

ZOOLOGY:SEMESTER-VII

Remarks	Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
For Honours in Zoology/ Honours with Research in Zoology	CC-H1 4credit	B23-ZOO-701	Advances of Cell Biology	4	4	30	70	100	3hrs.

Level of the course: **400-499**

Pre-requisite for the course(if any): **Zoology as single major in 3 years UG**

Course Learning Outcomes(CLO)

1. This core course will make students able to understand how the cell functions as a unit of life.
2. Through this course, students will be able to appreciate the importance of various cell function and structures in the evolution of multi cellular organisms.
3. The studies will make the students reveal elegance, dynamics and economy in the living cell and a gratifying unity in the principles by which a cell functions.
4. The students will know about the basic cellular and molecular approaches for cancer development and treatment.

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No.1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	1. Bio membranes 1.1 Molecular composition and arrangement, functional consequences 1.2 Cellular Transport – Recapitulation of the plasma membrane; diffusion, active transport and pumps, uniports, symports and antiports. 1.3 Donnan equilibrium; ion movements and cell function: acidification of cell organelles 1.4 Maintenance of cellular pH; cell excitation; bulk transport; Receptor mediated endocytosis 1.5 Trans epithelial transport 2. Cytoskeleton and cell movement 2.1 Introduction to cytoskeleton and its role 2.2 Molecular structure of Actin, myosin and their organisation 2.3 Structure and dynamic organizations of microtubules and microfilaments 2.4 Microtubule motors and movement 2.5 Intermediate filaments 2.6 Role of Centrioles and basal bodies 2.7 Structure and functions of Cilia and flagella	15
II	3 The Extra Cellular Matrix and Cell interactions 3.1 Cell walls 3.2 The E C M and cell-matrix interactions 3.3 Cell-cell interactions: adhesion junctions, tight junctions, gap junctions, plasmodesmata 3.4 Ca ⁺⁺ dependent and Ca ⁺⁺ independent Homophilic cell-cell adhesion 4 Cell matrix adhesion 4.1 Integrins 4.2 Collagen 4.3 Non-collagen components 4.4 Auxin and cell expansion 4.5 Cellulose fibril synthesis and orientation 5 Protein sorting and transport 5.1 Protein uptake into the ER 5.2 Membrane proteins and Golgi sorting 5.3 Mechanism of vesicular transport 5.4 Lysosomes 5.5 Molecular mechanism of secretory pathway	15

III	6	Cell cycle 6.1 Eukaryotic cell cycle 6.2 Regulators of cell cycle progression 6.3 Role of Meiosis in Genetic Variation	15
	7	Cell–Cell signaling 7.1 Signaling molecules and their receptors 7.2 Pathways of intracellular signal transduction	
	8	Biology of Cancer 8.1 The development and causes of cancer 8.2 Oncogenes 8.3 Tumor suppressor genes 8.4 Molecular approaches to cancer treatment	
IV	9	Genome organization 9.1 Chromosomal organization of genes 9.2 Transposons in prokaryotes and eukaryotes 9.3 Morphological and functional elements of eukaryotic chromosomes	15
	10	Cell Death 10.1 Necrosis and Programmed cell death 10.2 Molecular Mechanism 10.3 Applications and Significance	
	11	Biology of Ageing 11.1 Morphological, Physiological and Functional changes during Ageing 11.2 Telomeres and Ageing 11.3 Theories of Ageing	
Total Contact Hours			60
Suggested Evaluation Methods			
Internal Assessment: 30		End Term Examination: 70	
➤ Theory	30	➤ Theory:	70
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		
Part C-Learning Resources			
Recommended Books/e-resources/LMS:			
1. Molecular Cell Biology ,J. Darnell, H.Lodish and D.Baltimore ScientificAmerican Book,Inc., USA.			
2. Molecular Biology of the Cell,B.Alberts,D.Bray,J.Lewis,M.Raff,K.RobertsandJ.D.Watson.Garland Publishing Inc., New York.			
3. Cell and molecular biology Phillip Sheeler,Donald E.BianchiWiley,1987			
4. Life: The Science of Biology by David Sadava			
5. Cell and Molecular Biology by De Robertis			
6. Cell Biology by A.K.Berry, EMKAY Publications			
7. Molecular Cell Biology, Lodish et al.,W.H. Freeman and Company (8thEd.2016)			
8. Molecular Biology, Weaver R. F.,Mc Graw-Hill Education(5thEd. 2011)			

ZOOLOGY: SEMESTER-7 (FOR HONOURS/HONOURS WITH RESEARCH IN ZOOLOGY)									
Remarks	Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
For Honours in Zoology/ Honours with Research in Zoology	CC-H2 4credit	B23-ZOO-702	Biochemistry and Bio-techniques	4	4	30	70	100	3hrs.
Level of the course: 400-499									
Pre-requisite for the course(if any): Zoology as single major in 3 years UG									
Course Learning Outcomes (CLO): Students will be able to understand A basic knowledge of the underlying principles and practical strategy of the analytical and preparative techniques that are fundamental to study and understanding of life processes. - The general reactions of various metabolic pathways. - The principle, working, materials used and applications of various biological techniques that are used to study the basic biological processes. - The underlying description of the structure and classification of bio molecules.									
Instructions for Paper-Setter - Nine questions will be set in all. All questions will carry equal marks. - Question No.1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No.1 and four more questions selecting one question from each unit.									
UNIT	TOPICS							CONTACT HOURS	
I	1.0 General Principles of Biochemistry and chemical composition of life 1.1 General Introduction to Bio molecules 2.0 Protein Biology: 2.1 Primary, Secondary, tertiary and quaternary structure of proteins : i) Domain, ii) Ramachandran plot and its significance 3.0 Enzyme: 3.1 Classification and nomenclature, 3.2 Co-enzymes and Cofactors 3.3 Induced fit and Molecular Mechanism of Enzyme action, 3.4 Enzyme feedback mechanism, Isozymes. 4.0 Nucleic acids: Structure and Functions 4.1 DNA structure and functions 4.2 RNA structure and functions, 4.3 DNA choreography 4.4 Qualitative and quantitative estimation of DNA							15	
II	5.0 Metabolism: 5.1 Glycolysis, citric acid cycles its regulation and role as metabolic hub. 5.2 Hexose monophosphate pathway its regulation and significance. 5.3 Cholesterol biosynthesis, its metabolism and steroidogenesis. 5.4 Bile acids and their metabolism 5.5 Saturated and unsaturated fatty acid and their metabolism.							15	

III	6.0 Chemical and Biological assays(<i>in vitro</i> and <i>in vivo</i> assays). 7.0 Principles and uses of analytical instruments: 7.1 Microscopes and imaging 7.2 Spectrophotometers, 7.3 NMR spectrophotometer 8.0 Microbiological and cell culture Techniques 8.1 Setting of microbiological laboratory, 8.2 Sterilization and Media preparation techniques 8.3 Inoculation and growth monitoring (Standard plate count technique), 8.4 Isolation of a microbial colony and slant preparation. 8.5 Design and functioning of tissue culture laboratory, 8.6 Basics of cell/tissue culture, Culture media preparation, 8.7 Cell proliferation measurements 8.8 Cell viability testing and Cell harvesting methods. 8.9 Bio safety levels 9.0 Cryotechniques: 9.1 Cryopreservation for cells, tissue, organisms 9.2 Cryotechniques for microscopy.	15
IV	10.0 Separation techniques in biology. 10.1 Molecular separations by chromatography, electrophoresis, precipitation etc. 10.2 Organelle separation by centrifugation. Density gradient centrifugation, Ultra Centrifugation, unit gravity centrifugation, affinity adsorption, anchorage based techniques etc. 10.3 Cell separation by flowcytometry and FACS 11.0 Radio isotope and mass isotope techniques in biology: 11.1 Carbon dating and radioactive counting 11.2 Autoradiography 11.3 Biosensors 12.0 DNA fingerprinting	15
	Total Contact Hours	60
Suggested Evaluation Methods		
Internal Assessment: 30 > Theory • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 10 • Mid-Term Exam: 15		End Term Examination: 70 > Theory • Written Examination
Learning Resources		
1. Animal Cell Culture—A practical approach, Ed. John R.W. Masters, IRL Press. 2. Introduction to Instrumental analysis, Robert Braun, McGraw Hill International editions 3. A Biologists guide to Principles and Techniques of Practical Biochemistry, K.Wilson and K.H. Goulding, ELBS Edn. 4. Lehninger AL, Nelson DL & Cox MM(1993) Principles of Biochemistry, 2nd edn. New York: Worth. 5. Stryer L (1995) Biochemistry, 4th edn. New York: W H Freeman. 6. Voet D, Voet J G & Pratt C W (1999) Fundamentals of Biochemistry. New York: Wiley.		

ZOOLOGY:SEMESTER-VII

Remarks	Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
For Honours in Zoology/ Honours with Research in Zoology	CC-H3 4credit	B23-ZOO-703	Structure and Function of Invertebrates	4	4	30	70	100	3hrs.

Level of the course: **400-499**

Pre-requisite for the course (if any): **Zoology as single major in 3 years UG**

Course Learning Outcomes (CLO)

- The study of invertebrates reveals progressive evolutionary history and adaptations together which forms the basis of huge complex and diverse life forms.
- Students will acquire a clear understanding about organization of minor phyla and their relationship with other animal phyla
- Students will be able to know the structure and significance of various systems of Invertebrates
- Will have detail understanding of adaptations and significance of Invertebrates

Instructions for Paper-Setter

- Nine questions will be set in all. All questions will carry equal marks.
- Question No.1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	1.0 Introduction to invertebrates with their general characters, Basic body plan, Concept of Invertebrate v/s Vertebrata and Non-Chordata v/s Chordata 2.0 Organization of coelom 2.1 Concept and structure of Acoelomate, Pseudo coelomates and Coelomates. 2.2 Protostomia and Deuterostomia 2.3 Metamerism in Annelida, Pseudometamerism. 3.0 Minor Phyla: 3.1 Concept and significance 3.2 Organization and general characters of Acoelomate, Pseudo coelomates and Coelomates minor phyla (with special emphasis on Ctenophora, Rotifera, Endoprocta, Ectoprocta, Phoronida, Sipunculida and Echiuroidea).	15
II	4.0 Locomotion 4.1 Flagella and ciliary movement in Protozoa 4.2 Hydrostatic movement in Coelenterata, Annelida and Echinodermata 5.0 Nutrition and Digestion 5.1 Patterns of feeding and digestion in lower metazoa 5.2 Filter-feeding in Polychaeta, Mollusca and Echinodermata 6.0 Respiration 6.1 Organs of respiration: Gills, lungs, trachea, skin, Cloacal chamber, Bucco pharyngeal area etc. 6.2 Respiratory pigments 6.3 Mechanism of respiration	15
III	7.0 Excretion 7.1 Organs of excretion: Coelom, coelomoducts, Nephridia and Malpighian tubules. 7.2 Mechanism of excretion and osmoregulation 8.0 Nervous system 8.1 Primitive nervous system: Coelenterata and Echinodermata 8.2 Advanced nervous system: Annelida, Arthropoda (Crustacea and Insecta) and Mollusca (Cephalopoda). 8.3 Trends in neural evolution.	15

	9.0	Social life in insects, Social life in Isoptera and Hymenoptera	
IV	10.0	Invertebrate larvae	15
	10.1	Larval forms of free living invertebrates	
	10.2	Strategies and Evolutionary significance of larval forms	
	10.3	Conservation of invertebrates.	
	11.0	Introduction to insects	
	11.1	Mouthparts of Insects	
	11.2	Mechanism of insect flight and hovering	
	11.3	Metamorphosis in insects	
11.4	Hormonal control of moulting.		
12.0	Economic importance of Invertebrates; Various Adaptations in Invertebrates		
Total Contact Hours			60
Suggested Evaluation Methods			
Internal Assessment:30		End Term Examination: 70	
➤ Theory	30	➤ Theory:	70
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		
Part C-Learning Resources			
RecommendedBooks/e-resources/LMS:			
1. Hyman,L.H. The invertebrates, Vol.I. Protozoa through Ctenophora, Mc GrawHil lCo., NewYork.			
2. Barrington,E.J.W. Invertebrate structure and function. Thomas Nelson and Sons Ltr J.London.			
3. Jagerstein,G. Evolution of Metazoan life cycle, Academic Press, New York &London.			
4. Barnes,R.D. Invertebrate Zoology, 3 rd edition.W.B.SaundrsCo.,Philadelphia.			
5. Russel-Hunter,W.D. A Biology of higher invertebrates, theMacmillinCo.Ltd.London.			
6. Hyman,L.H.the Invertebratessmaller coelomate groups,Vol. V. Mc GrawHillCo., NewYork			
7. Read, C.P. Animal Parasitism. PrenticeHallInc.,NewJersey.			
8. Sedgwick,A.A. Student text book of Zoology. Vol.I,II and III CentralBookDepot, Allahabad			
9. Parker,T.J.,Haswell,W.A. Textbook of Zoology, McMillanCo., London.			

ZOOLOGY: SEMESTER-VII									
Remarks	Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
For Honours in Zoology/ Honours with Research in Zoology	DSE-H1 4 credit (option 1)	B23-ZOO-704	Biosystematics and Biostatistics	4	4	30	70	100	3hrs.
Level of the course: 400-499									
Pre-requisite for the course (if any): Zoology as single major in 3 years UG									
Course Learning Outcomes(CLO): Students will be able to understand: 1. Knowledge of Taxonomy helps in classifying and identifying biodiversity and biologist study the well understood relationships by making phylogenetic trees. 2. It will help to understand the overall biodiversity of the world and their application in all the fields of biological sciences. 3. Biostatistics helps to generate a hypothesis from a set of observation and then design experiment to test the hypothesis. 4. Able to acquire, analyze and understand the significance of data.									
Instructions for Paper-Setter 1. Nine questions will be set in all. All questions will carry equal marks. 2. Question No.1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No.1 and four more questions selecting one question from each unit.									
UNIT	TOPICS						CONTACT HOURS		
I	1.0 Biosystematics and taxonomy: Definition and perspectives, 2.0 Historical resume, Importance and applications of systematics in biology. 2.1 Concepts of newer aspects of biosystematics: Chemotaxonomy, Cytotaxonomy, Molecular taxonomy. 3.0 Dimensions of speciation and taxonomic characters: 3.1 Different Species concepts – species category, 3.2 Sub-species and other intra-specific categories. 4.0 Theories of biological classification, hierarchy of categories. 5.0 Taxonomic characters – different kinds, weighing of characters						15		
II	6.0 Methodology: 6.1 Taxonomic collections, preservation, curation process and identification. 6.2 Taxonomic keys-different kinds of taxonomic keys, their merits and demerits. 7.0 Systematic publications: 7.1 Different kinds of publications. 7.2 International code of Zoological Nomenclature (ICZN): principles, objectives and rules: Stability, Priority, Concept of availability, formation of names, synonymy, homonymy, the type method, kinds of type specimen, type-designation: 8.0 Principles of Bioethics in Biodiversity						15		
III	9.0 Measures of central value: 9.1 Arithmetic mean, mode and median, Definition, calculation and its properties. 10.0 Measures of Dispersion: 10.1 Range, Interquartile range, 10.2 Quartile deviation. 10.3 Mean deviation and standard deviation, 10.4 Standard error						15		

	11.0 Correlation: 11.1 Types and Methods studying correlation – Scatter diagram method, Graphic method, Karl Pearson coefficient of correlation, Rank correlation. 12.0 Regression analysis (Regression lines and regression equation) 13.0 Chi-square analysis	
IV	14.0 Concept of sampling and sampling methods: 14.1 Definition and law of sampling, 14.2 Judgment sampling, Random sampling, stratified sampling, systematic sampling, multi-stages sampling and quota sampling. 15.0 Test of significance for large samples and small samples (student t-test, F- test; ANOVA). 16.0 Probability and law of probability, Theoretical probability distribution: Binomial distribution, Poison distribution, Normal distribution. 17.0 Components of computers, Basic functioning of computers, Use of Statistical Software in Biology	15
	Total Contact Hours	60
Suggested Evaluation Methods		
Internal Assessment: 30 > Theory • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 10 • Mid-Term Exam: 15		End Term Examination: 70 > Theory • Written Examination
Learning Resources		
1. M. Kato. The Biology of Biodiversity, Springer. 2. E.O. Wilson, Biodiversity, Academic Press, Washington. 3. G.G. Simpson, Principle of animal taxonomy, Oxford ISH Publishing Company. 4. E. Mayer, Elements of Taxonomy. 5. E.O. Wilson, The Diversity of Life (The College Edition), W.W. Northerm & Co. 6. Fundamental of statistics by S.C. Gupta. Himalayan Publishing House 7. Elements of Biostatistics. By Satguru Prasad. Rastogi Publication.		

ZOOLOGY: SEMESTER-VII									
Remarks	Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
For Honours in Zoology/ Honours with Research in Zoology	DSE-H1 4 credit (option 2)	B23-ZOO-705	Computational Biology	4	4	30	70	100	3 hrs.
Level of the course: 400-499									
Pre-requisite for the course (if any): Zoology as single major in 3 years UG									
Course Learning Outcomes (CLO) 1. Students will be able to describe basic components of computer hardware and software 2. Students will be able to access Working with MS Excel, MS Word and MS power point. 3. Students will be able to describe about computational statistics. 4. Students will be able to understand the bioinformatics techniques of data handling and processing.									
Instructions for Paper-Setter 1. Nine questions will be set in all. All questions will carry equal marks. 2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.									
UNIT	TOPICS							CONTACT HOURS	
I	Basic components of Computer: Hardware, CPU, input devices, output devices). Computer Memory, concepts of computing. Software: Basics of Operating system and its utilities., Application Software, word Processing, introduction to MS excel, Use of worksheet to enter Data, edit data, copy data, move data. Graphical tools in excel for data presentation, Various Formula and functions.							16	
II	MS-word processor-editing, copying, formatting, table insertion, flow charts. Working with MS Powerpoint, Data handling and image Processing. Internet, Search engines, Web browser. E-governance websites, Working with arc GIS, Working with Google Earth Pro, USGS.QGIS , GPS KIT. UTM converter. Working with software like DISTANCE, PREFER., RAVEN.							16	
III	Use of in-built statistical functions for computation of mean, S.D, correlation and regression coefficient, correlation, regression coefficient, ANOVA, PCA, Confidence Interval, Chi square test, Z-test, T-test, F-Test.. Computational use of histogram, bar diagram, scatter plot. Statistical errors. Data handling, Image processing.							16	
IV	Introduction to Bioinformatics, Introduction to computational genomics and proteomics. Basics of Microarray and Image analysis. Basics of Molecular Modelling. Biological Data base, Primary , Secondary and composite database, Protein and Nucleic Acid Data base.							16	
Suggested Evaluation Methods									
InternalAssessment: 30 ➤ Theory - Class Participation: 5 - Seminar/presentation/assignment/quiz/class test etc.: 10 - Mid-Term Exam: 15						End Term Examination: ➤ Theory Written Examination: 70			
Learning Resources									
1. Kelley, S.T., & Didulo, D. (2018) Computational Biology: A Hyper text book (ASM Books). ASM press. 2. Low,L & Tammi, M (2017) Bioinformatics: A Practical hand book of next generation , sequencing and applications. World scientific publishing cooperation. 3. Ghosh, Z and Mallick, B 92008) Bioinformatics, principles and application. Oxford Universty Press.									

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Remarks	Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
For Honours in Zoology/ Honours with Research in Zoology	PC-H1 4 credit	B23-ZOO-706	Practical Based on B23-ZOO-701 TO 704/705	4	8	30	70	100	6 hrs.

Level of the course: 400-499

Pre-requisite for the course (if any): **Zoology as a Subject at B.Sc. Level**

Course Learning Outcomes (CLO)

- Students will develop skills in basic laboratory techniques and understand the principles in Biology.
- Students will be able to apply the scientific method to the process of experimentation.
- This course will make students able to understand the regulation of chemical reactions in living cells.
- Students will be able to understand the computational biology and techniques of data handling and processing.

Course Content	TOPICS		CONTACT HOURS
	1. Preparation of mitotic chromosomes from onion root tips. 2. Preparation of meiotic chromosomes from grasshopper testes. 3. Preparation of karyotypes from micrographs. 4. Calculation of morphometric data and preparations of idiogram. 5. Study of permanent slides of different stages of meiosis and mitosis. 6. Proteins: Quantitative estimation of proteins by Biuret method and Lowry’s method. 7. Carbohydrates: quantitative estimation of total carbohydrates and glucose 8. Analysis of Fats/Oils: iodine number, saponification value,acid value quantitative estimation of total lipids. 9. Paper chromatography:amino acids and carbohydrates. 10. Tools: demonstration of parts and working of the following tools: PCR, GLC, Spectrophotometers, various kinds of microscopes, pH meter, Electrophoresis, Centrifuges, Tissue culture unit, Incubators 11. Slides and Museum specimens of phylum Protozoa to Hemichordata 12. Study of various types of Larvae of class Insecta. 13. Study of various types of larvae of class Crustacea. 14. Identification and study of various types of Mouth parts in class insecta. DSE-H1 (option 1) 15. Preparation and use of different types of taxonomic keys. 16. Statistical analysis of data using manual and computer software methods DSE-H1 (option 2) 15. Use of Search engines like scopus Science direct of collection of reference material. 16. Use of GIS software like ARCGIS, Google earth pro etc		120 Hrs

Suggested Evaluation Methods

Internal Assessment: 30 > Practicum - Class Participation: 5 - Seminar/presentation/assignment/quiz/class test etc.: 10 - Mid-Term Exam: 15	End Term Examination: 70 > Practicum Lab record, Viva-Voce, Execution of the practical Write up
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Learning Resources

- Sharma R K, Sangha S P S (2009). Basic Techniques in Biochemistry and Molecular Biology, I.K. International Publishing House Pvt. Ltd. New Delhi
- Podder T, Mukhopadhyay S, Das SK (2003). An Advanced Laboratory Manual of Zoology Published by Rajiv Beri for Macmillan India Limited, Rajkamal Electric Press, Delhi
- Sadasivam S, Manickam A (1997). Biochemical Methods, Ed. 2nd, New Age International Publishers, New Delhi
- David T. Plummer (1987). An Introduction to Practical Biochemistry. Ed., 3rd, McGraw-Hill Publisher, Rajkamal Electric Press, Delhi

ZOOLOGY:SEMESTER-VIII

Remarks	Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
Honours in Zoology	CC-H4 4 credit	B23-ZOO-801	Structure and Function of Vertebrates	4	4	30	70	100	3hrs.

Level of the course: 400-499

Pre-requisite for the course(if any): **Zoology as single major in 3 years UG**

Course Learning Outcomes (CLO)

- Students will be able to understand various biological functions, the evolution of life from most primitive to most advanced form with respect to their habit and habitat.
- Students will have acquaintance with the basic concepts, external morphology and sexual dimorphism in chordates and understand the various systems, adaptation and dentition in chordates.
- Students will also Understand the Classification various classes of phylum Chordate i.e., Pisces, Reptiles, Aves and Mammals.
- This course will make students familiarize with the vertebrate diversity around them

Instructions for Paper-Setter

- Nine questions will be set in all. All questions will carry equal marks.
- Question No.1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	1.0 Introduction to Chordates with their general characters. 1.1 Origin of Chordates 1.2 Concept of Proto chordata or pre-vertebrates 1.3 Classification of Vertebrates up to orders 1.0 Integument and its derivatives 1.1 Development, general structure and functions of skin and its derivative 1.2 Glands, scales, horns, claws, nails, hoofs, feathers and hair	15
II	3.0 Skeletal system 3.1 Form, function, body size and skeletal elements of the body 3.2 Comparative account of jaw suspensorium, Vertebral column 3.3 Limbs and girdles 4.1 Digestive system 4.1 Dentition, Stomach, Digestive Glands 4.2 Anatomy of gut in relation of to feeding habits- herbivores, carnivores and omnivores. 5.0 Respiratory system 5.1 Characters of respiratory tissue, Internal and External Respiration 5.2 Comparative account of respiratory organs	15
III	6.0 General plan of circulation in various groups 6.1 Components of Blood 6.2 General plan of circulation in reptiles, birds and mammals 6.3 Evolution of heart, aortic arches and Portal systems 7.0 Evolution of Urino-genital system in vertebrate series 7.1 Structure and functions of different types of kidney 7.2 Urino-genital ducts 8.0 Flight adaptation in birds, Migration in fish and Birds	15
IV	8.0 Nervous system 8.1 Comparative anatomy of the brain in relation to its functions 8.2 Comparative anatomy of spinal cord 8.3 Nerves-Cranial, Peripheral and Autonomous nervous systems 9.0 Sense organs 9.1 Simple receptors 9.2 Organs of Olfaction and taste 9.3 Lateral line system	15

	9.4	Electroreception	
Total Contact Hours			60
Suggested Evaluation Methods			
Internal Assessment:30		EndTermExamination:70	
➤ Theory	30	➤ Theory:	70
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		
Part C-Learning Resources			
RecommendedBooks/e-resources/LMS:			
1. Barrington, E.J.W. The Biology of Hemichordata and Protochordata .Oliver and Boyd, Edinbough.			
2. Bourne,G.H.The structure and functions of nervous tissue. Academic Press, New York.			
3. Carter,G.S. Structure and habit invertebrate evolution-Sedgwick and Jackson, London.			
4. Kingsley,J.S. Outlines of Comparative Autonomy of Vertebrates. Central Book Depot, Allahabad.			
5. Kent, C.G. Comparative anatomy of vertebrates.			
6. Milton Hilderbrand. Analysis of vertebrate structure. IV. Ed. John Wiley and Sons Inc., NewYork.			
7. Sedgwick,A. A Students Text Book of Zoology, Vol. II.			
8. Torrey,T.W. Morphogenesis of vertebrates. John Wiley and Sons Inc., New York and London.			
9. Walters,H.E. and Sayles, L.D. Biology of vertebrates. MacMillan &Co. ,NewYork.			

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Remarks	Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
Honours in Zoology	CC-H5 4credit	B23-ZOO-802	Comparative Physiology	4	4	30	70	100	3hrs.

Level of the course: **400-499**

Pre-requisite for the course (if any): **Zoology as single major in 3 years UG**

Course Learning Outcomes (CLO)

1. An appropriate understanding of functioning of each system of different groups of animals with their comparison will be acquainted.
2. The students will be able to explore all reasoning and queries that how animals work.
3. The students will be able to learn that how the physiology of different groups of organisms is influenced by the different environments of their niches
4. Since this course also have some important practical component where interesting exercises will be conducted to perform experiment and answer various queries of animal physiology.

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No.1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	1.0 Digestion 1.1 Feeding mechanisms and regulation 1.2 Comparative physiology of digestion and absorption in different animal groups 2.0 Respiration 2.1 Respiratory organs, Types of respiration, mechanism of breathing 2.2 Transport of respiratory gases 2.3 Respiratory pigments through different phylogenetic groups. 2.4 Physiological response to oxygen deficient stress. 3.0 Excretion 3.1 Patterns of nitrogen excretion among different animal groups 3.2 Functional anatomy of renal unit; mechanisms of ultra filtration, Counter Current mechanism, Dialysis 4.0 Osmo regulation in different animal groups 4.1 Definition and basic classification of organisms on the basis of osmo regulation 4.2 Osmotic challenges of different environments 4.3 Mechanism of Osmoregulation in fresh water, Estuarine and Marine animals 4.4 Osmoregulation in migratory organisms, Control and regulation of osmoregulation	15
II	5.0 Thermoregulation 5.1 Homeothermic animals, Poikilotherms, Hibernation and Aestivation, 5.2 Physical, chemical, neural regulation, Physiological adaptations acclimatization & acclimation in response to high, low ambient temperature 6.0 Circulation of body fluids and the irregularity among different animal groups 6.1 Systems of circulation, heart beat and blood pressure, 6.2 Cardiac cycle, Cardiac output and its regulation, 6.3 Lymphatic system 7.0 Receptor physiology—a comparative study of Mechanoreception, Photoreception, Chemoreception and Equilibrium reception	15

	8.0 Muscle and Contractile physiology 8.1 Contractile elements, cells and tissues among different phylogenic groups; Muscle structure and function-correlation; 8.2 Electric organs and tissues	
III	9.0 Comparative testicular physiology in animals 9.1 Morphology, Differentiation, Function and its regulation 10.0 Comparative ovarian physiology and differentiation in vertebrates 10.1 Morphology, Endocrinolgy, Oogenesis, vitellogensis 11.0 Neuronal physiology 11.1 Structure and classification of neurons and glial cells. 11.2 Synaptic action, dendritic properties and functional operation of spinal cord, Brain stem 11.3 Autonomic nervous system.	15
IV	12.0 Principles of synaptic transmission 12.1. Ca ²⁺ and neurotransmitter release; post synaptic transmission mechanism; 12.2. Diversity of neurotransmitters: acetylcholine, catecholamine, serotonin, GABA, glycine, histamine, peptides, NO, and opioids. 13.0 Physiological adaptations to different environments 13.1 Physiological adaptations acclimatization &acclimation in response to high, low ambient temperature, 13.2 Physiological adaptation at high altitude and in deep sea environment. 14.0 Stress Physiology: Concept of Stress and Strain, 14.1 Stress hormones and stress regulatory mechanisms.	15
Total Contact Hours		60
Suggested Evaluation Methods		
Internal Assessment: 30		End Term Examination: 70
➤ Theory	30	➤ Theory: 70
• Class Participation:	5	Written Examination
• Seminar/presentation/assignment/quiz/class test etc.:	10	
• Mid-Term Exam:	15	
PartC-Learning Resources		
RecommendedBooks/e-resources/LMS:		
1. C.L.Prosser. Comparative Animal Physiology. W.B.Saunders & Company. 2. R.Eckert. Animal Physiology: Mechanisms and Adaptation. W.H. Freeman &Company. 3. W.S. Hoar. General and Comparative Animal Physiology 4. Schiemdt-Nielsen. Animal Physiology: Adaptation and Environment. Cambridge. 5. C.L.Prosser. Environment and Metabolic Physiology. Wiley-Liss, NewYork. 6. DavidRandall,WarrenBurggren ,KathleenFrench:Eckert Animal Physiology 7. Guyton, A.X.,Text Book of Medical Physiology,7 th edition,SaundersCompany(1986).		

ZOOLOGY:SEMESTER-VIII

Remarks	Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
Honours in Zoology	CC-H6 4credit	B23-ZOO-803	Population Genetics & Evolution	4	4	30	70	100	3hrs.

Level of the course: **400-499**

Pre-requisite for the course(if any): **Zoology as single major in 3 years UG**

Course Learning Outcomes (CLO)

- To provide students the basic insight about the mechanism of evolution and to make them able to relate different forms of life on our planet earth. It will also provide them in-depth knowledge about the changing frequency and distribution of alleles within the population.
- Acquire a clear understanding about genetic equilibrium in natural populations
- To know about genetics of quantitative traits in populations
- Detail understanding of molecular phylogenetics and methods of construction of phylogenetic tree

Instructions for Paper-Setter

- Nine questions will be set in all. All questions will carry equal marks.
- Question No.1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	1.0 Concepts of evolution and theories of organic evolution with an emphasis on Darwinism. 2.0 Emergence of Neo-Darwinism-Neutral Hypothesis 3.0 Neo Darwinism 3.1 Hardy-Weinberg law of genetic equilibrium 3.2 A detailed account of destabilizing forces: 3.2.1 Natural selection 3.2.2 Mutation 3.2.3 Genetic drift 3.2.4 Migration 3.3 Meiotic drive	15
II	4.0 Quantifying genetic variability 4.1 Genetic structure of natural populations 4.2 Phenotypic variations 4.3 Models explaining changes in genetic structure of populations 4.4 Factors affecting human disease frequency 5.0 Molecular population genetics 5.1 Patterns of change in nucleotide and amino acid sequences 5.2 Ecological significance of molecular variations 6.0 Genetics of quantitative traits in populations 6.1 Analysis of quantitative traits 6.2 Estimation of heritability 6.3 Genotype-environment interactions 6.4 Inbreeding depression and heterosis 6.5 Molecular analysis of quantitative traits 6.6 Phenotypic plasticity	15
	7.0 Genetics of speciation 7.1 Concept of species 7.2 Patterns and mechanisms of reproductive isolation	

III	7.3	Modes of speciation (Allopatric, Sympatric, Parapatric, Peripatric)	15
	8.0	Molecular Evolution	
	8.1	Gene Evolution	
	8.2	Evolution of gene families, Molecular drive	
	8.3	Assessment of molecular variations	
	9.0	Origin of higher categories	
	9.1	Phylogenetic gradualism and punctuated equilibrium	
IV	9.2	Major trends in the origin of higher categories Micro-and Macro-evolution	15
	10.0	Molecular phylogenetics	
	10.1	Concept of phylogenetic trees.	
	10.2	Methods of construction of Phylogenetic trees.	
	11.0	Population genetics and ecology	
	11.1	Metapopulations	
	11.2	Monitoring Natural Populations	
	11.3	Populations size and extinction	
	11.4	Loss of genetic variations	
		Conservation of genetic resources in diverse taxa	
Total Contact Hours			60
Suggested Evaluation Methods			
Internal Assessment:30		End Term Examination: 70	
➤ Theory	30	➤ Theory:	70
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		
Part C-Learning Resources			
RecommendedBooks/e-resources/LMS:			
1. Dobzhansky, Th .Genetics and Origin of Species. Columbia University Press. Dobzhansky, Th.,F.J.Ayala,G.L. Stebbines and J.M. Valentine. Evolution. Surjeet Publication, Delhi.			
2. Futuyama,D.J. Evolutinary Biology, SuinuaerAssociates,INCPublishers,Dunderland.			
3. Hartl,D.L. APrimer of Population Genetics. Sinaue r Associates,Inc, Massachusetts.			
4. Jha,A.P. Genes and Evolution. JohnPublication,New Delhi.			
5. King,M. Species Evolution-The role of chromosomal change. The Cambridge University Press,Cambridge.			
6. Merrel,D.J .Evolution and Genetics. Holt, Rinehartand Winston,Inc.			
7. Smith,J.M. Evolutinary Gentic. Oxford University Press, New York.			
8. Strikberger,M.W. Evolution. Jones and Bartett Publishers, Boston London.			

ZOOLOGY: SEMESTER-8

Remarks	Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
Honours in Zoology	DSE-H2 4 credit (Option 1)	B23-ZOO-804	Population and Community Ecology	4	4	30	70	100	3hrs.

Level of the course: 400-499

Pre-requisite for the course (if any): **Zoology as single major in 3 years UG**

Course Learning Outcomes (CLO): Students will be able to understand

1. Explanations of the need for intra- and interdisciplinary cooperation in researching different ecosystems.
2. The all biotic and abiotic factors that are related to individual, population, community and ecosystem and defines the relationships between them.
3. Information about the benefits of ecosystem and can be used in the management of natural resources for sustainable development in ways that leave the environment healthy.
4. Scope of the specialization within ecology such as marine, vegetation and statistical ecology to better understand the environment around them.

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No.1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	1.0 Basic Concepts: Definition, Scope and Significance of Ecology, Concept of biosphere, atmosphere, lithosphere and hydrosphere. 2.0 Organizational level of ecological systems, Ecological aspects of abiotic, biotic and edaphic factors, limiting factors 3.0 Ecosystem: Concept, Kinds and components 4.0 Ecological energetic and energy flow: Food chains, food webs, trophic structure; concept of productivity: primary, secondary, gross and net, Energy flow models.	15
II	5.0 Restoration Ecology Ecology of Disturbed Ecosystems: disturbance and its impact on the structure and functioning of terrestrial and aquatic ecosystems. 6.0 Population Characteristics 6.1 Introduction and concepts of population ecology 6.2 Attributes of populations 6.3 Population density, methods of population density measurement 6.4 Growth rate and growth forms 6.5 Natality, mortality, survivorship curves and life tables 6.6 Biotic potential– Generation time, net reproductive rate reproductive values 6.7 Population and distribution. 6.8 Population dispersion	15
III	7.0 Population regulation and Interactions 7.1 Extrinsic and intrinsic mechanisms 7.2 Concept of density dependent and density independent factors in population regulation. 7.3 Concept of intra specific and inter specific population interactions 7.4 Proto-cooperation, mutualism and commensalisms 7.5 Host-parasite interactions, Life history strategies–r and k selection. 8.0 Competition and niche theory 8.1 Intra specific and inter specific interactions 8.2 History of niche concepts 8.3 Gause's theory of niche	15

IV	9.0 Predation	15
	9.1 Theory; predator-prey oscillations	
	9.2 Model of prey–predatory dynamics	
	9.3 Role of predation in nature	
	9.4 Parasitism	
	10.0 Community characteristics	
	10.1 Species diversity; Biodiversity indices: Diversity, dominance, Similarity& dissimilarity Index	
	10.2 Ecological Succession	
	10.3 Ecological dominance	
	10.4 Ecotones and Edge effect	
	11.0 Ecological Impact Assessment	
	Total Contact Hours	60
Suggested Evaluation Methods		
Internal Assessment: 30 > Theory •Class Participation:5 •Seminar/presentation/assignment/quiz/class test etc.:10 •Mid-TermExam:15		End Term Examination: 70 > Theory Written Examination
Learning Resources		
1. ColinvauX,P.A.(1993). Ecology. II Edition. Wiley, John and Sons, Inc. 2. Krebs,C.J.(2001). Ecology. VI Edition. Benjamin Cummings. 3. Odum, E.P.,(2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole 4. Robert Leo Smith Ecology and field biology Harper and Row publisher 5. Ricklefs, R.E.,(2000).Ecology. V Edition. ChironPress 6. Rockwood Larry L.(2015) Introduction to Population Ecology, 2 nd Edition Wiley-Blackwell		

ZOOLOGY:SEMESTER-VIII

Remarks	Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment Marks	End Term Marks	Max. Marks	Exam Duration
Honours in Zoology	DSE-H2 credit (Option 2)	B23-ZOO-805	Environment and Public Health	4	4	30	70	100	3 Hrs.
Level of the course: 400-499									
Pre-requisite for the course (if any) : Zoology as single major in 3 years UG									
Course Learning Outcomes (CLO) 1. Students will be able to explain the linkages between environmental factors (air, water, soil) and public health, and analyze the influence of nutrition, socio-cultural, and developmental aspects on individual health. 2. Students will be able to assess the impacts of climate change and modern agricultural and industrial practices on public health, with emphasis on pollution and disease outcomes. 3. Students will be able to classify various types of diseases (deficiency, infectious, pollution-related, non-communicable) and evaluate the role of hygiene, nutrition, and sanitation in disease prevention. 4. Students will be able to explain key concepts in epidemiology, disease surveillance, and public health interventions, including AYUSH systems, immunization programmes, and occupational health management. 5. Students will be able to critically evaluate environmental management policies and practices in India, particularly in waste management, pollution control, and their role in promoting public health.									
Instructions for Paper-Setter 1. Nine questions will be set in all. All questions will carry equal marks. 2. Question No.1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.									
UNIT	TOPICS							CONTACT HOURS	
I	1.0 Linkages between Environment and Health 1.1 Understanding linkages between Environment and Public Health: Effect of quality of air, water and soil on health. 1.2 Perspective on Individual health: Nutritional, socio-cultural and developmental aspects. 1.3 Dietary diversity for good health, Human developmental indices for public health.							14	
II	2.0 Climate Change and Implications on Public Health 2.1 Global warming: Agricultural practices (chemical agriculture) and Industrial technologies (use of non-biodegradable materials like plastics, aerosols, refrigerants, pesticides). 2.2 Manifestations of climate change on Public Health 2.3 Burning of fossil fuels, automobile emissions and acid rain.							14	
III	3.0 Diseases in Contemporary Society 3.1 Definition and need for good health- factors affecting health. 3.2 Types of diseases: Deficiency diseases, infectious diseases, pollution-related diseases, allergies, respiratory diseases, cardiovascular diseases, and cancer. 3.3 Personal hygiene and food: Balanced diet, food habits and cleanliness, food adulterants, avoiding smoking, drugs and alcohol. 3.4 Communicable diseases: Mode of transmission; epidemic and endemic diseases. 3.5 Management of hygiene in public places: Railway stations, bus stands and other public places. Infectious diseases: Role of sanitation and poverty; case studies on TB, diarrhea, malaria, viral diseases Non-communicable diseases: Role of lifestyle and built environment; diabetes and hypertension.							14	
IV	4.0 Perspectives and Interventions in Public Health 4.1 Epidemiological perspectives: Disease burden and surveillance. 4.2 Alternative systems of medicine: Ayurveda, Yoga, Unani, Siddha and Homeopathy (AYUSH); 4.3 Universal Immunization Programme (UIP). Reproductive health: Youth Unite for Victory on AIDS (YUVA) programme of Government of India. 4.4 Occupational health hazards: physical, chemical and biological. Occupational diseases: prevention and control. 5.0 Environmental Management Policies and Practices 5.1 Municipal solid waste management: Definition, sources, characterization, collection and transportation, and disposal methods. Solid waste management system in urban and rural areas. 5.2 Municipal Solid waste rules.							18	

	5.3 Policies and practices with respect to Environmental Protection Act, Forest Conservation Act, Wildlife Protection Act, Water and Air Act, Industrial, Biomedical and E- waste disposal rules.	
Suggested Evaluation Methods		
Internal Assessment: • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 10 • Mid-Term Exam: 15		End Term Examination: Written Examination: 70
Learning Resources		
1. Indian Academy of Paediatrics. (2011). Guidebook on Immunization. MFC Bulletin, 45-50. 2. Nandini, N., Sunitha, N. and Tandon, S. (2007). Environmental Studies. Sapna Book House, Bangalore. 3. Park, K. (2011). Preventive and Social Medicine. Benarsi Das Publications, (pp. 16- 19, 24-27). 4. McKinney, M. L., Schoch, R. M. and Yonavjak, L. (2015). Environmental Science: systems and solutions. Jones & Barlett Publishers, Canada. 5. Vir, S.C. (2011) Public Health Nutrition in Developing Countries. (Part-2). Woodhead Publishing India 6. Gupta, AD., Sachin, Bhateja, S. and Rajshekhar (2022). Environment and Public Health. Academic Guru Publishing House, India. 7. Biswas, K. and Biswas, P. (2015). Environment and Public Health. Himalayan Publishing House Pvt. Ltd., India.		

ZOOLOGY: SEMESTER-VIII

Remarks	Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
For Honours in Zoology/	PC-H2 4 credit	B23-ZOO-806	Practical Based on B23-ZOO-801 TO 804/805	4	8	30	70	100	6 hrs.

Level of the course: 400-499

Pre-requisite for the course (if any): **Zoology as single major in 3 years UG**

Course Learning Outcomes (CLO)

- Students will be able to understand the processes involved in the recognition of key groups of vertebrates.
- Students will be able to identify and classify the available specimens of vertebrate classes. This course will make students able to understand the regulation of chemical reactions in living cells.
- Students will be able to understand the computational biology and techniques of data handling and processing.

Course Content	TOPICS		CONTACT HOURS
	1. Museum specimens and slides :from Protochordates to mammals 2. Demonstration of cranial nerves and aortic arches of Scoliodon, Degestive system, Nervous system, Arterial and venous system of frog, Lizard, Pigeon and rabbit. 3. Comparative Osteology of Axial and appendicular skeleton 4. Construction of Phylogenetic tree 5. Histochemistry: Methods of fixation of different tissues. 6. Histochemical test: (a) Haemotoxylin-eosin (b) Toluidine Blue (c) Sudan Block-B (d) Mercury bromophenol blue (e) Methyl green-pyronin-Y (f) Periodic acid Schiff's (g) Acid phosphatase (h) Alkaline phosphatase 7. Demonstration of live gametes and their staining procedure. 8. Determination of optimum pH, temperature and concentration for optimum activity of salivary amylase 9. To demonstrate that the optimum activity of trypsin enzyme is pH and temperature dependent. 10. Qualitative test of vitamins and Quantification of vitamin A and C. 11. Total RBC, WBC and Differential WBC count 12. Estimation of Blood plasma 13. Methods of population density measurements		120 Hrs
	DSE- H2 (option 1) 14. Study of various components of pond and grassland ecosystem. 15. Determination of Water quality characteristics viz: Dissolved oxygen, pH, free carbon dioxide, salinity, transparency, alkalinity, chloride and hardness.. 16. Estimation of biodiversity indices. 17. Field Visit to Aquatic, Forest and other ecosystems for identification of biota.	DSE- H2 (option 2) 14. Detection of Adulterants in Common Food Items 15. Survey and Analysis of Waste Management and Sanitation Practices in a Public Place 16. Awareness Survey on Lifestyle Diseases and Personal Habits 17. Observation and Report on Solid Waste Management System in a Locality 18. Case Study Analysis on Occupational Health Hazards	

Suggested Evaluation Methods	
Internal Assessment: 30 ➤ Practicum • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 10 • Mid-Term Exam: 15	End Term Examination: 70 ➤ Practicum - Lab record, - Viva-Voce, - Execution of the practical - Write up
Learning Resources	
1. Sharma R K, Sangha S P S (2009). Basic Techniques in Biochemistry and Molecular Biology, I.K. International Publishing House Pvt. Ltd. New Delhi 2. Podder T, Mukhopadhyay S, Das SK (2003). An Advanced Laboratory Manual of Zoology Published by Rajiv Beri for Macmillan India Limited, Rajkamal Electric Press, Delhi 3. Sadasivam S, Manickam A (1997). Biochemical Methods, Ed. 2nd, New Age International Publishers, New Delhi 4. David T. Plummer (1987). An Introduction to Practical Biochemistry. Ed., 3rd, McGraw-Hill Publisher, Rajkamal Electric Press, Delhi	

ZOOLOGY:SEMESTER-VIII (FOR HONOURS WITH RESEARCH IN ZOOLOGY)									
Remarks	Course Type	Course Code	Name of the Course	Credit	Contact Hours/Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
Honours with Research in Zoology	CC-H4 4credit	B23-ZOO-801	Structure and Function of Vertebrates	4	4	30	70	100	3hrs.
Level of the course: 400-499									
Pre-requisite for the course (if any): Zoology as single major in 3 years UG									
Course Learning Out comes (CLO)									
1. Students will be able to understand various biological functions, the evolution of life from most primitive to most advanced form with respect to their habit and habitat.									
2. Students will have acquaintance with the basic concepts, external morphology and sexual dimorphism in chordates and understand the various systems, adaptation and dentition in chordates.									
3. Students will also Understand the Classification various classes of phylum Chordate i.e., Pisces, Reptiles, Aves and Mammals.									
4. This core course will make students familiarize with the vertebrate diversity around them									
Instructions for Paper-Setter									
1. Nine questions will be set in all. All questions will carry equal marks.									
2. Question No.1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.									
UNIT	TOPICS							CONTACT HOURS	
I	1.0 Introduction to Chordates with their general characters. 1.1 Origin of Chordates 1.2 Concept of Proto chordate or pre-vertebrates 1.3 Classification of Vertebrates up to orders 2.0 Integument and its derivatives 2.1 Development, general structure and functions of skin and its derivative 2.2 Glands, scales, horns, claws, nails, hoofs, feathers and hair							15	
II	3.0 Skeletal system 3.1 Form, function, body size and skeletal elements of the body 3.2 Comparative account of jaw suspensorium, Vertebral column 3.3 Limbs and girdles 4.0 Digestive system 4.1 Dentition, Stomach, Digestive Glands 4.2 Anatomy of gut in relation to feeding habits- herbivores, carnivores and omnivores. 5.0 Respiratory system 5.1 Characters of respiratory tissue, Internal and External Respiration 5.2 Comparative account of respiratory organs							15	
III	6.0 General plan of circulation in various groups 6.1 Components of Blood 6.2 General plan of circulation in reptiles, birds and mammals 6.3 Evolution of heart , aortic arches and Portal systems 7.0 Evolution of Urino-genital system in vertebrate series 7.1 Structure and functions of different types of kidney 7.2 Urino-genital ducts 7.3 Flight adaptation in birds, Migration in fish and Birds							15	
IV	8.0 Nervous system 8.1 Comparative anatomy of the brain in relation to its functions 8.2 Comparative anatomy of spinal cord 8.3 Nerves-Cranial, Peripheral and Autonomous nervous systems 9.0 Sense organs							15	

	9.1 Simple receptors 9.2 Organs of Olfaction and taste 9.3 Lateral line system 9.4 Electroreception	
Total Contact Hours		60
Suggested Evaluation Methods		
Internal Assessment:30		End Term Examination: 70
➤ Theory	30	➤ Theory: 70
• Class Participation:	5	Written Examination
• Seminar/presentation/assignment/quiz/class test etc.:	10	
• Mid-Term Exam:	15	
Part C-Learning Resources		
Recommended Books/e-resources/LMS:		
1. Barrington,E.J.W.The Biology of Hemi-chordata and Protochordata. Oliver and Boyd, Edinburgh.		
2. Bourne,G.H.The structure and functions of nervous tissue. Academic Press, New York.		
3. Carter,G.S. Structure and habit in vertebrate evolution-Sedgwick and Jackson, London.		
4. Kingsley,J.S. Outlines of Comparative anatomy of Vertebrates. CentralBook Depot, Allahabad.		
5. Kent, C.G.Comparative anatomy of vertebrates.		
6. Milton Hilderbrand. Analysis of vertebrate structure. IV.Ed.JohnWiley and Sons Inc., New York.		
7. Sedgwick,A. A Students Text Book of Zoology, Vol. II.		
8. Torrey,T.W. Morphogenesis of vertebrates. John Wiley and Sons Inc., New York and London.		
9. Walters, H.E. and Sayles,L.D. Biology of vertebrates. MacMillan & Co., New York.		

ZOOLOGY:SEMESTER-VIII (FOR HONOURS WITH RESEARCH IN ZOOLOGY)									
Remarks	Course Type	Course Code	Name of the Course	Credit	Contact Hours/Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
Honours with Research in Zoology	CC-H5 4credit	B23-ZOO-802	Comparative Physiology	4	4	30	70	100	3hrs.
Level of the course: 400-499									
Pre-requisite for the course(if any): Zoology as single major in 3 years UG									
Course Learning Outcomes (CLO)									
1. An appropriate understanding of functioning of each system of different groups of animals with their comparison will be acquainted. 2. The students will be able to explore all reasoning and queries that how animals work 3. The students will be able to learn that how the physiology of different groups of organisms is influenced by the different environments of their niches 4. Since this course also has some important practical component where interesting 5. exercises will be conducted to perform experiment and answer various queries of animal physiology									
Instructions for Paper-Setter									
1. Nine questions will be set in all. All questions will carry equal marks. 2. Question No.1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.									
UNIT	TOPICS							CONTACT HOURS	
I	1.0 Digestion 1.1 Feeding mechanisms and regulation, 1.2 Comparative physiology of digestion and absorption in different animal groups 3.0 Respiration 3.1 Respiratory organs, Types of respiration, mechanism of breathing 3.2 Transport of respiratory gases 3.3 Respiratory pigments through different phylogenetic groups. 3.4 Physiological response to oxygen deficient stress. 4.0 Excretion 4.1 Patterns of nitrogen excretion among different animal groups 4.2 Functional anatomy of renal unit; mechanisms of ultra filtration, Counter Current mechanism, Dialysis 4.3 Osmoregulation in different animal groups 4.4 Definition and basic classification of organisms on the basis of osmoregulation 4.5 Osmotic challenges of different environments 4.6 Mechanism of Osmoregulation in freshwater, Estuarine and Marine animals 4.7 Osmoregulation in migratory organisms, Control and regulation of osmoregulation							15	
II	5.0 Thermoregulation 5.1 Homeothermic animals, Poikilotherms, Hibernation and Aestivation, 5.2 Physical, chemical, neural regulation, 5.3 Physiological adaptations acclimatization & acclimation in response to high, low ambient temperature 6.0 Circulation of body fluids and their regulation among different animal groups 6.1 Systems of circulation, heart beat and blood pressure, 6.2 Cardiac cycle, Cardiac output and its regulation, 6.3 Lymphatic system 7.0 Receptor physiology—a comparative study of Mechano reception, Photoreception, Chemo reception and Equilibrium reception							15	

	8.0 Muscle and Contractile physiology 8.1 Contractile elements, cells and tissues among different phylogenic groups; Muscle structure and function-correlation; 8.2 Electric organs and tissues	
III	9.0 Comparative testicular physiology in animals 9.1 Morphology, Differentiation, Function and its regulation 10.0 Comparative ovarian physiology and differentiation in vertebrates 10.1 Morphology, Endocrinolgy, Oogenesis, vitellogenesis 11.0 Neuronalphysiology 11.1 Structure and classification of neurons and glial cells. 11.2 Synaptic action, dendritic properties and functional operation of spinal cord, Brain stem 11.3 Autonomic nervous system.	15
IV	12.0 Principles of synaptic transmission 12.1 Ca2+and neurotransmitter release; post synaptic transmission mechanism; 12.2 Diversity of neurotransmitters:acetylcholine,catecholamine,serotonin, GABA, glycine, histamine, peptides, NO, and opioids. 12.3 Physiological adaptations to different environments 12.4 Physiological adaptations acclimatization & acclimation in response to high, low ambient temperature, 12.5 Physiological adaptation at high altitude and in deep sea environment. 13 .0 Stress Physiology: Concept of Stress and Strain, Stress hormones and stress regulatory mechanisms.	15
Total Contact Hours		60
Suggested Evaluation Methods		
Internal Assessment: 30		End Term Examination: 70
➤ Theory	30	➤ Theory: 70
• Class Participation:	5	Written Examination
• Seminar/presentation/assignment/quiz/class test etc.:	10	
• Mid-Term Exam:	15	
Part C-Learning Resources		
Recommended Books/e-resources/LMS:		
1. C.L.Prosser. Comparative Animal Physiology. W.B. Saunders & Company.		
2. R.Eckert. Animal Physiology: Mechanisms and Adaptation. W.H .Freeman &Company.		
3. W.S. Hoar. General and Comparative Animal Physiology		
4. Schiemdt-Nielsen. Animal Physiology: Adaptation and Environment. Cambridge.		
5. C.L.Prosser. Environment and Metabolic Physiology. Wiley-Liss, NewYork.		
6. David Randall, Warren Burggren, Kathleen French: Eckert Animal Physiology		
7. Guyton, A.X., Text Book of Medical Physiology,7 th edition, Saunders Company(1986).		

ZOOLOGY: SEMESTER-VIII (FOR HONOURS WITH RESEARCH IN ZOOLOGY)									
Remarks	Course Type	Course Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks (Report)	End Term Marks (Viva)	Max. Marks	Exam Duration
Honours with Research in Zoology	Project/ Dissertation (12 credit)	B23-ZOO-807	Project/ Dissertation	8+4	-	200 (Report as Dissertation)	100 (Viva-Voce)	300	-
Level of the course: 400-499									
Pre-requisite for the course (if any): Zoology as single major in 3 years UG									
Course Learning Outcomes (CLO) :Students will be able to 1. Formulate a focused research question and design a robust, methodologically sound investigation to address it. 2. Employ appropriate experimental, analytical, or field techniques to collect, analyze, and interpret botanical data effectively. 3. Critically evaluate research findings in light of existing theories, and communicate results clearly through well-structured scientific writing and presentations. 4. Exhibit independence, time management, and scientific integrity throughout the research process, while responding thoughtfully to feedback and defending									
Description								CONTACT HOURS	
I	Each student is required to undertake a research project in a relevant area of Zoology. The outcome of this research will be compiled into a dissertation and submitted for evaluation at the end of the semester. Students will also present their dissertation before an external examiner. Both internal and external assessments of the project and training will be conducted as per the prescribed evaluation criteria. Assessment Structure Internal Assessment: • Submission of Project Synopsis • One Mid-Semester Progress Report and/or Presentation External Assessment: • Final Project Report (Dissertation) • Viva-Voce Presentation before an External Examiner Dissertation Report Submission Guidelines 1. Structure of the Dissertation Report: The dissertation should include the following components in order: ○ Cover page ○ Certificate signed by the student and supervisor ○ Table of contents ○ Introduction ○ Objectives ○ Literature review ○ Methodology ○ Results and Discussion ○ Conclusion ○ References 2. Formatting Requirements: ○ Paper size: A4 ○ Font: Times New Roman, size 12 ○ Line spacing: 1.5 (one and a half spacing) ○ Printing: Double-sided (print on both sides of the paper) ○ Length: The written portion should be between 40 to 60 pages 3. Submission Requirements: ○ Students must submit three hard-bound copies of the dissertation along with a CD containing a soft copy, to the department by the specified deadline. 4. Evaluation and Presentation:								

	○ The student will be required to defend the dissertation/project work through a formal presentation before an external examiner at the end of the semester. ○ Marks will be awarded based on both the written report and the oral presentation.	
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