75
INSECT PEST MANAGEMENT		
Course objective	The course offers variety of interacting processes to study the factors responsible for achieving pest status, plant-insect interactions, different methods of pest management and integration of pest management in best possible manner in order to make the environment ecofriendly.	
Unit	Topics	Total No. of Lectures
I	Basics of insect, pest and its categories • Insect, abundance and its diversity • Insect classification based on economic importance • Insect pest, origin of insect pest • Pest status and factors • Economic injury level (EIL) economic threshold, action threshold • Pest spectrum, pest complex	10
II	Principals of pest management and history • Concept of IPM, history • Ecological method of pest management • Legal, Cultural, Physical, Mechanical control of pest	10
III	Biological Control • Predators • Parasites • Parasitoids • Microbes-Fungi, Bacteria and Viruses • Entomopathogenic Nematodes	10

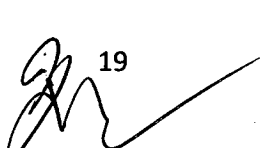
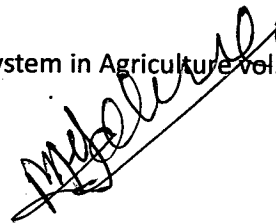





IV	Chemical Control • Plant protection Equipment • Pharmacodynamics • Nomenclature • Classification • Mode of action • Different insecticide groups • Types of formulation	10
V	• Attractants, repellants and pheromones • Feeding deterrents • Chemosterilants • IGRs • Genetic Techniques • Transgenic plants	10
VI	Insecticide Resistance and Management • Antibiosis • Antiixenosis • Tolerance • Factors mediating resistance • Insect resistant transgenic crops (particularly Bt-crops) • Bt-Crops as substitute for Insecticides. • Insect resistance due to secondary Metabolites	10

Suggested Reading –

1. G.S. Dhaliwal and Ramesh Arora (2003) Integrated Pest Management : Concepts and Approaches, Kalyani publication, New Delhi.
2. R.L. Metcalf and W. H. Lackmann (1982) Introduction to Insect Pest Management, John Willey and Sons, New York.
3. Upadhyay R.K., Mukharji K.G. and Rajak, R.L. (1999) IPM System in Agriculture vol. -3 – vol. -7 Eds. Aditiya Books Pvt. Ltd. New Delhi.

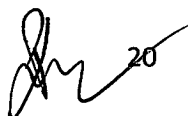


4. Horowitz A.R. and I Shaaya (2004) Insect Pest Management. Field and Protected Crops, Springer, New Delhi.
5. Atwal A.S. and Dhaliwal G.S. (2009) Agricultural pests of South Asia and their Management, Kalyani Publication, New Delhi.
6. Saxena A.B. (2003) Biological control of Insect Pests, Anmol Publication New Delhi.
7. Dhaliwal, G.S. and Cuperus, G.W., (2004) Integrated Pest Management: Potential, Constraints and Challenges, CABI Publishing.
8. Srivastava, K.P. A Textbook of Applied Entomology, Kalyani Publishers, New Delhi.





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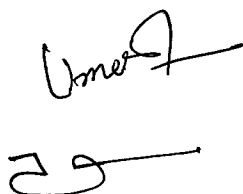


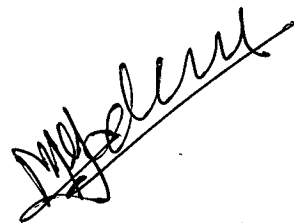
M.Sc. Zoology Semester IX (Elective course-5)		
Paper code: B050907T		Total Marks 25+75
Human Population and Pollution		
Unit	Topics	Total No. Of Lectures
I	Introduction to human population biology • Variation within and among populations. • Views on an evolutionary time scale. • The structure of human populations - Vital statistics. • Past and present human population sizes. The age structure of populations	12
II	Population genetics • The genetic basis of evolution of human population. • Hardy-Weinberg law and random mating effect • Mutation. Migration. Inbreeding. • Genetic drift. • Population growth and regulation • Models of population growth and regulation. Density dependent population regulation.	12
III	Human fertility • Birth spacing and the reproductive span. • Natural fertility. • The proximate determinants of fertility. • Reproductive aging and post-reproductive life. • Human aging and mortality • Models of human senescence. Pandemic diseases and human population	12
IV	Pollution and its sources • Air pollution and air quality index • Water pollution and aquatic life • Land and soil pollution • Waste management (waste water, plastic waste, electronic waste and hazardous waste)	12

V	Addressing pollution • Global challenges and opportunities in the context of the 2030 Agenda • Government initiatives and various laws related to pollution • International summits and conferences and their outcome • Ozone hole and international efforts • Greenhouse gases management • Sustainable development and green planet	12
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Suggested Readings:

- | | |
|---|---|
| • The Population Bomb | Paul R. Ehrlich |
| • Population Genetics : A Concise Guide | John H. Gillespie |
| • Demography: The Study of Human Population | D. Yaukey, L. Anderton, J. H. Lundquist |
| • Living Within Limits | Garrett Hardin |
| • Human Population Genetics | John Relethford |
| • Environmental pollution and control | P. Aarne Vesilind |
| • Environmental Pollution Control Engineering | C. S. Rao |
| • Waste management practices | John Pichtel |

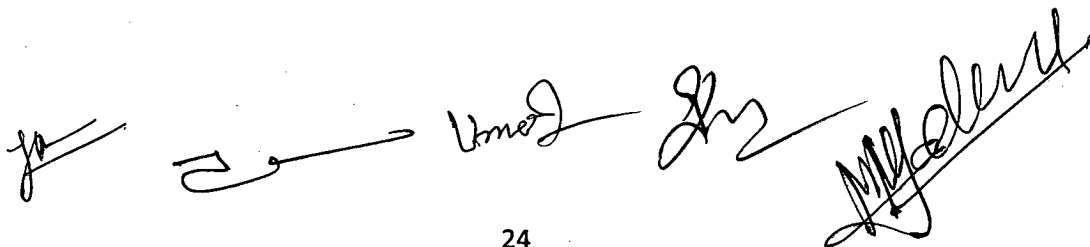


M.Sc. Semester IX (Elective Course -6)		
Paper code: B050908T		Total Marks: 25+75
Vectors and Vector Borne Diseases		
Course objective	The course enables you to learn basics of vector ecology and behavior, the pathogens they transmit, the diseases caused by those pathogens and also about current methods being implemented around the globe to control vector borne disease transmission.	
Unit	Topics	Total no. of Lecturers
I	Basic introduction to arthropods and insects A Brief History of Medical-Veterinary Entomology, Identification and Systematics of Arthropods of Medical-Veterinary importance, Types of Problems Caused by Arthropods Arthropod Toxins and Venoms	10
II	Mosquito biology, ecology and behavior Tick biology, ecology, and behavior	10
III	Epidemiology of Vector-Borne Diseases Components of Transmission Cycles, Modes of Transmission, Vertical Transmission, Horizontal transmission, Transmission Cycles, Inter-seasonal Maintenance, Vector incrimination, Surveillance, Emerging Vector-Borne Diseases	10
IV	Bacterial pathogens Ticks and Borellia, Ticks and Rickettsia, Lice and fleas Viral pathogens Mosquitoes and Togaviridae/Bunyaviridae, Mosquitoes and Flaviviridae, Ticks and viruses	10

V	Protozoan pathogens: Mosquitoes and Plasmodium, Tsetse flies, Trypanosomes Kissing bugs and Sand flies Nematodes and Trematode pathogens: Mosquitoes and filarial worms, Snails and Schistosoma	10
VI	• Ethical and ecological considerations in public health entomology • Vector control and prevention of vector borne disease transmission • WHO "Core Vector Control Methods" Molecular Tools Used in Medical and Veterinary Entomology- Molecular Techniques, Non-molecular Techniques, Genomics: Sequencing, Cataloging, and Study of an Organism's Genes	10

Suggested Reading –

1. Eldridge, B. F., & Edman, J. D. (2004). *Medical entomology: A textbook on public health and veterinary problems caused by arthropods*. Kluwer Academic Publishers.
2. Mullen, G. R., & Durden, L. A. (n.d.). *Medical and Veterinary Entomology*. Academic Press, an imprint of Elsevier.
3. WHO. (n.d.). *Ethical issues associated with vector-borne diseases: Report of a who scoping meeting WWHO*. World Health Organization. Retrieved September 11, 2022, from <https://www.who.int/publications/i/item/ethical-issues-associated-with-vector-borne-diseases-report-of-a-who-scoping-meeting>



M.Sc. Zoology Semester IX (Elective Course-7)

Paper code: B050909T

FISHCULTURE

Total
Marks:
25+75

Unit	Topics	Total No. Of lectures
I	Pisciculture- definition and aim of Pisciculture, history of Pisciculture in India, types of Pisciculture and methods.	10
II	Quality of culturable fishes, types of cultivable fishes, factors affecting pisciculture, management of pisciculture: breeding pond- types of breeding (natural and induced), fish seed, hatching pit, transport of fish fry to nursery pond, rearing ponds, stocking ponds, harvesting.	10
III	Methods of fishing, fishing industry in India.	10
IV	Diseases in fishes- fungal diseases, bacterial diseases, protozoan diseases and fluke diseases; prophylactic measures for the prevention of fish diseases.	10
V	Pisciculture and water pollution; economic importance of Pisciculture.	10
VI	By-products of Pisciculture industry and their utilization, Employment potential and income generation.	10

Books recommended:

1. Lagler KF, Bardach, JE, Miller, RR, Passino DRM. 1977. Freshwater Fishery Biology by Ichthyology, 2ndEd. John Wiley & Sons, New York
2. Santosh Kumar and Manju Tembhre. 2011. Fish and Fisheries.

M.Sc. Zoology Semester IX (Elective Course-8)

Paper code: B050910T

Apiculture

**Total
marks:
25+75**

Unit	Topics	Total No. Of lectures
I	• Introduction to Apiculture • Study of habit, habitat and nesting behavior of <i>Apis dorsata</i>, <i>Apis indica</i>, <i>Apis floera</i>, <i>Apis mellifera</i>.	10
II	• Life cycle, Colony organization and division of labor. • Bee behavior and communication.	10
III	• Morphology of honey bee, it's pollen basket and the sting apparatus. • Mechanism of separation of honey and pollen in the gut of honey bee	10
IV	• Bee keeping equipment: Bee box, Honey extractor, Smoker, Bee-veil, Gloves and other hive tools • Bee keeping and seasonal management	10
V	• Collection, composition and the use of the bee products: Honey, Wax, Venom, Royal jelly and Pollen. • Diseases and enemies of Bees: a) Bee diseases- Protozoan, Bacterial, viral, Fungal. b) Bee pests- Wax moth (Greater and Lesser), wax beetle. c) Bee predators- Bee eater, King crow, Wasp, Lizard, Bear, Man.	10
VI	• Bee pollination and management of bee colonies for pollination. • Marketing of apiculture products	10

Books:

- Bee and Bee Keeping, 1978, Roger A. Morse, Conell University Press, London.
- The Behavior and social Life of Honey Bees, C. R. Ribbandas. Dover Publication inc. New York.
- Chapman, R.F. (1998) The insects Structure and function. Cambridge University Press, Cambridge
- Tembhare, D. B. (1997). Modern Entomology. Himalaya Pub. House, Mumbai.
- Kohls, R. L. Uhl, J. N. (2002) Marketing of agricultural products. Prentice-Hall Inc. USA
- Robert W. Matthews, Janice R. Matthews (2010) Insect Behavior John Wiley & Sons, Inc. USA,
- Brian, M.V. (1983) Social Insects, Ecology and Behavioral Biology. University Press, Cambridge, UK

M.Sc. Zoology Semester IX (Elective Course-9)

Paper code: B050911T

Total
Marks:
25+75

Biodiversity Conservation

Unit	Topics	Total No. of Lecture
I	Fundamental concepts and history of biodiversity, Biodiversity- definition, levels. (Four main levels of biodiversity are species, genetic, ecosystem, and global biodiversity) and types; Scope and Constraints of Biodiversity Science, Composition and Scales of Biodiversity: Genetic Diversity, Species/Organismal Diversity, Ecological/Ecosystem Diversity, Landscape/Pattern Diversity, Agrobiodiversity, Bicultural Diversity and Urban Biodiversity; Factors promote high diversity, latitudinal and altitudinal gradients of biodiversity; biodiversity extinctions. Instrumental/Utilitarian value and their categories, Direct use value; Indirect/ Non-consumptive use value, Introduction to Ecological Economics; Monetizing the value of Biodiversity; Intrinsic Value; Ethical and aesthetic values, Anthropocentrism, Biocentrism, Ecocentrism and Religions; Intellectual value; Deep Ecology.	09
II	Phytogeography and zoogeographical regions, Introduction of species, Theories of distribution, Endemism, Community concept; Community composition, qualitative and quantitative characters of community; methods of studying vegetation; Techniques for survey and assessment of endangered and threatened plant species, species diversity and stability relationship; Diversity indices, Plant and animal communities in forest, grassland, desert and mangrove ecosystems; high altitude communities; zonation and stratification of plant and animal communities. Measuring genetic diversity: The Hardy-Weinberg law; genetically effective populations size, Gene flow-Genetic pollution and gene erosion; Genetic drift: Wahlund effect, Inbreeding depression, Out breeding depression, Mutation, Natural selection: Genetic load and Mutation-selection balance; Time scale of concern in species revival; Use of genetic information in identification and prioritization of groups for conservation, for designing and implementation of reproductive strategies in plants and animals, and in population estimation; Understanding different levels of population exploitation on of genetic diversity.	15
III	Biodiversity values-evolutionary, economic, social, cultural and intrinsic values, threats to biodiversity-Indian context, important threatened/endemic plant and animal taxa of India, biodiversity and ecosystem services. Habitat Destruction, Fragmentation, Transformation, Degradation and Loss: Causes, Patterns and consequences on the Biodiversity of Major Land and Aquatic Systems Invasive Species: their introduction pathways, biological impacts of invasive species on terrestrial and aquatic systems Pollution: Impacts of Pesticide pollution, Water pollution and Air Pollution on biodiversity; Overexploitation: Impacts of Exploitation on Target and Non-target Terrestrial and Aquatic species and Ecosystems Extinction: Types of Extinctions, Processes responsible for Species Extinction, Current and Future Extinction Rates, IUCN Threatened Categories, Sixth Extinction/Biological Crisis.	8

IV	Climate change and biodiversity; Biodiversity of Indian subcontinent: biodiversity hotspots, their characteristic flora and fauna, Ecological Succession & climax ecosystems (e.g. Sholas) Maximizing usage of Habitat resources by populations Insular habitats & insular flora & fauna Extreme Habitats and their flora & fauna (Dark Caves, deep sea etc. Concept of Home range, Familiar areas Manipulating Home ranges to increase population density Territoriality and Habitat utilization in animals Concept of niches, its realization & its continuity Micro-Habitats: Fallen Log, Treetop-puddles etc. Biodiversity resources of north-east India, threatened vascular plant species in India; Threatened categories, biological invasions and Biodiversity, Biodiversity and Biotechnology, Biopiracy. Buffer zones, Wildlife corridors, Strategies to reduce human-wildlife interactions.	10
V	Biodiversity conservation strategies: in situ conservation: Biosphere reserve, sanctuaries, national parks, ex situ conservation: botanical garden, zoological garden, in vitro conservation: germplasm or gene bank, tissue culture; Global approaches to biodiversity conservation, Indigenous approaches to biodiversity conservation, biodiversity & ethnomedicinal resources, Indian initiatives in biodiversity conservation-biodiversity act 2002, Biodiversity Rules 2004, national biodiversity strategy and action plan (NBSAP), Plant Varieties Protection and Farmer's Rights Act, 2001, National biodiversity authority (NBA) etc.; protected area network (PAN)-biosphere reserves, national park, sanctuary, community conservation area, important bird areas in India, ecological sensitive zone; traditional knowledge digital library(TKDL). Role of NGOs in conservation, International NGOs; UNEP, GEF, WCS, Bird Life International, Important NGOs in India & their contributions, WWF, ATREE, BNHS, WTI, Kalpavriksha etc., Important NGO movements, Chipko movement, Narmada Bachavo Aandholan, Pani Panchayats, Seed Movement etc.	09
VI	History, Establishment, types and management of Protected Area- comprehensive global area systems, National and bioregional reserve system, Systemic Reserve selection method, Planning process for establishment of Protected Area, Threats to Protected Area Community conserved Areas (CCAs) - Range and significance of CCAs, Legal and policy context, Limitation and problems, Management principles; IUCN Protected Area management. International programs for biodiversity conservation, convention on biological diversity (CBD), CITES, ITTA, UNFCCC, Kyoto Protocol, TRIPS, Ramsar Convention on Wet Lands, Cartagena Protocol on Bio-Safety 2000 (CPB); The Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal, The Montreal Protocol, IPR.	09

Books Recommended:

1. Groom, M. J., Meffe, G. R. and C. R. Carroll. 2006. Principles of Conservation Biology. Sinauer Associates, Inc., USA.
2. Primack, R. 2006. Essentials of Conservation Biology. Sinauer Associates, Inc., USA.
3. Hamblin, C. 2004. Conservation. Cambridge University Press.
4. Van Dyke, F. 2008. Conservation Biology Foundations, Concepts, Applications 2nd Edition, Springer.
5. Lockwood, M., Vorboys, G. and Kothari A. (Ed.). Managing Protected Areas
6. Stuart, C., Spalding, M and Jenkins, M. the world's Protected Areas: Status, Values and prospects in 21st century
7. Turner, M.G., Gardner, R. H. and O'Neill, R. V. Landscape ecology in theory and practice: pattern and process
8. Chapin, F.S. Pamel, A. M. and Vitousek, P Principles of terrestrial Ecosystem ecology 14 Scheme of Examination and Syllabus Passed Through Academic Council Sub-Committee Meeting Held on 31.07.2015
10. Perrow, M. R. and Davy, A. J. Handbook of ecological Restoration Vol I Principles of restoration
- Groom, M. J., Meffe, G. R. and Carroll, C. R. 2006. Principles of Conservation Biology, Sinauer Associates, Inc., USA.
11. Gardner, E. J. 1975. Principles of Genetics. John Wiley and Sons.
12. Hamilton, M. 2009. Population Genetics. Wiley-Blackwell Publications, USA
13. Hedrick, P. W. 1999. Genetics of Population. Jones and Bartlet Publishers, Inc., London.
14. Gaston, K.J and Spicer, J.I. 2004. Biodiversity: An Introduction. Blackwell Publishing Company, USA.
15. Richard. B. Primack. 1998. Essentials of conservation biology. Sinauer Associates, Inc. USA.
16. Ray S. and Ray A.K. 2010. Biodiversity and biotechnology. New central book Agency (P) Ltd. Kolkata.
17. Nautiyal, S and Kaul, A.K. 1999. Forest Biodiversity and its conservation Practices in India. Oriental Enterprises, Dehradun.
18. Ian. F. Spellberg. 1992. Evaluation and Assessment for Conservation. Chapman Hall, London, UK.
19. Stanley, A.H., 2002. Managing our wildlife resource. Prentice-Hall, USA.
20. Edward, O.G., 2004. Ex situ plant conservation. Island Press, Washington, DC

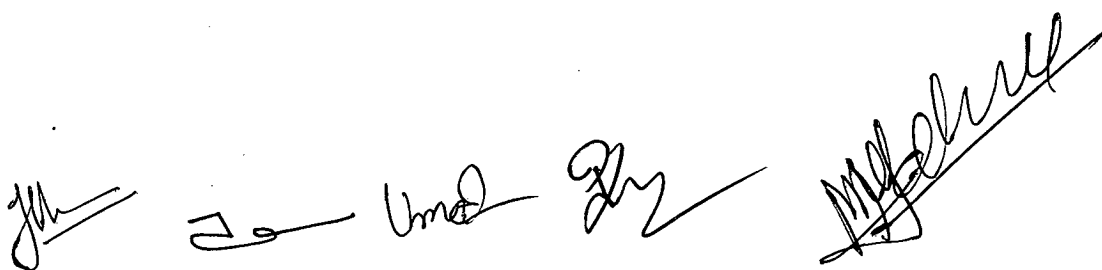
M.Sc. Zoology Semester IX (Elective Course-10)

Paper code: B050912T

**Total
Marks:
25+75**

Conservation of Endangered Species

Unit	Topics	Total No. of Lecture
I	Definition of Wildlife and Biodiversity: Concept, approach and significance Causes of wildlife species depletion; Economic importance of wildlife; need for wildlife conservation; rare, endangered, threatened and endemic species of fishes, amphibians, reptiles, birds and mammals in India- India as a mega wildlife diversity country. Endangered species : Their status in various states of India – Endangered species of World. (Marine turtles, crocodiles & other reptiles, birds, whales, dolphins, Dugongs and other mammals and their management). IUCN criteria for allocation into different Red List classes. Significance, Depletion, Wildlife values, Major threats	8
II	Conservation methods – Special conservation programs. Wildlife management : Legislative, administrative and ecological approaches in India, Forest Acts, Wildlife Act, other relevant acts, schedules, latest amendments, different organizations and supporting agencies. National and International Agencies and conventions concerned with wildlife and conservation. Wildlife projects sponsored in India. Role of Government and Non-Governmental organizations in conservation -Study of different Govt. and other important projects of world to protect endangered species, eg- Project Tiger. Measures Taken for Conservation of Tigers under the Wildlife Act, 1972. Tiger Task Force, Core and Buffer Zones., The Gir Lion Sanctuary Project, Himalayan Musk Deer Project, The Manipur Brow-antlered Deer Project, Project Hangul, Crocodile Breeding Project, Project Snow Leopard, Project Elephant, Elephant Corridors. in-situ and ex-situ conservation: Wildlife Sanctuaries, National Parks, Tiger Reserves, Vulture and Biosphere reserves: Definition, formation, management and administration; Zoos and Zoological Parks: Definition- Aims of Zoos- Formation and Management of Zoos and Zoological Parks- Central Zoo Authority of India; Captive breeding: Aims, Principles, methods; germplasm or gene bank, tissue culture; Global approaches to biodiversity conservation, Indigenous approaches to biodiversity conservation, biodiversity and ethnomedicinal resources.	13

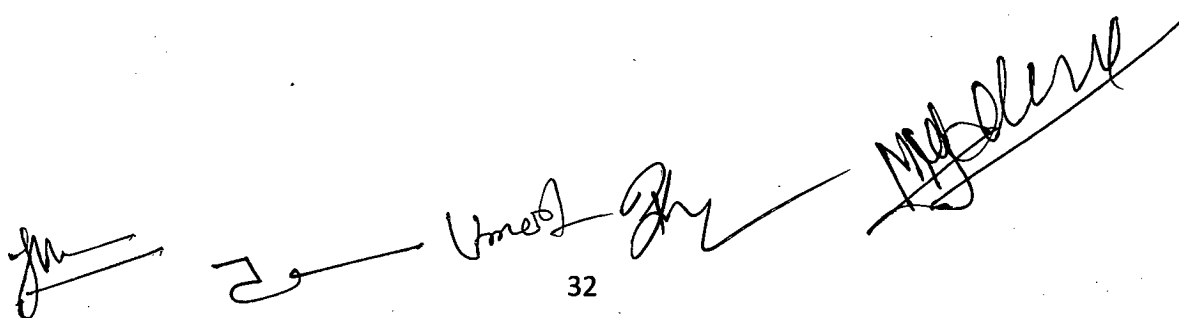


III	Conservation methods and trials for sustainable development – Natural resource management and conservation – Importance and performance of joint forest management (JFM) – Role of Non- Government Organizations (NGO). Indian initiatives in biodiversity conservation-biodiversity act 2002, Biodiversity Rules 2004, national biodiversity strategy and action plan (NBSAP), Plant Varieties Protection and Farmer's Rights Act, 2001, National biodiversity authority (NBA) etc; protected area network (PAN)-biosphere reserves, national park, sanctuary, community conservation area, important bird areas in India, ecological sensitive zone; traditional knowledge digital library(TKDL). Role of NGOs in conservation ,International NGOs; UNEP, GEF, WCS, Bird Life International, Important NGOs in India & their contributions, WWF, ATREE, BNHS, WTI, Kalpavriksha etc., Important NGO movements, Chipko movement, Narmada Bachavo Aandholan, Pani Panchayats, Seed Movement etc.	09
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IV	Wetland ecosystems: Freshwater Bodies – Impact and significance of Human Intervention on Biodiversity, Threatened flora and fauna and conservation methods(Kondakarla Lake as a case study) – Modern methods of documentation of wildlife(still and video photography), Zoogeography: Geographical distribution of animals – Oriental, Palearctic, Nearctic, Neotropical, Ethiopian and Australian Regions.	09
V	Infectious wildlife diseases and their treatment: Viral diseases: Rabies-Rinderpest-Foot and Mouth -Viral encephalitis-Yellow fever- Bacterial disease: Anthrax-Brucellosis – Clostridiosis -Listeriosis. Protozoan disease: Trypanosomiasis - Toxoplasmosis-Babesiosis - Coccidiosis. Helminth disease: Fasciolopsis – Schistosomiasis – Taeniosis – Hydatidosis Non-infectious diseases of wild animals: Diseases of the digestive system: Stomatitis-catarrhal, gastroenteritis-hemorrhagic gastroenteritis; Respiratory system: Catarrhal, bronchopneumonia-exudative pleurisy; Excretory system: Paralysis of urinary bladder-urolithiasis. People and conservation -Traditions & cultures, Women in conservation, Traditional Societies (e.g. Bishnois), Human – wildlife interactions	12
VI	Wildlife Crimes: Wildlife forensics and its applications in detecting wildlife crimes; Wildlife Toxicology: Types of contaminants, methods of toxicity evaluation, bioconcentration- bioaccumulation and biomagnifications; impacts of pesticides and heavy metals on birds and mammals; CAMP and PHVA – Analyses and Reports; Environmental Impact Assessment (EIA) methods and their role in wildlife Conservation; Administrative set up - Advisory bodies- National Board for Wildlife –Wildlife (Protection) Act, 1972 and its Amendments; Wildlife trade and regulations; Biodiversity Act 2000; Eco-Development, Eco-Restoration and Ecotourism programs, Anti-poaching operations –Village Forest Council(VFC).	09

Books Recommended:

1. Groom, M. J., Meffe G. R. and C. R. Carroll. 2006. Principles of Conservation Biology. Sinauer Associates, Inc., USA.
2. Krishnamurthy, K. V. 2003. Textbook of Biodiversity. Science Publication.
3. Primack, R. 2006. Essentials of Conservation Biology. Sinauer Associates, Inc., USA.
4. Hambler, C. 2004. Conservation. Cambridge University Press.
5. Van Dyke, F. 2008. Conservation Biology Foundations, Concepts, Applications 2nd Edition, Springer.
6. Groom, M. J., Meffe, G. R. and Carroll, C. R. 2006. Principles of Conservation Biology, Sinauer Associates, Inc., USA.
7. Gardner, E. J. 1975. Principles of Genetics. John Wiley and Sons.
8. Groom, M. J., Meffe, G. R. and C. R. Carroll. 2006. Principles of conservation biology. Sinauer associates, Inc., USA.
9. Hamilton, M. 2009. Population Genetics. Wiley-Blackwell Publications, USA Hedrick, P. W. 1999. Genetics of Population. Jones and Bartlett Publishers, Inc., London.
10. Gaston, K. J. and Spicer, J. I. 2004. Biodiversity: An Introduction. Blackwell Publishing Company, USA.
11. Ray S. and Ray A. K. 2010. Biodiversity and biotechnology. New central book Agency (P) Ltd. Kolkata.
12. Agarwal, S. K. 2002. Biodiversity conservation. Rohini Publishers, Jaipur.
13. Robert S Shumaker 2020 Saving Endangered Species: Lessons in Wildlife Conservation from Indianapolis Prize Winners, Johns Hopkins University Press
14. Elizabeth Kolbert, 2019, National Geographic Photo Ark Vanishing: The World's Most Vulnerable Animals, National Geographic.

The bottom of the page features several handwritten signatures and marks. From left to right, there is a signature that appears to be 'Jm', followed by a stylized 'Z' or '2' with a horizontal line. Then, there is a signature that looks like 'Vinesh' or 'Vinesh Singh', followed by another signature that is partially obscured. Finally, there is a large, bold signature that appears to be 'M. S. Sharma' or similar, written in a cursive style.

M.Sc. Zoology Semester IX (Elective Course-11)

Paper code: B050913T		Total Marks: 25+75
Aquaculture		
Unit	Topics	Total No. Of Lectures
I	Introduction to aquaculture- scope and definition, branches of aquaculture; history of aquaculture and its present state with special reference to India.	10
II	Selection of sites for aquaculture, selection of species for aquaculture, design and construction for aquafarms; nutrition and feeds, health and diseases in aquaculture.	10
III	Sustainability and environmental management of aquaculture; control of weeds, pest and predators in aquaculture.	10
IV	Aquaculture practices: fishes- carps, salmons, trout, catfishes, tuna, cod and eels; shrimps and prawns; cray fish and crabs; oysters and mussels; clams and scallops and sea weeds.	10
V	Integration of aquaculture with crop and livestock farming: rice fields aquaculture; integrated farming of fish and duck.	10
VI	Polyculture bivalves and sea weeds in marine environment; National planning of aquaculture development.	10
Books recommended: 1. De Silva SS & Anderson TA. 1995. Fish Nutrition in Aquaculture. Chapman & Hall Aquaculture Series. 2. Ojha JS. 2005. Aquaculture Nutrition and Biochemistry. Daya Publ. 3. Rath RK. 2000. Freshwater Aquaculture. Scientific Publ. 12. Landau M. 1992. Introduction to Aquaculture. John Wiley & Sons. 4. Pilley, TVR and Dill, WMA. 1979. Advances in Aquaculture. Fishing News Books, Ltd. England. 11. 5. Pillay TVR and Kutty MN. 2005. Aquaculture- Principles and Practices. Blackwell.		

M.Sc. Zoology Semester IX (Elective Course-12)

Paper code: B050914T		Total Marks: 25+75
Sericulture		
Unit	Topics	Total no. Of Lectures
I	- History of Sericulture in India - Introduction to the mulberry and non- mulberry silk worms Mulberrycultivation and soil fertility	10
II	- Life cycle of Bombyx mori - Popular silkworm races of India - Anatomy of the silk gland and silk spinneret - Common diseases of the silk worms	10
III	- Silk worm rearing: Rearing house and equipment; disinfection, Rearingoperations - brushing, young and late-age silkworm rearing, moulting, mounting and spinning. - Cocoon harvesting, Cocoon preservation and storage. - Post harvesting technology: silk reeling, weaving and dyeing.	10
IV	- Silk worm seed production - Entrepreneurship development	10
V	- By-products of sericulture industry and their utilization: - Employment potential and income generation	10
VI	- Sericulture organization in India - Marketing of sericulture products	10

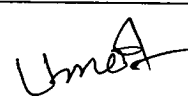
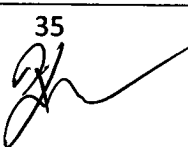
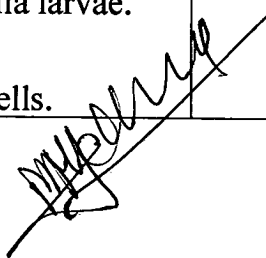
Books recommended:

- Devaiah M.C et al. (2001); Advances in Mulberry Sericulture. Dept. of Sericulture, UAS, Bangalore
- Tanaka Y. (1964); Sericology, Central Silk Board Publication, Bangalore.
- Ganga, G., and J. Sulochana Chetty. (1991) an introduction to sericulture. Oxford & IBH publishingcompany.
- Hisao Arguo 1994 Principle of Sericulture, Oxford and Co
- FAQ Manual of Sericulture. Vol-I Mulberry Cultivation, Vol- II Silkworm Rearing. Central Silk Board,Bangalore.
- Kohls, R. L. Uhl, J. N. (2002) Marketing of agricultural products. Prentice-Hall Inc. USA
- Brian, M.V. (1983) Social Insects, Ecology and Behavioral Biology. University Press, Cambridge, UK



Program Class: M.Sc. Zoology	Course: M.Sc. Subject: ZOOLOGY Year: Fifth Semester: IX	Course code B050915P
	Course Title: Practical	
Credits: 4	Marks: 75 External	Practical/ week 4
Unit	Topics Total Number of Practical Classes (60)	Practical
I	Study from the permanent slides: Protozoa: Amoeba, paramecium, Euglena Porifera: Canal systems in sponges: Ascon, sycon, Leucon and Ragon types, spongin fibers and spicules. Coelenterata: Hydra morphology, Budding and gamete formation. Museum specimens: Gorgonia, Pennatula Platyhelminthes: Morphology of Planaria, Fasciola and Taenia. Gravid proglottid, T. S. of Fasciola and Taenia at various levels, Nematoda: Pin worm, Hook worm, thread worm and Whip worm, Annelida: Mounting Nereis parapodium Studying the Sections of hetero nereis with gonads Studying the Sections of Pheretima at various levels.	12
II	Arthropoda: Morphology and dissection of the statocyst, hastate plate and the nervous systems of prawn. Morphology and dissection of the digestive and nervous system of Grasshopper. Permanent slide preparation of mosquito larvae, male and female mosquitoes and mouth parts of some insects. Museum specimens: Leptocorisa, Scorpion, Nepa, Belostoma, Dragonfly nymph Life cycle of insects: Silk worm and honey bee Mollusca: Studying the Morphology of Apple snail and dissection of its ospharidium, radula and Nervous system. Mounting: Glochidium Larva and Bipinnaria larva. - Preparation of polytene chromosomes from the salivary glands of Chironomus/Drosophila larvae. - Preparation of gene map of the polytene chromosome. - Extraction of DNA from human cheek cells.	12



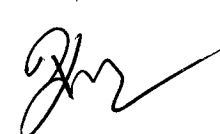
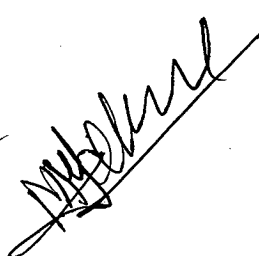




	• Polyacrylamide gel electrophoresis of protein sample. • Agarose gel electrophoresis of DNA sample. • Western blotting for immune response. • Digital modelling of the experimental results.	
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III	Museum specimens/ charts Protochordates: Balanoglossus, Herdmania, Ascidia, Amphioxus Petromyzon and Ammocoete larva Protopterus, Torpedo, Chimaera, Hippocampus, Exocoetus, anabas Ambystoma and Axolotl larva Salamander, Necturus, Alytes, Bufo, Hyla Identifying Typhlops, Cobra, Viper, Python, Turtle, Draco, Phrynosoma, Heloderma Ostrich, Kiwi, Kite, Owl Identifying permanent Slides: Skin of a bird and mammal T.S. Through h intestine showing villi, T. S through Lungs showing alveoli, T.S. of brain showing aggregation of Neurons and fiber tracts T.S. of spinal cord showing white and grey matter and spinal nerves. Mounting: Placoid, cycloid and Ctenoid scales	12
IV	Museum specimen/ Chart to study morphology of the following: Heart of a fish, Amphibia, Reptilia, Bird and mammal Kidney of a fish, Amphibia, Reptilia, Bird and mammal Brain of a fish, Amphibia, Reptilia, Bird and mammal Skull of a fish, Amphibia, Reptilia, Bird and Mammal Identification and study of the following bones of Amphibia, Reptilia, Bird and Mammal: Vertebrae: Atlas, Axis, Cervical, Thoracic, Lumbar, sacral and caudal. Sternum and ribs Humerus, Radius and Ulna Femur, Tibia and Fibula Pectoral and pelvic girdles Modification of vertebrae: Fused thoracic, synsacrum, Caudal vertebrae, Coccyx and pygostyle, Modification of Beaks and legs of birds.	12

	A field visit to study the biodiversity of animals.	
V	Elective- 1	6
VI	Elective- 2	6



OPTIONAL COURSE A - ENTOMOLOGY

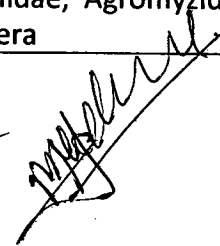
SEMESTER X		
Paper Code B051001T	INSECT MORPHOLOGY AND ANATOMY	
Course Objectives	• To learn the external morphology of insects in order to identify the various kinds • To study specialization and adaptability of their external and internal structures	
UNIT	TOPICS	NO. OF LECTURES (60)
I	Morphology: Integument, structure of insect head, orientation of insect head, sulci, sclerites and other areas; Appendages – structure and types of antennae, types of mouth parts. Structure of insect thorax- sulci and areas of thorax, thorax as a locomotory organ. structure, articulation and coupling of wings, nomenclature of insect wing venation, structure and functioning of insect legs.	12
II	Structure of insect abdomen: Diaphragms and sinus. pregenital abdominal appendages, male genitalia and their modifications, female ovipositor, genitalia and its Modifications and oviposition.	08
III	Anatomy: Digestive system – basic structure of digestive system including musculature, cardiac and pyloric valves, peritrophic membrane, filter chamber, rectal pads. Modification of gut in insects. Excretory system- Malpighian tubules their modifications, other modified excretory glands in insects.	12
IV	Respiratory system: basic structure of trachea, tracheoles, spiracles and air sacs. Respiration in terrestrial, aquatic and parasitic insects. Circulatory system- structure of heart and aortae, Accessory pulsatile organs, blood or hemolymph with other cells.	12
V	Nervous system- central nervous system- Brain morphology and Anatomy, ventral nerve cord and ganglia, peripheral nervous system, sensory cells and sense organs, Insect eye, stemmata and Ocelli. Stomato-gastric nervous system.	10
VI	Reproductive system- male and female internal reproductive organs.	06

Semester X		
Paper Code B051002T	INSECT PHYSIOLOGY AND DEVELOPMENT	
Course Objectives	- To understand the insect body organization and function - To obtain the knowledge of insect reproduction, fertilization, metamorphosis and hormonal control	
UNIT	TOPICS	NO. OF LECTURES (60)
I	Insect physiology: physiology of digestion, physiology of excretion.	10
II	Production and reception of sound: physiology of photoreception and light production.	10
III	Insect eye and theory of mosaic vision. Endocrine glands, insect hormones, their mechanism of action and neurosecretions.	10
IV	Development: structure of egg, embryonic development. Types of insect larvae and pupae.	10
V	Types of metamorphosis and significance of metamorphosis, hormonal control of metamorphosis.	10
VI	Ecdysis and diapause in insects.	10

Semester X		
Paper Code B051003T	INSECT SYSTEMATICS	
Course Objectives	• To become familiar to the rules of zoological nomenclature to learn evolutionary history of insects • To develop understanding of insect taxonomic techniques of description and learning of identification of insects	
UNIT	TOPICS	NO. OF LECTURES (60)
I	Systematics: knowledge of international code of nomenclature with special references to law of priority concept of holotype, allotype, paratype and lectotype. Linear hierarchy, taxonomic characters, evolution of insects and fossil insects, history of entomology in India.	06
II	Concept of hexapoda and apterygota with special reference to ectognatha and entognatha: Orders Aptera, Protura, Collembola and Thysanura	06
III	Exopterygota Orders: Ephemeroptera, Plecoptera, Odonata, Orthoptera Families: Acrididae, Gryllidae, Tettigonidae, locust and phase theory of locust. Phasmida, Dermaptera, Blattaria, Mantodea, Isoptera.	12
IV	Exopterygota Orders: Phthiraptera- Anopleura and Mallophaga; Psocoptera, Thysanoptera, Heteroptera Families– Pentatomidae, Coreidae, Pyrrhocoridae, Reduviidae, Lygaeidae, Tingidae, Belostomatidae, Nepidae, Gerridae; Homoptera Families: Membracidae, Jassidae, Aleyrodidae, Psyllidae, Aphididae, Coccidae.	12
V	Endopterygota Orders: Coleoptera Families - Carabidae, Dytiscidae, Dermastidae, Hydrophilidae, Chrysomelidae, Meloidae, Coccinellidae, Buprestidae, Tenebrionidae, Cerambycidae, Scarabaeidae, Curculionidae; Trichoptera.	12
VI	Endopterygota Orders: Lepidoptera Families – Noctuidae, Sphingidae, Pyralidae, Bombycidae, Papilionidae, Nymphalidae, Pieridae; Hymenoptera Families– Ichneumonidae, Braconidae, Chalcididae, Vespidae, Apidae, Formicidae; Diptera Families- Tipulidae, Psychodidae, Chironomidae, Simuliidae, Cecidomyiidae, Tabanidae, Asilidae, Syrphidae, Agromyzidae, Muscidae, Trypetidae, Hippoboscidae; Order Siphonaptera	12



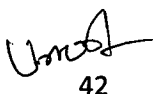
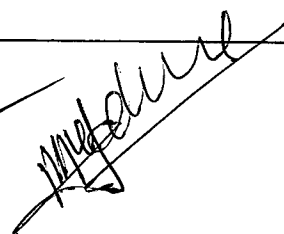




SEMESTER X		
Paper Code B051004T	ECOLOGY AND APPLIED ENTOMOLOGY	
Course Objectives	- The student will be able to learn the biology of harmful and useful insects and their control - To understand the intimated biology of insect vectors and their capacity to disperse the vectors	
UNIT	TOPICS	NO. OF LECTURES (60)
I	Ecology of insects: Abiotic factors influencing insect life, effect of temperature on insect development; Biotic factors- insect parasitism, entomophagus insects, social life in termites, bees and ants.	12
II	Parental care, myrmecophily and termitophily.	06
III	Applied Entomology- economic importance of insects, concept of insectcontrol by use of insecticides, concept of biological control and male sterility.	12
IV	Apiculture, sericulture and lac culture in India.	08
V	Life history, damage and control of the main pests of: sugarcane crop, paddy crop, cotton crop, stored grains.	12
VI	Insect vectors of various diseases like malaria, dengue, filariasis, kala- azar, yellow fever, sleeping sickness, Loa loa etc., transmitted to cattle and man, and their control measures.	10

Books Recommended:

- Atkins, Michael D. *Introduction to insect behaviour*. Macmillan Publishing Co., Inc., 1980.
- Atwal, A. S. : agricultural pests of India and South-East Asia. Kalyani publication. New Delhi 1988.
- Chapman, , and Reginald Frederick Chapman. *The insects: structure and function*. 4th edition, Cambridge university press, 1998.
- Chapman, R.F (Reginald Frederick). (1998) *The insects Structure and function*. Cambridge University Press, Cambridge
- Davies, R. G. "Insect structure and function." *Outlines of Entomology*. Springer, Dordrecht, 1988. 7-96.
- Essig, E. O. "College Entomology (Indian Print)." *Satish Book* (1982).
- Fox, R. M. and Fox, J. W. introduction to comparative entomology. Aff. East- West Press Pvt. Ltd. New Delhi 1968.
- M.S. Mani College Entomology
- Snodgrass Insect morphology
- Imms Entomology
- Wigglesworth Insect Physiology
- Gillet Entomology
- Insect Ecology
- Manual of Sericulture. Vol-I Mulberry Cultivation, Vol- II Silkworm Rearing. Central Silk Board, Bangalore.


42

- Gllott, C. *Entomology*. Plenum Press, New York, 1982.

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- Richards, O. W. and Davies, R. G. :Imm's General Textbook of Entomolgy. 10th edition vol. 1 and2, Chapman and Hall, London 1976.
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- Snodgrass, R. E. *Principles Of Insect Morphology*. Tata McgrawHill Publications.New Delhi, 1998.
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OPTIONAL COURSE A: (C 20) PRACTICAL ENTOMOLOGY

Semester X

Paper Code B051005T

Practical

1. Anatomy of common grasshopper, cockroach, honey bee, wasp and Morphology of dysdercus, mylabris, belestoma (giant water bugs) .
2. Dissection and mounting of-
 - Sting apparatus of honey bee and wasp.
 - Tympanal organs of grasshopper
 - Testes of cockroach
 - Aristate antennae of housefly
 - Different types of mouth parts of insects.
 - Different types of wings and antennae of insects.
 - Tentorium of grasshopper
3. Identification and comment on insects of different orders and families.
4. Identification with the help of dichotomous keys of common insects from different orders and families.
5. Study of prepared permanent slides of insect morphology and anatomy.
6. Study trip and the study of Insect life in different ecosystems.

Tentative guidelines for marks distribution of practical exam

Duration: 5 hours

Maximum Marks: 75

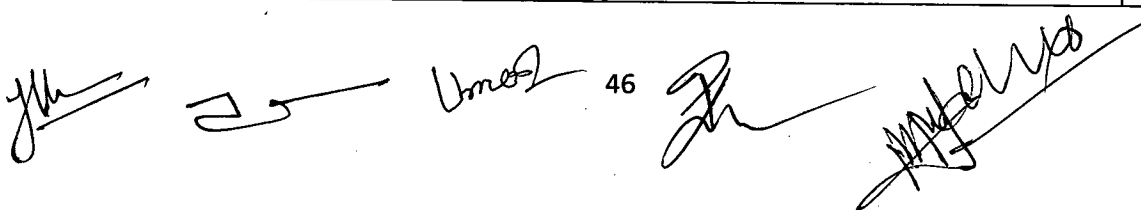
1. Major dissection	15
2. Minor dissection	05
3. Permanent stained preparations	05
4. Identification and comment upon eight spots	24
5. Special identification and comment with the help of dichotomous key	10
6. Viva- voce	04
7. Sessional records:	
• Practical record book	04
• Permanent microscopic preparation exhibits	04
• Collection as a result of field studies	04
Total Marks	75

Semester X		
Paper Code B051006R	Research Project: Methodology	
UNIT	TOPICS	
I	Teaching Research Methodology for doing a Research Project. Learning how to identify a research work, do and Present a Research Project Report	10 LECTURES
II	Learning the literature which forms the base for identifying a research problem Identifying the lacuna (Need for a study/work) available in the existing knowledge. .	10 LECTURES
III	Formulating the methodology to do the work and identifying the tools and techniques involved in doing the research Project	10 LECTURES
IV	Doing the work under the guidance of the Research Supervisor and documenting the observations, results, and findings	10 LECTURES
V	Collecting the observations of the Research work done in the form of data, Pictures or recordings and arranging them in the proper form of Results or observations or findings presentable as a Research Project. The data collected can be analysed using the needful statistical analysis and expressed in the form of graphs	10 LECTURES
VI	In writing the discussion, findings of the Research work should be correlated with the available literature to justify the findings. The relevant literature related to the work quoted in the Project work should be arranged in the form of References. Finally, the Research Project work can be organised and submitted in the Presentable form to the University.	10 LECTURES
NOTE	The same guidelines and provisions shall apply, mutatis mutandis, to Paper Code B051012R (Ichthyology), Paper Code B051018R (Parasitology), and Paper Code B051024R (Wildlife and Environmental Biology).	

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OPTIONAL COURSE B – ICHTHYOLOGY

Semester X		
Paper Code B051007T	SYSTEMATICS AND MORPHOLOGY OF FISHES	
Course Objectives	• To learn origin, classification of fishes and their adaptive radiation • To understand their morphology and their various habitats	
UNIT	TOPICS	NO. OF LECTURES (60)
I	Systematics: Classification- evolutionary classification, merits and demerits of Berg's classification; Ostracoderms, Placoderms.	12
II	Origin and evolution of fishes: Elasmobranchs, bony fishes.	08
III	Adaptive radiation in fishes – elasmobranchs and bony fishes; Hill stream adaptations and deep sea adaptations.	10
IV	Morphology: integument – scales and coloration; Fins and their origin, locomotion, electric and light producing organs.	10
V	Nutrition- food, feeding habits, alimentary canal in relation to its physiology of digestion.	08
VI	Respiration- structure of gills in elasmobranchs and bony fishes, gill ventilation; Fish blood as oxygen carrier; Air breathing fishes; Swimbladder and Weberian ossicles.	12

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Semester X C-17		
Paper Code B051008T	PHYSIOLOGY AND EMBRYOLOGY OF FISHES	
Course Objectives	To study the phenomenon of integrated functioning of fishes and to learn their developmental process	
UNIT	TOPICS	NO. OF LECTURES (60)
I	Physiology: stato-acoustic and lateral line system, chemoreceptors, organ of sight, and organ of smell.	06
II	Osmoregulation and mechanism of water salt balance in fresh water and marine water fish; migration and parental care.	12
III	Circulation, excretory and nervous system.	12
IV	Embryology: reproductive system	06
V	Structure and kind of eggs, maturation cleavage an early embryonic development; hatching and post embryonic development including fundamentals of morphogenesis.	14
VI	Endocrine glands: neuro-endocrine and co-ordination.	10





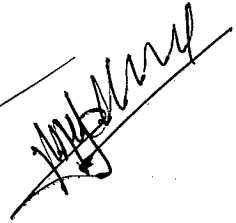


Semester X		
Paper Code B051009T	AQUACULTURE AND FISHERIES	
Corse Objectives	To study the culture of economically important aquatic animals under controlled environmental conditions	
UNIT	TOPICS	NO. OF LECTURES (60)
I	Indian aquaculture: composite prawn culture, oyster culture; oyster fishery sea mussels.	08
II	Pearl oyster fishing, fishery, spat collection; culture methods: raft methods, long line methods, rack method, pole culture, bottom culture method, harvesting, cleaning and marketing.	08
III	Net and craft of inland and marine water, electric fishing and eco sounders, effect of lights, temperature, turbidity, dissolved gases and solids in water, types of planktons and their role, maintenance of fresh water aquarium.	10
IV	Fisheries: pond culture and its management, principle cultivable fishes- brief account of indigenous and exotic fishes; Procurement of seed collection, identification and transport of seed.	10
V	Induced breeding- stripping, hypophysation techniques; Special culture: composite fish culture, fish culture in paddy fields, sewage fish culture and integrated fish culture; Fish diseases and their control- fungal diseases, bacterial diseases, protozoan disease induced by pollutants, prophylactic measures.	12
VI	Fish preservation and processing- causes of spoilage, methods of preservation and their merits and demerits, fish pollution and toxicity, age and growth, length and weight relationship, tagging of fish.	12

SEMESTER X		
Paper code B051010T	PISCICULTURE AND ECONOMIC IMPORTANCE	
Course Objectives	To study the breeding, rearing and transplanting of fishes by artificial means involving raising of fishes commercially in enclosures for food To understand the economic importance of fishes	
UNIT	TOPIC	NO. OF LECTURES (60)
I	Pisciculture- definition and aim of Pisciculture, history of Pisciculture in India, types of Pisciculture and methods.	10
II	Quality of culturable fishes, types of cultivable fishes, factors affecting pisciculture, management of pisciculture: breeding pond- types of breeding (natural and induced), fish seed, hatching pit, transport of fish fry to nursery pond, rearing ponds, stocking ponds, harvesting.	10
III	Methods of fishing, fishing industry in India.	10
IV	Diseases in fishes- fungal diseases, bacterial diseases, protozoan diseases and fluke diseases; prophylactic measures for the prevention of fish diseases.	10
V	Economic importance of Pisciculture.	10
VI	By-products of Pisciculture industry and their utilization, Employment potential and income generation.	10

Books:

1. Jhingran VG. 1991. Fish and Fisheries of India, Hindustan Publishing Corporation.
2. A Hatchery Manual for the Common, Chinese and Indian Major Carps by V.G. Jhingran and R.S.V. Pullin, Asian Development Bank, ICLARM, Manila, Philippines
3. Reid GR. 1961. Ecology and Inland waters and Estuaries. Rein Hold Corp., New York.
4. Pilley, TVR and Dill, WMA. 1979. Advances in Aquaculture. Fishing News Books, Ltd. England. 11.
5. Pillay TVR and Kutty MN. 2005. Aquaculture- Principles and Practices. Blackwell.
6. Nikolsky GV. 1963. Ecology of Fishes, Academic Press.
7. Norman JR and Greenwood PH. 1975. A History of Fishes, Halsted Press.
8. Potts GW and Wootten RJ. 1984. Fish Reproduction: Strategies and Tactics, Academic Press.
9. De Silva SS & Anderson TA. 1995. Fish Nutrition in Aquaculture. Chapman & Hall Aquaculture Series.
10. Ojha JS. 2005. Aquaculture Nutrition and Biochemistry. Daya Publ.
11. Rath RK. 2000. Freshwater Aquaculture. Scientific Publ.
12. Landau M. 1992. Introduction to Aquaculture. John Wiley & Sons

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OPTIONAL COURSE B: (C 20) PRACTICAL ICHTHYOLOGY

Semester X

Paper code B051011P

Practical

1. A) Anatomy of scoliodon, sting ray, electric ray, wallago and macronis.
B) accessory respiratory organs of sacobranthus, clarias and anabas.
2. Osteology of a fresh water teleost.
A) mounting: permanent preparation of different kinds of scales, Ampulla of Lorenzini and fish tissue, skin, muscles, T S of vertebra).
B) preparation of: (i) girdles (ii) pectoral and pelvic (iii) vertebra and tail fin
3. Examination of prepared slides and whole mount of fishes.
4. Identification and comment on museum specimens of various groups both marine and fresh water fishes.
5. Identification of fresh water fishes.
6. Various structure used in age determination of fishes.
7. Fish physiology:
 - (i) Preparation of the stained blood film of fish
 - (ii) Differential count of corpuscles
 - (iii) Identification of planktons in given samples of water
 - (iv) Examination of gut contents
 - (v) Adaptation in fishes
8. Survey of fish resources, candidates would be required to have excursions to the coastal regions and freshwater system.

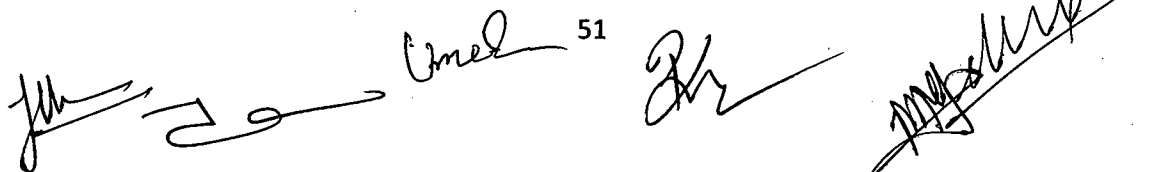
Tentative guidelines for marks distribution of practical exam

Duration: 5 hours

Maximum Marks: 75

1. Major dissection	15
2. Minor dissection	05
3. Permanent stained preparations	05
4. Identification and comment upon eight spots	24
5. Special identification and comment with the help of fauna and atlas (2 Nos.)	10
6. Viva- voce	04
7. Sessional records:	
• Practical record book	04
• Permanent microscopic preparation exhibits	04
• Collection as a result of field studies	04

Total 75

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OPTIONAL COURSE C – PARASITOLOGY

SEMESTER X		
PAPER Code B051013T	PARASITOLOGY -GENERAL PARASITOLOGY	
Course objective	• To provide knowledge about concepts of parasitology, diseases spread by parasites, their cure and prevention. • To provide knowledge of parasitic classification and transmission.	
Unit	Topics	No. of lecture (60)
I	Introduction and definition of parasitic mode of life, study of parasites, life cycles, host-parasite interactions, invasion, adaptations and their etiology, transmission of parasites, diseases caused by parasites; Types of Parasites.	8
II	Introduction to Broad areas of parasitology: Systematic Parasitology, Parasites of man, livestock, pets and wild animals. Agriculture, Veterinary, Medical, Fisheries and, Aquaculture Parasites; Evolution of Parasitism, Vectors of parasites; Applications of Parasitology;	7
III	Parasitic Protozoa: General Classification, Classification of parasitic protozoa, General characters of parasitic protozoa. Identification characters, Location, host range, morphology, Structure, life cycle, pathogenicity, epidemiology, treatment and control of: Human Parasitic protozoa: Entamoeba sp., Giardia, Trichomonas, Naegleria sp., Trypanosoma, Leishmania, Plasmodium, Toxoplasma gondii, Balantidium sp.(in herbivorous reptiles, humans), Acanthamoeba sp., Acanthamoeba keratitis, Balamuthia mandrillaris and Sappinia pedata.	14

IV	Protozoa Parasites of fishes: Myxozoa, Microsporidia, Ichthyophthirius, Opalinida sp. (in reptiles, amphibians and fishes) and Haemogregarina; Parasites of poultry: Eimeria tenella and Haemoproteus; Parasites of cattle: Babesia and Theileria; Invertebrate protozoa parasites: Gregarina sp.; Parasites of Herbivorous reptile etc. Nyctotherus	14
V	Other zooparasites of Mesozoa, porifera, coelenterata, ctenophora, nematomorpha, rotifer, rhyncocoela, annelida, mollusca, crustacea, pycogonida, tardygrada, pentastomatida, echinoderms and vertebrates.	7
VI	Helminthes: Taxonomy and classification and characters- Nematodes -secernentia, Aphasmodia/Adenophora; Platyhelminthes-classification and characters of monogenia (ectoparasites of fishes), turbellaria (planarians), trematoda (flukes) and cestoda (tapeworms), larval stages of helminthes, structure and types of larvae.	10

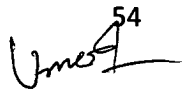
Books recommended-

1. Hyman, LH, The invertebrates. Vol. 1, Protozoa through ctenophora, McGrawHill Book Co. New York
 2. parasitic protozoa, vol8, edited by julius p Kreier, Springer, Academic press, 6 april 1993
 3. Read OP Animal Parasitism, Prentice Hall, Englewood, New Jersey, USA
 4. Baker, JR, Parasitic Protozoa (Hutchinson University Library: Biological Sciences.) Pp. 176. (Hutchinson: London, November 1969.) Hardback 33s; paperback 14s.
 5. Thomas C Cheng, General parasitology, 2nd edition, Academic press, ISBN-13:978-0121707552, Kindle etextbook store.
- Read OP, Animal Parasitism, Prentice Hall, Englewood, New Jersey, USA

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SEMESTER X		
PAPER Code B051014T	PARASITOLOGY-BIOLOGY OF PARASITES	
Course objective	• Provide knowledge about concepts of parasitology, diseases spread by parasites, their cure and prevention. • To give concepts which can be used professionally.	
Unit	Topics	No. of lecture (60)
I	Taxonomy, characters & General Pattern of life cycle of Nematodes (animals, plant parasitic & Entomopathogenic), General Organization, -and morphology, Host Range Biology; Specialized structures associated with the cuticle, digestive, excretory system, reproductive system and sense organs. Nematodes and diseases; behavior of nematodes. Pathogenesis, mortality/lethality caused by nematodes, Economic importance, Diseases Caused by Nematodes; Management of Nemic Diseases; Nematicides and their Uses; Life cycle, pathogenicity and control of -Trichinella spiralis, Trichuris trichura, Oesophagostomum, oxocara, Draunculus mediensis, Haemonchus, Strongyloides stercoralis, Ancylostoma duodenale, Ascaris lumbricoides, Wuchereria bancrofti, Enterobius vermicularis, Angiostrongylus cantonensis.	9
II	Biology of Platyhelminthes parasites; Egg containing organs in cestodes. ultrastructure of tegument. Hosts and its types, Life cycle; Parasitic adaptations in structures and physiology. Adhesive organs in General organization, Ultrastructure of tegument in Trematodes, Morphology, Structure, adhesive organs, life cycle, larval forms of Fasciola hepatica (onchomeracedium, miracidium, cercaria, metacercaria), pathogenicity, diseases and control of Polystoma, Diplozoon, Gyrodactylus	7
III	Trematoda: General characters and Classification, Types of Trematodes, Larval forms; Identification characters, morphology, Structure, adhesive organs, life cycle, larval forms (onchomeracedium, miracidium, cercaria, metacercaria) pathogenicity, diseases and control of digenetic trematodes : Chlonorchissinensis, Paragonimus westermani and	10







	Blood flukes (<i>Schistosoma haematobium</i> , <i>Schistosoma mansoni</i> and <i>Schistosoma japonicum</i>) fasciola buski, <i>Opisthorchis</i> , <i>Paramphistomum</i> , <i>Cotylophoron</i> and <i>Dicrocoelium</i>	
IV	Cestoda: General characters and Classification, Types and Larval forms; Identification characters, morphology, Structure, adhesive organs, par uterine organ, life cycle, larval forms (metacestodes), pathogenicity and control of- <i>Hymenolepis nana</i> and <i>Hymenolepisdiminuta</i> , <i>Diphyllobothriumlatum</i> , <i>Taeniasolium</i> , <i>T. saginata</i> , <i>Moniezia</i> , <i>Echinococcus granulosus</i> , <i>Dipylidium</i> sp., <i>Spirometra</i> sp., <i>Acanthocephala</i> – <i>Macracanthorhynchushirudinaceus</i> .	10
V	Arthropods: Insects and human diseases. Role of insects in transmission of parasitic diseases.;; Identification characters, morphology, structure, biology, life cycle, pathogenecity and diseases caused and control of-Bugs-Cimex, lice- <i>Pediculus</i> , <i>Haematopinus</i> flies, flesh flies, ticks, mites, fleas, maggots of fly spp. Causing 'myiasis' and <i>Anopheles</i> , <i>Culex</i> and <i>Aedes</i> , clinical and medical importance, insect vectors, its control and disease mitigation	
	Nutrition Uptake and digestion in protozoa, trematoda, cestoda and nematode. Metabolism- Carbohydrate, protein metabolism and energy assimilation and utilization; Physiology of respiration in protozoa, trematoda, cestoda and nematode; Excretion -Excretory and lymphaticsystems in termatodes; body waste excretion, Nitrogen excretion and water and ionic regulation in parasites. Nervous system and sense organs- Morphology of nervous system and sense organs, nervous transmission and neurosecretion and behaviouralcoordination . Parasiticreproduction- Asexual, sexual, reproduction, synchronization of parasite with host reproduction,Eggshell- Formation in helminthes, development of eggs and chemistry of egg shell formation, role of Mehli's glands, larvae its transfer with in host body, host to animals, animals to man, antibiotics, its use and resistance. Sporulation or encystment, parasitic castration.	

Books recommended-

1. Read OP, Animal Parasitism, Prentice Hall, Englewood, New Jersey, USA
2. Cheng TC, The biology of Animal Parasites, WB Saunders an Co., Philadelphia and London.
3. Hyman, LH, The Invertebrates, vol II and III, McGrawHill, NY.
4. Dawes, B. The Trematoda. Cambridge University Press
5. Chatterjee: Parasitology, Chatterjee Medical Publishers, 1981.
6. Chandler & Read: Introduction to Parasitology, Wiley, 1970.
7. Noble & Noble: Parasitology, Lea & Febiger, 1973. 4. Smith: Animal Parasitology, Cambridge University Press, 1996.
8. Roberts L.S. and Janovy J. Foundations of Parasitology, McGraw-Hill Publishers, New York, USA.
9. Cheng TC, The biology of Animal Parasites, WB Saunders an Co., Philadelphia and London.

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SEMESTER X		
PAPER Code B051015T	PARASITOLOGY- PARASITOLOGICAL TECHNIQUE	
Course objective	• provide knowledge about concepts of Parasitology, diseases spread by parasites, their cure and prevention • To provide knowledge of parasitic diagnosis and various techniques used in parasitology.	
Unit	Topics	No. of lecture (60)
I	Tools and techniques of routine diagnostic use, microscopic methods used for morphological study of parasites. Methods and Laboratory techniques for collection, preservation and examination of protozoa. Blood, soil and stool tests, in vitro cultivation of parasites. Various Technologies that are significant for routine diagnostic use, microscopic and morphological analysis of parasites. Methods of collection, preservation and preparation of Helminthes parasites and their identification.	7
II	<i>Techniques for preservation and examination of helminth parasites; blood and stool tests, in vitro cultivation of parasites; Diagnostic tools for the detection of specific blood-borne and intestinal parasitic diseases: DHA or IHA: direct or indirect hemagglutination assay; RDT: rapid diagnostic test; PCR: polymerase chain reaction; RT-PCR: real-time polymerase chain reaction; QT-NASBA: quantitative nucleic acid sequenced-based amplification; RT-QT-NASBA: real-time quantitative nucleic acid sequenced-based amplification; LAMP: loop-mediated isothermal amplification; OC-PCR: oligochromatography Polymerase chain reaction; LDMS: laser desorption massspectrometry; MALDI-ToF: matrix-assisted laser desorption/ionization time of flight; SELDI-ToF: surface-enhanced laser desorption/ionization time of flight, ss</i>	16







III	Immunity and parasitic populations Immunodiagnosis, intradermal tests and their significance, immunopathology in parasitic infections. Vaccination and parasitism, vaccines against protozoan and helminth parasites. Role of Biotechnology in the development of vaccines for animal parasites; Approaches and Diagnostic tools for the detection of specific blood-borne and intestinal parasitic diseases: FAST-ELISA: Falcon assay screening test; RIPA-ELISA: radioimmunoprecipitation assay; DFA or IFA: direct or indirect immunofluorescence assay; LIPS: luciferase immunoprecipitation system; CATT: CardAgglutination test for Trypanosomiasis; Immuno electrophoresis, IFA: immunofluorescent assay, EIA: Enzyme immunoassay, RT-PCR: Real time PCR, IB: immunoblot.	16
IV	Technologies that are significant for routine diagnostic use, microscopic and morphological analysis of parasites; Methods and Laboratory techniques for collection ,preservation and examination of helminth and arthropod parasites; blood and stool tests, in vitro cultivation of parasites, Culturing, Harada-Mori technique culture method (Strongoloides), media used, suspension and agar plate culture.	7
V	Diagnostic tools for the detection of specific intestinal parasitic diseases:Random Amplified Polymorphic DNA (RAPD),Amplified Fragment Length Polymorphism (AFLP),Restriction Fragment Length Polymorphism (RFLP), microsatellite marker method, LuminexxMAP-based technology.	8
VI	Quantitative analysis of Parasites: Use of statistical analysis in Aggregated distribution of parasites among host individuals-Chi-Square Test, Fisher's Exact Test, Bootstrap test, Mood's median test, stochastic equality test.	6

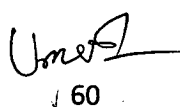
Books recommended-

- 1.Cobb, NA, Nematodes and their relationships, Year book, US Dept. Of Aquaculture, 1914:457-4902. 2. Corfton, H B, Nematodes, Hutchinson University Library, London.
- 3.Dewes, B. The Trematoda, Cambridge University Press.
4. Smyth., The Animal Parasitology, Cambridge Univ
5. AC., Introduction to Parasitology, J. Wily andSons.
6. Thomas C Cheng, General parasitology, 2nd edition, Academic press, ISBN- 13:978-0121707552, Kindle e textbookstore.
7. 1.Read OP, Animal Parasitism, Prentice Hall, Englewood, New Jersey, USA
- 8.Cheng TC, The biology of Animal Parasites, WB Saunders and Co., Philadelphia and London.
- 9.Hyman, LH, The Invertebrates, vol II and III, McGrawHill, NY.

SEMESTER X		
PAPER Code B051016T	PARASITOLOGY- HOST PARASITES INTERACTION	
Course objective	● Provide knowledge about concepts of parasites interactions. ● To provide knowledge of parasitic relationships.	
Unit	Topics	No. of lecture (60)
I	Host-Parasite Relationship, Parasite Specificity, parasitic associations, Introduction and effect of parasites on hosts, toxic and poisonous secretion, utilization of host, nutrition, parasitic induced alterations, host specificity, Diversity between parasitic organisms.	10
II	Taxonomy and phylogenetic relationships of Parasites; Recent developments in DNA based diagnostic methods to identify species and to investigate the relationship between groups at various taxonomic scales; Taxonomic relationships of host variety in vertebrates and invertebrates, Parasitic adaptations, Host Resistance, Host parasite interplay, Nematode Interactions with Micro-Organisms, Mutualism.	10
III	Plant Nematode Relationship: Host parasite relationship, Mechanism involved in injury & histopathology of infected tissue, Interaction with other microorganism; Soil and plant parasitic nematodes with special reference to Meloidogyne, Aphelenchoides. Types of Plant nematodes. Structure, Life Cycle, Epidemiology, Pathogenicity and Control of Root knot and Cyst Nematodes. Crop losses and economic damage.	10
IV	Population ecology; host selection, specialized traits and life-history strategies, stabilization of parasitic life, and colonization inside hosts. Parasite-avoidance strategies employed by hosts; Conservation biology of parasites; Degenerative characters of parasites; Fate of Parasite, Parasitic Adaptations; Disguising relationships between species- Host Parasite Relationship: Host specificity {(Ectoparasite: 1. Larval stages parasitic and adult free living, 2. Adult parasitic and larval stages free living, 3.. Both larva and adult parasitic); (Endoparasite: 1. Larval stages parasitic and adult free living; 2. Adult parasitic and larval stages free living)}, Action of Parasite upon their Hosts (Effects of parasites upon Invertebrates, Effects of parasites upon Vertebrates).	12

V	vectors of human diseases; Mode of transmission of pathogens by vectors, Chemical, biological and environmental control of anthropoid vectors; Insects carrying Vesication, Urtrication and envenomation, venom toxins, Arachnida- Biology, importance, diseases caused and bio-control	8
	Parasite transmission- Mechanism of host selection, penetration and circadian rhythm. Periodicity in parasites; ecology of parasitism- Host finding and selection and its consequences, negative interaction, problems of escape and dispersal, problem of mate finding, niche biology, population dynamics, crowding effect. , microenvironment and phases of parasitism; Growth and establishment of parasite- Hatching, establishment, site selection, migration.	
Books recommended- 1. Chander, AC., Introduction to Parasitology, J. Wiley and Sons. 2. Thomas C Cheng, General parasitology, 2nd edition, Academic press, ISBN-13:978-0121707552, Kindle e textbook store. 3. Read OP, Animal Parasitism, Prentice hall, Englewood, New Jersey, US 4. Hyman, LH, The Invertebrates, vol II and III, McGraw Hill, NY. Edited By Gert Flik, 5. Geert Wiegertjes-Host-Parasite Interactions, ISBN 9781859962985 Published July 1, 2004 by Taylor & Francis		





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OPTIONAL COURSE C: PRACTICAL PARASITOLOGY

SEMESTER X		
PAPER Code B051017P	PARASITOLOGY –PRACTICAL	
Unit	Topics	No. of lecture (60)
I	Spotting- Identify and comment – <i>Trichinella spiralis</i>, <i>Trichuris trichiura</i>, <i>Oesophagostomum</i>, <i>Toxocara</i>, <i>Draunculusmediensis</i>, <i>Haemonchus</i>, <i>Strongyloidesstercoralis</i>, <i>Ancylostomaduodenale</i>, <i>Ascaris lumbricoides</i>, <i>Wuchereria bancrofti</i>, <i>Enterobius vermicularis</i>, <i>Angiostrongyluscantonensis</i>. <i>Polystoma</i>, <i>Diplozooan</i>, <i>Gyrodectulus</i>, <i>Chlonorchissinensis</i>, <i>Paragonimus westermani</i>, <i>Schistosoma sp.</i>, <i>Diphylobothrium</i>, <i>Acanthocephala</i>, <i>Macracanthorhynchushirudinaceus</i> <i>Liver flukes</i>, <i>Fasciola hepatica</i> and <i>Dicrocoeliumdendriticum</i>, egg of <i>Fasciola</i>, a typical larval stage and the adults, <i>Taenia</i> tapeworm eggs, Types of larval tapeworms, the cysts such as <i>cysticercus</i> of <i>Taeniasaginata</i>, <i>coenurus</i> of <i>Taeniamulticeps</i>, <i>hydatid</i> of <i>Echinococcus</i>, Adult tapeworms of different sizes and shapes such as <i>Dipylidiumcaninum</i>, <i>Echinococcusgranulosus</i>, <i>Anoplocephala</i>, <i>Taneiapisiformis</i>. <i>Entamoebahistolytica</i>, <i>Giardia</i>, <i>Trichomonas</i>, <i>Naegliariaspps</i>, <i>Trypanosoma</i>, <i>Leishmania</i>, <i>Plasmodium</i>, <i>Toxoplasma gondii</i> , <i>Balantidium spp.</i>(in herbivorous reptiles, humans), <i>Acanthamoebaspp</i> , <i>Acanthamoeba,keratitis</i>, <i>Balamuthiamandrilarisana Sappiniapedata</i>; <i>Myxozoa</i>, <i>Microsporidia</i>, <i>Ichthyophthirius</i> , <i>Opalinida</i> , <i>Haemogregarina</i> , <i>Eimeria</i> , <i>Tenella</i>, <i>Haemoproteus</i> , <i>Babesia</i> , <i>Theileria</i>, <i>Nyctotherus</i>. <i>WM, TS and LS of above mentioned parasites,as applicable</i>	11
II	Routine diagnosis, microscopic study for morphology of protozoa. Collection, preservation and examination of protozoan parasites. Blood, soil and stool tests, in vitro cultivation of parasites. Protozoan parasites of the intestinal tract of the cockroach, <i>Periplanetaamericana</i>, earth worm and human faeces.	11

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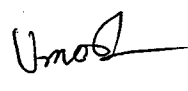
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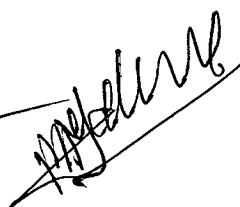
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III	Diagnosis for nematodes ,their eggs and cysts in poultry faeces , microscopic and morphological analysis of parasites. Diagnostic tests of , Soil for nematodes ,their eggs and cysts, microscopic and morphological analysis of parasites. Field Collection of nematodes : Extracting nematodes from soil and plant samples, their identification, Collection, preservation and preparation ; their	12
	study and sampling (soil and plant samples). Processing nematodes for observation- Identification , study of their morphology and structures associated with cuticle, digestive system Observation of Asexual, sexual, reproduction, synchronization of parasite with host reproduction, in vitro cultivation of parasites; Egg shell	
IV	Platyhelminthes -Blood and stool tests for Diagnosis and detection of specific blood-borne and intestinal parasitic diseases. in vitro cultivation of Platyhelminthes parasites-Hatching in vitro of oncospheres/hexacanth larvae of <i>Hymenolepis diminuta</i> or any other parasite.	10
V	Platyhelminthes-Glycogen utilisation and deposition in flatworm parasites Study of parasitic damage such as as fluke infected liver and a lung with <i>Echinococcus</i> cysts.	5
VI	Quantitative analysis of Parasites: Use of statistical analysis in Aggregated distribution of parasites among host individuals-Chi-Square Test, Fisher's Exact Test , Bootstrap test, Mood's median test, stochastic equality test.	11
Books recommended- 1.Cobb,NA, Nematodes and their relationships, Year book, US Deptt. Of Aquaculture, 1914:457-490 2.Corfton, H B ,Nematodes ,Hutchinson University Library,London. 3. Dewes, B. The Trematoda, Cambridge University Press. 4. Smyth.,The Animal Parasitology,Cambridge University Press. 5.Chandeler,AC., Introduction to Parasitology,J.Wily and Sons. 6. Thomas C Cheng ,General parasitology,2nd edition,Academicpress,ISBN- 13:978-0121707552,Kindle e textbook store. 7. 1.Read OP ,Animal Parasitism,Prentice hall, Englewood, New Jersey,USA 8.Cheng TC ,The biology of Animal Parasites,WB Saunders an Co.,Philadelphia and London. 9.Hyman,LH ,The Invertebrates,vol II and III,McGrawHill,NY.		

Marks Distribution of Practical Exams:- As per the format given in course C20 Entomology Practical







OPTIONAL COURSE D WILDLIFE AND ENVIRONMENTAL BIOLOGY

SEMESTER X		
PAPERCode B051019T	Wildlife Ecology	
Course Objectives	This course is designed to imparts the knowledge about the basic concept and structure of the wildlife ecology, ecosystem, concept of community, animal habitat interaction, behavioral aspectssuch as feeding ecology, frugivory and predation. Food selection and pattern of habitat utilization. Group size and mate selection.	
Unit	Topics	No. of Lectures
I	Population Ecology: Demographic and life history parameters, r & K selection, allometry, aging and sexing. Life tables, age and stage structures models, methods of estimation of life history parameters. Population dynamics: exponential, logistic and other forms of growth of population, density dependent and independent growth, predator-prey systems, carrying capacity,	15
II	Habitat Ecology: Historical, ecological & evolutionary perspectives of Habitat Ecology, basic concepts. Ecology of major terrestrial habitats: Deserts, Grasslands, Wetlands, Forests. Habitat diversity: edge, ecotones, interspersion and juxtaposition. Physical and anthropogenic factors influencing terrestrial habitats. Habitat degradation and fragmentation. Successional changes and wildlife habitat. Evaluation and monitoring of wildlife habitat parameters, use and availability of habitatresources.	15

III	Behavioural Ecology: Proximate and ultimate mechanisms, causal and functional explanations in animal behaviour. Group living: costs, benefits and optimal group size. Predator prey relationships and evolutionary arms race. Competition for resources: ideal free distributions and resource defence. Concept of optimality in decision making in animals;	15
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	optimal foraging theory. Sexual selection; parental care and mating systems. Cooperation and helping in mammals, birds and fishes.	
IV	Community Ecology: Definition and nature of communities; scale and approaches. Measurement of species richness; diversity; evenness. Community structure, organization and its stability (guilds, resource partitioning, niche, competitive exclusion). Factors governing species diversity. Models of competition; simple community models. Concept and measurement of niche. Trophic interactions; top-down and bottom-up processes. Energy and productivity and its implications for species diversity. Functional diversity and food webs. Evolution of communities and neutral theory.	15





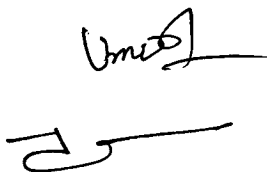


Suggested Readings:

1. Elements of ecology and Field Biology by R.L. Smith
2. Ecology and our endangered life support system by Eugene, P. Odum
3. The Science of Ecology by Roush Garden and Ehrlich
4. Concept of Ecology by Edward.J. Kormondy
5. Community Ecology: Pattern and Process by Anderson and Kikkawa
6. Ecological Concept by J.M. Cherrett
7. Comparative Ecology by Jiro Kikkawa
8. Population Ecology: A unified study of Animals and Plants by M. Begon.
9. Ecology of Populations by Boughy and S. Arthur
10. Viable Population for Conservation by Michael E. Soule
11. An Introduction to Plant Population Ecology by J. Silvertown
12. Guide to the Study of Animal Population by J. T. Tanner
13. An Introduction to the Study of Animal Population by H. G. Andrewartha
14. Population Growth Estimation by E. S. Marks

Suggestive digital platforms web links-

1. Pubmed [www.ncbi.nlm.nih.gov/pubmed]
2. Science direct [www.sciencedirect.com]
3. Nature publishing group [www.nature.com]
4. Cochrane library [www.cochranelibrary.org]
5. High wire [www.stanfordhighwire.org]



SEMESTER X		
PAPERCode B051020T	Wildlife Biodiversity and Conservation	
Course Objectives	The course is expected to help students to study classification and morphological, physiological adaptation and reproductive strategies of wildlife in Indian sub-continent. Course will help to know the initiatives taken by the government of India for the conservation and protection.	
Unit	Topics	No. of Lectures
I	Introduction of Indian Wildlife, wildlife distribution in ecological subdivision of India, IUCN categories of wildlife. Protected area network: National parks, Wildlife sanctuaries, Biosphere reserves and Zoos in India. Gene pool, habit, habitat and breeding biology of endangered mammals.	15
II	Causes of wildlife depletion: Habitat fragmentation, habitat destruction, commercial wildlife exploitation, overgrazing etc. Wildlife conservation policies and programmes, special projects for endangered species: Project Tiger, Asiatic Lion Reintroduction Project, Crocodile conservation Project, Project elephant, Project snow leopard, Project hangul.	15
III	Principle and practice of wildlife management: Management of special habitats; riparian zones, grasslands. Introduction to conservation biology, conservation values and ethics of conservation of natural resources. Conservation of biodiversity, patterns and processes, concepts of biodiversity, levels of biodiversity, genetic diversity, intra specific diversity, species richness, richness of higher taxa, ecosystem and biome diversity.	15

IV	National and International conventions & summits on conservation, Ex-situ and in-situ conservation, conservation breeding strategies. Institutions and their role in conservation: Zoos, Natural History Museums and Collections, Zoological Survey of India. National and international zoological institutes, societies	15
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	and academic bodies. Brief account of Wildlife Acts and their amendments in India and World. Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).	
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Suggested Readings:

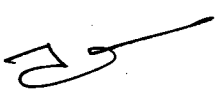
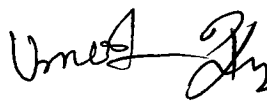
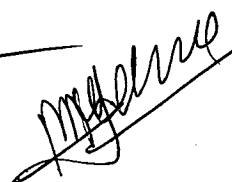
1. Asish Ghosh. 2007, Biodiversity Conservation. APH Publishing Corporation, New Delhi,
2. Kasthuri Reddy. 2010. Biodiversity and Land Conservation. Pacific Publication, New Delhi.
3. Pawan Kumar 'Bharti', Avinash Chauhan, Kaoud, H.A.H. 2013. Aquatic Biodiversity and Pollution. Discovery Publishing House, New Delhi.
4. Pullaiah, T. 2006. Biodiversity in India. Regency Publications, New Delhi.
5. Sharma, B.D, Indian Wildlife Resources Ecology and Development, Daya Publishing House, Delhi.
6. Trivedi, P. R. 2004. Natural Resources Conservation. APH Publishing Corporation, New Delhi.
7. Bose, N.K. 2009. Wildlife Management in India. Cyber Tech Publications, New Delhi.
8. Hosetti, B. B and M. Venkateshwaralu. 2001. Trends in Wildlife Biodiversity
9. Conservation and management. Daya Publishing House, New Delhi.
10. John M. Fryxell, Anthony R. E. Sinclair and Graeme Caughley. 2014, Wildlife
11. Ecology, Conservation and Management. Wiley-Blackwell, US.
12. Mallapureddi Vikram Reddy. 2008. Wildlife Biodiversity Conservation. Daya Publishing House, New Delhi.
13. Nithin Patil. 2016. Models for Planning Wildlife Conservation in Large Landscapes. Agrotech Press, Jaipur, New Delhi.
14. Ranga, M.M. 2012. Wildlife Management and Conservation. Agrobios (India).
15. Sharama, B.D., Indian Wildlife Resources Ecology and Development. Daya Publishing House, New Delhi.

Suggestive digital platforms web links-

1. Pubmed [www.ncbi.nlm.nih.gov/pubmed]
2. Science direct [www.sciencedirect.com]
3. Nature publishing group [www.nature.com]
4. Cochrane library [www.cochranelibrary.org]
5. High wire [www.stanfordhighwire.org]

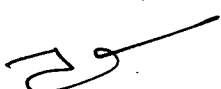
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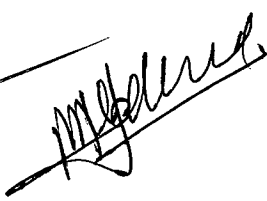
SEMESTER X		
PAPERCode B051021T	Environmental Physiology	
Course Objectives	This paper aims to build on conceptual understanding of students by exposing them to the basic principles behind various environmental processes. The course is expected to help students to understand to study about environment, properties, structure and composition of atmosphere. Course will help to know about the Mass and energy, Biogeochemical cycles, climates, natural resources etc which are major aspects of environment.	
Unit	Topics	No. of Lectures
I	Environment: Definition of Environment, Earth, Man and Environment, Evolution of environment, Physico-chemical and Biological Characteristics of environment. Structure and composition of atmosphere, hydrosphere, lithosphere and biosphere. Geographical classification, Distribution and zones.	15
II	Mass and energy: Transfer of mass and energy across various interfaces. First and second laws of thermodynamics, heat transfer processes, Biochemical cycles, gaseous and sedimentary turnover rate and turnover item, General relationship between landscape and climate. Climates of India, Indian monsoon, Drought, Tropical cyclones and western disturbances. Atmosphere stability and instability, temperature inversion and mixing heights, heat balance of the earth-atmosphere system, global climate change.	15

III	Natural resources: Types of natural resources, Forest resources: use and over-exploitation, deforestation, timber extraction, mining, dams and their effects on forests and tribal people. Water resources: use and utilization of surfaces and ground water, floods drought, dams-benefits and problems. Mineral resources: environmental effects of extracting and using mineral sources. Food resources: World food problems overgrazing, effects of modern agriculture, fertilizers-pesticides problems,	15
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	Water logging, salinity. Land resources: Land as a resource, Land degradation, man induced landslides, soil erosion and desertification	
IV	Energy resources: Concept and demand of energy, Growing energy needs, Renewable and nonrenewable sources, use of alternate energy sources, Wind energy, Solar energy, water as source of energy, Biofuels production, use and sustainability, use and overexploitation of energy sources and associated problems. Role of an individual in conservation of natural resources. Equitable use resources for sustainable lifestyles.	15



Suggested Readings:

- Renewable Energy – Environment and Development: M. Dayal; Konark Pub. Pvt. Ltd.
- Alternative Energy: S. Vandana; APH Publishing Corporation
- Nuclear Energy – Principles, practice and prospects: S. K. Agarwal; APH Publishing Corporation
- S. Glasstone, D. Van Nastrand, Source book on atomic energy, 3rd Edition, Germany, 1967
- M. Eisendbud, Environmental radioactivity, Academic Press
- E.D. Enger, B.E. Smith, Environmental Sciences- A study of Inter relationships, WCB Publication
- Bio-Energy Resources: Chaturvedi; Concept Pub.
- National Energy – policy, crisis and growth: V S. Mahajan; Ashis Publishing House
- Geography and Energy – Commercial energy systems and national policies: J. D. Chapman

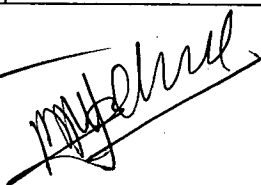
Suggestive digital platforms web links-

- Pubmed [www.ncbi.nlm.nih.gov/pubmed]
- Science direct [www.sciencedirect.com]
- Nature publishing group [www.nature.com]
- Cochrane library [www.cochranelibrary.org]
- High wire [www.stanfordhighwire.org]

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SEMESTER X		
PAPERCode B051022T	Environment Pollution and Management	
Course Objectives	This paper deals with different aspects of environmental contamination, which have adverse effects on human health. It will lay emphasis on understanding mechanisms of pollutants impacting human health by developing an understanding of different types of pollutants, their sources and mitigation measures.	
Unit	Topics	No. of Lectures
I	Air pollution: Types and sources, Effects of SO ₂ , NO ₂ , O ₃ , HF, photochemical smog and particulates on plants and human health, aeroallergens and allergies. Ozone layer depletion: Causes and consequences. Noise pollution: Types, sources and effects on human health. Water Pollution: Types and sources; Effects on water quality, plants and human health; Thermal pollution. Soil pollution: Types and sources, Radioactive pollution: Sources and hazards. Solid waste: Sources and effects. Bio-monitoring and bio-indication.	15
II	Toxicology: Principles of toxicology, dose-response relationships, Chronic and acute toxicity; Effective concentration, LD ₅₀ , Median tolerance limit and Margin of safety; Toxicity testing (Holistic and Numeric approach). Uptake, bioaccumulation, bio-transformation and excretion of xenobiotics. Role of temperature and humidity in human health. Effects of pesticides and heavy metals on ecosystems, mechanisms of metal toxicity, metallophytes.	15
III	Environmental Management: Principles and strategies. Indicators of environmental quality, environmental cost-benefit analysis; Environmental management system(EMS): ISO-14000; Environmental audit; Environmental clearance for establishing industries;	15



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IV	Environmental Impact Assessment (EIA); EIA guidelines 1994, Environmental taxes.	15
	International trade and environment; Trade Related Intellectual Properties (TRIPs), Intellectual Property Rights (IPRs), Corporate environmental ethics.	
Suggested Readings: • A. K. De. (3rd Ed). 2008 Environmental Chemistry. New Age Publications India Ltd. • I. C. Shaw and J. Chadwick. 1997. Principles of Environmental Toxicology. Taylor & Francis Ltd. • S.C. Santra. 2011. Environmental Science. New Central Book Agency. • Ira. S. Richards. 2008. Principles and Practices of Toxicology in Public Health. • C. N. Sawyer, P. L. McCarty and G. F. Parkin. 2002. Chemistry for Environmental Engineering and Science. John Henry Press. • H. H. Rump. 2000. Laboratory Manual for the Examination of Water, Waste water and soil. Wiley-VCH. • R. K. Sapru. 1987. Environmental Management in India (Vol. I & II). Ashish Publishing House. Suggestive digital platforms web links- • Pubmed [www.ncbi.nlm.nih.gov/pubmed] • Science direct [www.sciencedirect.com] • Nature publishing group [www.nature.com] • Cochrane library [www.cochranelibrary.org] • High wire [www.stanfordhighwire.org]		



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OPTIONAL COURSE D:

PAPERCode B051023P

PRACTICAL WILDLIFE AND ENVIRONMENTAL BIOLOGY

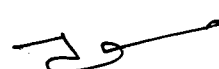
Max. Marks: 100	Min. Passing Marks: as per university schedule	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4.		
Unit	Topics	No. of Lectures
I	<u>Any two tour</u> Orientation Tour Orientation to field biology and natural history. Observations and collection of study material, wildlife signs and evidences. Techniques Tour (Ecology, Study Techniques, Wildlife & Vegetation Studies). Exercise on wildlife population parameters and census methods for various species. Vegetation studies. Studies on animal ecology. National Park Tour Visit a well known National Park (Corbett, Kanha, Ranthambore, Bharatpur) Specialized Techniques Tour Visit important wetlands in the country, the appraisal of the habitat, waterfowl census, and documentation of threats to wetlands.	120
II	Study of Social Organization in termites. Exercise to understand differential niches of two related taxa. Exercise to determine home-range of species. Sampling techniques for collection and observation of planktons. Application of transect and quadrat methods for animal abundance estimation. Life tables exercise and Population structure exercise. Estimation of abundance of wild animals by Line transects method.	

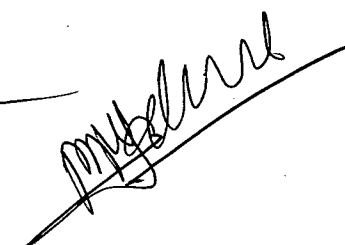
III	Demonstration and study of the working principles of common instruments used in wildlife studies. Adaptations in animals: use pictures or photographs with suitable labels. Examination and drawing of museum materials: skulls, feet, beak and eggs	
	Study and identification of pugmark and tracing. Identification and observation of Invertebrate. Following the individual animal to mark its home range. Study of epidermal derivatives; comparative morphology of dentition and skull. Examination and drawing of museum materials: skins, skulls, feet, eggs and nests of characteristic species. Study of Birds skin preparation and measurement of specimens. Study of morphology and identification of birds based on their feathers. Study and identification of birds based on their calls. Study of different bird nesting pattern. Study of composition of abandoned bird nest: contents and weights in priority The role of zoos, aquariums and botanic gardens in conservation. On a map of India locate & demarcate major tiger reserves/national parks/ wildlife sanctuaries. Using photographs / paintings / colored drawings identify and study distribution and ecological role of Endangered species of India Using photographs / paintings / colored drawings identify and study distribution and ecological role of Endemic species of Uttar Pradesh. Using photographs / paintings / colored drawings identify and study the extinct species. Exercise on human wildlife conflict; questionnaire survey. Study of lab vertebrate specimens. Comparative morphology of dentition. Comparative morphology of skull. Mapping the distribution of primates, carnivores and	

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	ungulates in India. Study on different wild animal coats. Mapping and distribution of primates, carnivores and ungulates.	
IV	Test of Soil samples for- pH, Texture, Total organic content. Test of Soil samples for- N, P, K contents. Test of Water samples for- Dissolved Oxygen, BOD, and COD. Test of Water samples for- Salinity, pH, hardness, Calcium, Magnesium, pH, conductivity, TDS etc.	

	Demonstration of LC50 & LD50.	
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Suggested Readings:

- Arora B. M. , Editor, Indian Wildlife Yearbook, AIZ & WV, Bareilly and Central Zoo Authority, New Delhi, 2002
- Brander, A.A, Wild Animals in Central India, Natraj Publisher, Dehradun.
- Bruce, C. Glavovic, Mic Kelly Robert Kay and Ailbhe Travers. 2015. Climate Change and the Coast. CRC Press, Taylor and Francis Group.
- Kadambari Sharma. 2010. Human Conflict and Wildlife Conservation. New Delhi, Jnanada Prakashan.
- Mallapureddi Vikram Reddy. 2008. Wildlife Biodiversity Conservation. New Delhi, Daya Publishing House.
- Elements of ecology and Field Biology by R.L. Smith
- Ecology and our endangered life support system by Eugene, P. Odum
- The Science of Ecology by Roufg Garden and Ehrlich
- Concept of Ecology by Edward J. Kormondy
- Community Ecology: Pattern and Process by Anderson and Kikkawa
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- Guide to the Study of Animal Population by J. T. Tanner
- An Introduction to the Study of Animal Population by H. G. Andrewartha
- Population Growth Estimation by E. S. Marks
- Ali, Salim (1997). The Book of Indian Birds, Oxford University Press, Mumbai.
- Bhamarh, H.S and Kavita Juneja. 2002. Introduction to Birds. Anmol Publication pvtltd . India.
- Gurudarshan Singh and H. Bhaskar. 2003. An Introduction to Birds. Campus Book. New Delhi.
- Khanna, D.R and P.R, Yadav, 2005. Biology of Birds. Discovery Publishing House. New Delhi.
- Rahmani, Asad R. & Ugra, Gayatri. Birds of Wetlands and Grasslands. Bombay Natural History Society, Mumbai.
- Sirsat CV. 2017. The Birds. Oxford Book Company, New Delhi.

Suggestive digital platforms web links-

- Pubmed [www.ncbi.nlm.nih.gov/pubmed]
- Science direct [www.sciencedirect.com]
- Nature publishing group [www.nature.com]
- Cochrane library [www.cochranelibrary.org]
- High wire [www.stanfordhighwire.org]

Marks distribution of practical exams:- As per the format given in C20 Entomology Practical

