KONGUNADU ARTS AND SCIENCE COLLEGE
(AUTONOMOUS)
COIMBATORE-641 029

DEPARTMENT OF ZOOLOGY
(PG)

CURRICULUM AND SCHEME OF EXAMINATIONS
(CBCS)
(2023- 2024)

PG PROGRAMME OUTCOMES (PO)

PO1	The programme creates the scientific attitudes among young minds which inturn prove to be beneficial for the society.
PO2	Students will be enriched with the knowledge on different group of animals, evolution, genetics and behaviour of animals.
PO3	Students will be familiarise with the concept in cell biology, physiology, Entomology and role of humans and animals in the ecosystem.
PO4	They will be able to qualitatively and quantitatively analyse the biological parameters using various statistical and bioinformatics and computational tools.
PO5	Students will be given ample opportunities to explore different career avenues.
PO6	Theoretical and practical knowledge gained through this programme will be helpful in designing Entrepreneurial opportunities for social welfare.
PO7	The program has been designed to avail in – depth knowledge on allied subjects also which will make students to equip them with employment skills.
PO8	Students will find opportunities in government departments, environmental agencies, universities, colleges, environmental/ecological fields.

PROGRAMME SPECIFIC OUTCOMES (PSO)

PSO1	Students will be able to clearly explain about the basic and advanced concepts in Zoology and relevant subjects and identify, classify and differentiate the different phyla of the invertebrata and chordata.
PSO2	The learned concepts and techniques in various subjects will provide an extra edge to our students who wish to undertake higher studies
PSO3	Understand the complexity of life processes, their molecular, cellular and physiological processes, their genetics, evolution and behaviour and their interrelationships with the environment
PSO4	The procedural knowledge about identifying and classifying animals will provide them for the professional advantages in teaching, research and taxonomist job in various government organizations including Zoological survey of India and National parks / Sanctuaries.
PSO5	Students will be able to access the primary literature, identify relevant works for a particular topic, and evaluate the scientific content of the works.

KONGUNADU ARTS AND SCIENCE COLLEGE (AUTONOMOUS)
COIMBATORE – 641 029

Course Name: M.Sc., Zoology

Curriculum and scheme of Examination under CBCS
(Applicable to the students admitted during the Academic Year 2023-2024)

Semester	Subject Code	Title of the Paper	Instruction hours/cycle	Exam. Marks			Duration of Exam (hours)	Credits
				CIA	ESE	TOTAL		
I	23PZO101	Core Paper 1. Comparative anatomy of Invertebrata and Chordata	5	25	75	100	3	**5**
	23PZO102	Core Paper 2. Animal physiology	5	25	75	100	3	**5**
	23PZO103	Core Paper 3. Cell and Molecular biology	5	25	75	100	3	**5**
		Core Practical 1	5	-	-	-	-	-
		Core Practical 2	5	-	-	-	-	-
	23PZO1E1	**Major Elective 1**	**5**	**25**	**75**	**100**	**3**	**5**
	Total		**30**	**-**	**-**		**-**	**20**
II	23PZO204	Core Paper 4. Microbiology and Immunology	5	25	75	100	3	4
	23PZO205	Core Paper 5. Molecular genetics	5	25	75	100	3	4
	23PZO206	Core Paper 6. Biostatistics and Research Methodology	5	25	75	100	3	4
	23PZO2CL	Core Practical 1	5	40	60	100	4	3
	23PZO2CM	Core Practical 2	5	40	60	100	4	3
	23PZO2E2	**Major Elective 2**	**5**	**25**	**75**	**100**	**3**	**5**
	Total		**30**	**-**	**-**		**-**	**23**

III	23PZO307	Core Paper 7. Entomology	5	25	75	100	3	5
	23PZO308	Core Paper 8. Evolution	5	25	75	100	3	5
	23PZO309	Core Paper 9. Developmental Biology	4	25	75	100	3	5
		Core Practical 3	5	-	-	-	-	-
		Core Practical 4	5	-	-	-	-	-
	23PZO3N1	**Non Major Elective1**	**4**	**25**	**75**	**100**	**3**	**4**
	-	**EDC Paper**	**2**	**100**		**100**	**3**	**2**
	Total		**30**	**-**	**-**		**-**	**21**
IV	23PZO410	Core Paper 10. Environmental Biology and Toxicology	6	25	75	100	3	5
	23PZO411	Core Paper 11. Aquaculture	5	25	75	100	3	5
	23PZO412	Core Paper 12. Endocrinology	5	25	75	100	3	4
	23PZO4CN	Core Practical 3	5	40	60	100	4	4
	23PZO4CO	Core Practical 4	5	40	60	100	4	4
	23PG14N2	**Non Major Elective2**	**4**	**25**	**75**	**100**	**3**	**4**
	23PZO4Z1	**Project and Viva voce**	**-**	**20**	**80**	**100**	**-**	**2**
	Total		**30**	**-**	**-**		**-**	**26**
Grand Total				**-**	**-**	**2200**	**-**	**90**

Note :

CBCS - Choice Based Credit system

CIA - Continuous Internal Assessment

ESE - End of Semester Examinations

Major Elective Papers
(2 papers are to be chosen from the following 4 papers)

1. Biophysics and Bioinformatics
2. Wildlife Ecology and Management
3. Animal Parasitology
4. Poultry Science and Management

Non Major Elective Papers
(2 papers are to be chosen from the following 4 papers)

1. Information Security#
2. Clinical Laboratory Techniques
3. Nanobiotechnology
4. Human genetics and Counseling

to be offered by the respective

Sub. Code & Title of the Extra Departmental Course (EDC) :

23PZO3X1 – EDC Paper – Entrepreneurial Opportunity in Sericulture

Note: In core subjects, no. of papers both theory and practical are included where ever applicable. However, the total credits and marks for core subjects remain the same as stated below.

Tally Table:

Subject	No. of Subjects	Total Marks	Credits
Core – Theory / Practical / Project	17	1700	70
Major Elective Papers	2	200	10
EDC Paper	1	100	2
Non Major Elective Papers	2	200	8
Grand Total	**22**	**2200**	**90**

- 25% CIA is applicable to all subjects except JOC and COP which are considered as extra credit courses.
- The student should complete any **MOOC On Learning platforms like SWAYAM, NPTEL, Course era,** IIT Bombay Spoken Tutorial etc., before the completion of the 5th semester and the course completed certificate should be submitted through the HOD to the controller of Examinations. Extra credits will be given to the candidates who have successfully completed.
- **Onsite Training** preferably relevant to the course may be undertaken as per the discretion of the faculty or HOD

Components of Continuous Internal Assessment

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Components		Marks	Total
Theory			
CIA I	75	(75+75 = 150/100) 15	25
CIA II	75		
Assignment / Seminar		5	
Attendance		5	
Practical			
CIA Practical		25	40
Observation Notebook		10	
Attendance		5	
Project			
Review		15	20
Regularity		05	

BLOOM'S TAXONOMY BASED ASSESSMENT PATTERN

(**K1**-Remembering; **K2**-Understanding; **K3**-Applying; **K4**-Analyzing; **K5**-Evaluating)

1. Theory Examination:
CIA I & II and ESE: 75 Marks

Knowledge Level	Section	Marks	Description	Total
K1 – K2 Q1 to 10	A (Answer all)	10 x 1 = 10	MCQ	75
K2 – K4 Q11 to 15	B (Either or Pattern)	5 x 5= 25	Short Answers	
K2 – K4 Q16 to 20	C (Either of Pattern)	5 x 8 = 40	Descriptive / Detailed	

2. Practical Examination

Knowledge Level	Section	Marks	Total
K3	Experiments	50	60
K4	Record Work	10	
K5			

Practical Examination Mark Breakup

Knowledge Level	Section
K3 to K5	**Major Experiments: 25**
	Protocol – 5
	Perform -10
	Result – 10
	Minor Experiments: 15
	Protocol – 5
	Perform – 5
	Result – 5
	Spotters – 10
	Record work - 10

3. ESE Project Viva Voce

Knowledge Level	Section	Marks	Total
K3 to K5	Project Report	60	80
	Viva voce	20	

Project *Viva-Voce* mark Breakup

Knowledge Level	Section	Marks	Total
K3 to K5	Review of Literature	10	80
	Methodology	10	
	Results	20	
	Discussion	10	
	Summary and Conclusion	10	
	Viva voce	20	

Sub. Code: 23PZO101

Programme code : 06	**M.Sc., Zoology**		
Core Paper 1. Comparative Anatomy of Invertebrata and Chordata			
Batch 2023-2024	Hours/ Week 5	Total Hours 75	Credits 5

Course Objectives

1. To make the students learn the functional morphology of invertebrates and chordates.
2. To impart the significance of Invertebrate and Chordate organization and their evolving adaptations in organ systems.
3. To understand the functional aspects of different systems ofinvertebrates and vertebrates in a comparative basis.

Course Outcomes (CO)

K1 to K5	**CO1**	Remember the organization, significance and evolving adaptations of coelom in Invertebrates.
	CO2	Understand the processes and mechanisms of digestive system, respiratory and excretory systems of invertebrates.
	CO3	Apply the concept of circulatory, nervous and reproductive systems in Invertebrates.
	CO4	Analyze the physiological functions of integument, digestive, respiratory and skeletal system of vertebrates.
	CO5	Evaluate the comparative anatomy of circulatory, nervous and urinogenital system of vertebrates.

Unit I **(15 Hours)**

Symmetry and its significance in animal organization; Organization of coelom- Acoelomates - Pseudocoelomates - Coelomate groups (schizocoel, enterocoel, and mesenchyme). Evolution of Metamerism - Body wall in Invertebrates. Amoeboid, flagellar and ciliary movement in Protozoa - Hydrostatic movement in Coelenterata and Echinodermata, Locomotion in Arthropods and Molluscs.

Unit II **(15 Hours)**

Patterns of feeding and digestion in Protozoans, Sponges, Coelenterates and Platyhelminthes, - Filter feeding in Polychaeta and Mollusca. Gills, book lungs, and trachea – Mechanism of respiration. Organs of excretion: Coelomoducts,Nephridia and Malphigian tubules - Mechanism of excretion.

Unit III **(15 Hours)**

Primitive nervous system in Coelenterata and Echinodermata - Advanced nervous system in Annelida, Arthropoda (Crustacea and Insecta) and Mollusca (Cephalopoda) - Reproduction in Invertebrates. Biological significance of hemichordate.

Unit IV **(15 Hours)**

Dermal and epidermal derivatives of vertebrates - Digestive system in Vertebrates, alimentary canal and associated glands. Pulmonary respiration in a mammal, Accessory respiratory organs in fishes and birds. Skeletal system in fish, Amphibia, reptiles, birds and Mammals.

Unit V **(15 Hours)**

Evolution of heart, aortic arches and venous system, Circulatory system of vertebrates, Comparative anatomy of brain in vertebrates. Excretory organs and Excretory products in vertebrates. Evolution of urinogenital system in vertebrates. Anatomy of male and female reproductive systems in Vertebrates. Oviparity, ovo- viviparity and viviparity in vertebrates.

*** denotes Self study**

Teaching Methods

Smart ClassRoom /Powerpoint presentation/ Seminar/ Quiz/ Discussion /Flipped Class

Text Books:

1. Kotpal, R.L.A, (2009), Modern text book of Zoology Vertebrates, Rastogi publications, Meerut.
2. Barrington, E.J.W. (1979), Invertebrate Structure and Function, II Edn. The English Language Book Society and Nelson.
3. Jordan & Verma (2006), Invertebrate Zoology. Chand & Co, New Delhi.

Reference books:

1. Linzey, D. (2001), Vertebrate Biology, McGraw-Hill, Singapore.
2. Colbert H. E. (2000), Evolution of the Vertebrates, New Age International, New Delhi.
3. Sinha, Adhikari, Ganguly, Bharati Goswami. (2004), Biology of animals Vol.II., New central book agency (P) Ltd.
4. Waterman A.J., (1971), Chordate Structure and Function, The Macmillan Publishing Co.
5. Romer, A.S., (1979) Hyman's Comparative Vertebrate Anatomy,3rd Ed., The University of Chicago Press, London.
6. Ruppert E.E., Fox, R.S. and Barnes, R.D. (2004), Invertebrate Zoology. 7th Ed., Cenage Learning, Singapore.

Sub. Code: 23PZO101

MAPPING

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 4
CO1	H	S	S	M	H
CO2	S	H	M	S	M
CO3	S	H	M	H	S
CO4	H	S	H	H	H
CO5	S	M	H	S	M

S-Strong H- High M-Medium L-Low

Sub. Code: 23PZO102

Programme Code : 06	M.Sc., Zoology		
Core Paper 2. Animal Physiology			
Batch 2023-2024	Hours / Week 5	Total Hours 75	Credits 5

Course Objectives

1. To get knowledge about the structure and functions of various systems
2. To understand the physiology of digestion, respiration, circulation and muscle fibres.
3. To study the structure and functions of endocrine glands.

Course Outcomes (CO)

K1 to K5	**CO1**	Know the importance of nutrients and digestion.
	CO2	Understand the physiology of respiration and circulation.
	CO3	Impart knowledge on the role of renal organs in excretion.
	CO4	Describe the muscle structure and function.
	CO5	Evaluate the structure of reproductive and endocrine glands.

SYLLABUS

Unit I: Digestion and Nutrition **(15 Hours)**

Nutritional Aspects: Role of Protein, carbohydrate, lipid, mineral and dietary fibers in nutrition, Calorific value of foods, BMR - factors influencing and physiological variations, Role of enzymes in digestion.

Unit II: Respiration **(15 Hours)**

Comparison of respiration in different animals. Process of gaseous exchange, Transport of oxygen and CO_2, Factors affecting O_2 and CO_2 transport, Respiratory quotient (RQ) and factors affecting respiratory quotient. Effects of Hypoxia, Oxygen therapy, Control of respiration, Regulation of respiration during exercise, Physiological adaptations at high altitude and deep sea*

Sub. Code: 23PZO102

Unit III: Circulation (15Hours)

Blood - Components, role and functions, types of blood pigments, structure and function, Plasma proteins- types, characteristics and its clinical importance. Comparative anatomy of vertebrate - heart, types of heart, cardiac cycle and its control mechanisms. Haematological abnormalities (anaemia, leucopenia, leucocytosis, Thromboctopenia) Blood pressure, cardiac cycle and ECG.

Unit IV: Muscle Physiology and Excretion (15Hours)

Ultra structure of muscle fiber, muscle proteins, Mechanism of muscle contractions, Comparison of vertebrate kidney, patterns of Nitrogen elimination, Mechanism of urine formation, Osmoregulation in fishes, Acid base balance, Regulation of excretion.

Unit V: Endocrine Glands and Reproduction (15Hours)

Pituitary, Thyroid, Parathyroid, Adrenal and Pancreatic glands, Gastrointestinal hormones, Reproductive hormones, *Neuroendocrinal regulation and feedback mechanism, Neurorobotics

*** denotes Self study**

Teaching Methods

Smart ClassRoom /Powerpoint presentation/ Seminar/ Quiz/ Discussion /Flipped Class

Text Books:

1. Goel, K.A, and K.V. Sastry (2012), Animal Physiology, Rastogi publications, Meerut.
2. Guyton C and John E. Hall (2006)., Text books of medical physiology- W.B. Saunders Company,
3. Rastogi, S.C. (2003). Essentials of Animal physiology- New Age International (P) Ltd., Publishers.

Reference Books:

1. Sunetra Roday (2012), Food science and Nutrition, IInd Ed. Oxford University Press, New Delhi.
2. William S. Hoar (1984) General and Comparative Physiology, Prentice Hall of India. New Delhi.
3. Singh H.R and Kumar, N (2007), Animal physiology and Biochemistry – Vishal publications, Jalandhar. ndramouli R. (2010), Physiology, Jaypee Brothers Publications.
4. Saradha subramaniam K and P. Madhavankutty, S. (2007). Text books of human physiology- Chand Company Ltd., New Delhi.
5. Christopher D. Moyes, Patricia M. Schulte (2005). Principles of Animal Physiology, 3rd edition. ISBN 13: 9780321838179.

6. Chard. R, W. Hill, Gordon A. Wyse and Margaret Anderson, 4th edition (2017). Animal Physiology. ISBN: 9781605357379.
7. Y. Fregnac: Herbbian synaptic platicity. In: The hand book of Brain Theory and Neural Networks, 2nd edn., ed. By M.A. Arbib (Bradford Books / MIT press, Cambridge 2003).

Web Link

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	M	H	H	H
CO2	H	H	M	H	H
CO3	M	M	H	S	S
CO4	M	S	H	H	H
CO5	M	S	H	H	H

S – Strong H – High M – Medium L – Low

23PZO103

Programme Code : 06	**M.Sc., Zoology**		
Core paper 3. Cell and Molecular Biology			
Batch 2023-2024	Hour/Week 5	Total Hours 75	Credits 5

Course Objectives

1. To study the cell membrane, cytoskeleton structure, nucleus and their functions.
2. To impart knowledge on protein synthesis.
3. To include knowledge on the cell cycle, apoptosis, programmed cell death and cancer biology.

Course Outcomes (CO)

K1 to K5	**CO1**	Get the knowledge about cell organelles and their functions
	CO2	Understand the various functions adapted inside the cells.
	CO3	Apply knowledge on molecular mechanisms of protein synthesis
	CO4	Describe the cell cycle, cell signaling pathways of cell death
	CO5	Evaluate the knowledge on the cancer biology and molecular mechanism of cancer treatment

SYLLABUS

Unit I Cell membrane and Organelles (15Hours)

Plasmamembrane: Ultra structure, chemical composition and molecular arrangement, Models of membranes (fluid mosaic). Membrane Transport: Difffusion and active transport, carrier proteins, channel proteins, Bulk transport, Receptor mediated endocytosis; types of cell junction – tight junctions, desmosomes, and gap junctions. Cell communication and endoplasmic reticulum, microfilaments and microtubules and mitochondria.

Unit II Nuclear and Chromosomal organisation (15 Hours)

Nucleus: Size, shape, structure and functions of interphase nucleus. Ultrastructure of nuclear membrane. Structure, types (A-DNA, B-DNA and Z-DNA) and composition of DNA. Unique and repetitive DNA, C- value paradox, satellite DNA and its role, transposons.

Chromosomes: Structure, types, chromosomal banding, Nucleosomes organization, structure and functions, Giant chromosomes – Polytene and Lampbrush.

Unit III Protein Synthesis and cell signalling (15 Hours)

Protein synthesis: RNA types and their structure and functions, RNA processing, capping, polyadenylation, splicing, transcription and translation in prokaryotes and eukaryotes, post translational modifications, lac operon concept, Cell signaling: hormones and their receptors,mechanism of spike protein and mammalian cell receptor interactions.

Unit IV Cell cycle and Organisation (15 Hours)

Cell cycle: Phases of cell cycle (G0, G1, S, G2 and M phases), Regulation of cell cycle: discovery of MPF, cyclins and cyclin dependent kinase, Chick points. Apoptosis: Characteristic features of cells undergoing apoptosis and necrosis, Mechanism of programmed cell death (PCD), direct activation by death signals, Pathways of apoptosis - extrinsic and intrinsic pathways and its significance.

Unit V Cancer Diagnosis and Treatment (15 Hours)

Cancer: Types and development of cancer, cancer stem cells, causes and properties of cancer cells. Metastasis, retroviral oncogenes, molecular mechanism of proto-oncogene activation, tumor suppressor genes – structure, functions and mechanism of pRB and p53.* Early detection of cancer, molecular diagnosis, treatment (radiotherapy, chemotherapy, immune therapy and stem cell therapy), Gene expression and regulation in cancer cells.

*** denotes Self study**

Teaching Methods

Smart Class Room /Powerpoint presentation/ Seminar/ Quiz/ Discussion /Flipped Class

Text books

1. Gupta, P. K (2019). Cell and Molecular Biology; Rastogi Publication, UP, India
2. Rastogi, S. C. (2010). Cell & Molecular Biology (3rdEdn.,) New Age International (P) Ltd, Publishers New Delhi.
3. De Robertis, E. D. P and E.M.F.De Robertis, (2010). Cell and Molecular Biology, 8thEdn., CBS Publishers & Distributors Pvt. Ltd.,

References:

1. Alberts, B., D. Bray., K. Hopkin, A. D. Johnson., J. Lewis, M. Raff, K. Roberts and P. Walter (2015). Essential Cell Biology. 4th edition. Garland Science, U.S.A
2. Lodish, H., A, Berk., S. L, Zipuoskry., P. Matsusdaira., D. Baltimore and J. Darnell (2010). Molecular Biology of the Cell (4th Edition). W.H Freeman & Co., New York.
3. Karp, Gerald (2013) Cell and Molecular Biology (7th Edition), Wiley Inc
4. Geoffrey M Cooper, Robert E Heusman (2016). The Cell; A Molecular Approach, (7thEdn), Sinculler Associates Inc.,

5. Alberts B, A Johnson, J Lewis, D Morgan, M Raff, K Roberts & P Walter (2014) Molecular Biology of The Cell (6thEdn), Garland Science, Taylor & Francis Group, LLC, an informa business, 711 Third Avenue, New York, NY 10017, USA
6. Verma P.S. and V. K. Agarwal (2016). Cell Biology (Cytology, Biomolecules and Molecular Biology), S. Chand Publishing.

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	M	H	H	H
CO2	H	H	M	H	H
CO3	M	M	H	S	S
CO4	M	S	H	H	H
CO5	M	S	H	H	H

S – Strong H – High M – Medium L – Low

Sub. Code: 23PZO204

Programme Code : 06	M.Sc., Zoology		
Core Paper 4. Microbiology and Immunology			
Batch 2023-2024	Hour/Week 5	Total hours 75	Credit 4

Course objectives

1. To aware the knowledge of microorganisms in water, soil, sewage and human body and sterilization techniques
1. To observe the importance of microorganisms in agriculture, food processing and medicine
2. To inculcate the basic knowledge of immunology and disorders in human being

Course outcomes (CO)

K1 to K5	**COI**	Outline the classification, importance and application of microorganisms
	CO2	Observe the role of microorganisms on food processing, environment, microflora on human health and disinfectation methods
	CO3	Illustrate the students pathology and microbial response.
	CO4	Analyse the techniques for the infectious disease diagnosis
	CO5	Make awareness of immunity and immune response.

SYLLABUS

Unit I: History and Scope of Microbiology (15 Hours)

Classification of microbes, Economic importance of bacteria, DNA and RNA viruses, Colony morphology and growth, Growth curve and Growth kinetics, Recombination in bacteria, Genetic applications of bacteria and viruses.

Unit II: Food and Environmental microbiology (15 Hours)

Microbes of milk, Pasteurization, food poisoning and food preservation methods. Micro-organisms in extreme environments - thermophilic, methanogenic and holophilic. Cyanobacteria. Role of microbes in environment protection and management. Normal microflora of human body. Basic concepts, Disinfection-physical and chemical agents.

Sub. Code: 23PZO204

Unit III: Pathology and microbial prevention (15 Hours)

Epidemiology, Pathogenecity, Infection, Virulence – Causative agents, Modes of transmission and preventive measures – Pneumonia, TB, Typhoid, Syphilis, AIDS, Viral Hepatitis A and B. Antimicrobial agents (Antibiotics).

Unit IV: Immunity (15 Hours)

Immunity – innate and acquired immunity- Immunoreactive cells - macrophages, granulocytes, NK cells, T and B lymphocytes. Lymphoid organs – Primary, Secondary and lymphoid tissues. Antigens and its types - immunogen, haptens, super antigen, tolerates, epitope, paratope. Antigenecity and immunogenicity. Immunoglobulin - structure, types and functions. Monoclonal and polyclonal antibodies. Complement cascade system - biological functions.

Unit V: Immune Response (15 Hours)

Humoral and cell mediated immune response, Antigen recognition and antigen antibody interaction. Antigen processing and presentation to T-lymphocytes. Major histocompatibility complex (MHC) – types and its functions. Role of cytokines, lymphokines and chemokines. Hypersensitivity – types and mechanisms, Autoimmunity, Tumor and Transplantation immunology, Artificial Intelligence in drug discovery.

*** denotes Self study**

Teaching Methods

Smart ClassRoom /Powerpoint presentation/ Seminar/ Quiz/ Discussion /Flipped Class

Text books

1. Pawar.C.B. Daginawala (2001). General Microbiology - Vol I & II, H.F. Himalaya publishing House, Mumbai- 400 004.
2. Jenni Punt, Sharon Stranford, Patricia A. Jones, Judy Owen (2013).Immunology, W.H.Freeman& Co Ltd
3. Subhash Chandra Parija (2012) Textbook of Microbiology & Immunology, Elsevier, India.

Reference Books

1. PelizarL.Jr. M. J.Chan, E.C.S (2007). Microbiology. Tata McGraw Hill company
2. Ananthanarayanan R. and C. K.JayaramPaniker (2000).Textbook of Microbiology- sixth Edition. Orient Longman Private Ltd.., Chennai.
3. Delves P.J, S.J. Martin, D.R. Bruton & I.M. RoiH, (2017) Roitt's EssentialImmunology, 13th edition, niley – Blackwell.
4. Punt J ,Stranfords, Jones. P. ,Owen .J.A Kuby Immunology 8thedn 2018 . Macmillan Learning.

5. Joanne Willey , Linda Sherwood Adjunt, Christopher J. Woolverton (2016). Prescotts Microbiology 10th edition,
6. Thomas J. Kindt, Barbara A. Osborne, Richard Goldsby (2006) Kuby Immunology 6th edition.

Web Reference

1. https://pubmed.ncbi.nlm.nih.gov/33779453/

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	M	H	H	H
CO2	H	H	M	H	H
CO3	M	M	H	S	S
CO4	M	S	H	H	H
CO5	M	S	H	H	H

S-Strong H- High M-Medium L-Low

Sub. Code: 23PZO205

Programme Code : 06	M.Sc., Zoology		
Core Paper 5. Molecular Genetics			
Batch 2023 -2024	Hours / Week 5	Total Hours 75	Credits 4

Course Objectives

2. To get knowledge about the components of genetic material.
3. To know about genome and their role in inheritance
4. To understand the relation between genes and diseases.

Course Outcomes (CO)

K1 to K5	**CO1**	Get knowledge about the structure, organization and functions of genetic materials.
	CO2	Understand the expression, regulation and mutation of gene.
	CO3	Apply the knowledge on the role of genes in heritability and its measurements
	CO4	Analyze the importance of viral oncogenes, regulation of gene expression and signal transduction by oncoproteins.
	CO5	Evaluate the knowledge on inheritance, gene mapping and genetic disorders.

SYLLABUS

Unit I **(15 Hours)**

Chromatin structure and nucleosome concept, organization & functions of genetic material, Repetitive DNA, Overlapping genes, Mitochondrial DNA, Types and structure of RNA, Transposons, Genetic structure and analysis of eukaryotic genomes.

Unit II **(15 Hours)**

Gene regulation in prokaryotes and eukaryotes, Mechanism of positive and negative control of gene expression. Translational and transcriptional control of regulatory mechanism of expression, Environmental effects on gene regulation, Regulation of gene expression by oncoproteins.

Sub. Code: 23PZO205

Unit III **(15 Hours)**

Mutation and mutagenesis; Mutation – Types (lethal, conditional and biochemical) causes and detection – loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis- molecular basis of mutation – Transition and Transversion – spontaneous and induced mutations.

Unit IV **(15 Hours)**

Linkage and crossing over, Linkage maps, tetrad analysis, Mapping with molecular markers, Mapping by using somatic cell hybrids, Lod score for linkage testing, Karyotyping, Pedigree analysis. Heritability and itsmeasurements, QTL mapping, CRISPR/CAS9 technology in genome editing.

Unit V **(15 Hours)**

Single Nucleotide polymorphism, polygenic inheritance and genetic disorders, inborn errors of metabolism, cytoplasmic inheritance in haploid and diploid organisms, *Genetic rearrangements and their evolutionary significance and epigenetics.

*** denotes Self study**

Teaching Methods

Smart Class Room /Powerpoint presentation/ Seminar/ Quiz/ Discussion /Flipped Class

Text Books

1. Verma, P.S. and V.K. Agarwal. (2010) Genetics, 21st Ed. S Chand publishers, New Delhi.
2. Rastogi, V. B. (2019). Genetics, 4th Edition, Medtech Publishers, New Delhi.
3. Gupta PK. (2005) Genetics. III Edn. Rastogi Publication, India.

Reference books

1. Robert H. Tamarin, (2008). Principle of genetics, 7th edition, McGraw-Hill Publishers, London.
2. Strickberger M W (2010). Genetics. II edn. Macmillon Publications. New York.
3. Weaver and Hedrick (1997). Genetics, III Edn.WMC Brown Publishers. McGraw Hill Companies Inc, U.S.
4. Robert H. Lewin (2002). Principles of Genetics, VII Edn. Tata McGraw Hill Publishin Company Ltd, New Delhi.
5. Benjamin Lewin (1997). Genes, Oxford University Press, New York.
6. Ajoy Paul (2018). Text Book of genetics, Books And Allied (P) Ltd.

Sub. Code: 23PZO205

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	M	H	H	H
CO2	H	H	M	H	H
CO3	M	M	H	S	S
CO4	M	S	H	H	H
CO5	M	S	H	H	H

S – Strong H – High M – Medium L – Low

Sub. Code: 23PZO206

Programme Code : 06	**M.Sc., Zoology**		
Core Paper 6. Biostatistics and Research Methodology			
Batch 2023-2024	Hours / Week 5	Total Hours 75	Credits 4

Course Objectives

1. To Creates awareness on collection, analysis of data and interpretation of results.
2. To Describe the statistical methods and probability distribution relevant for Molecular data analysis
3. To know the methodology of research and skill development for report writing.

Course Outcomes (CO)

K1 to K5	**CO1**	Describe the tools of Biostatistics and Bioinformatics
	CO2	Understand the data collection methods, test of significance and the Biological databases
	CO3	Apply the knowledge in Biostatistics and Bioinformatics tools to analyse the Biological data
	CO4	Analyze the various techniques in the biological research
	CO5	Evaluate the knowledge on identifying the research problems, interpretation and reporting

SYLLABUS

Unit I **(15 Hours)**

Variables in biology, Collection, Classification and Tabulation of data, Frequency distribution, Diagrammatic and graphical representation of statistical data, Sampling techniques, Measures of Central Tendencies- Mean, Median, Mode, Standard Deviation and Standard error.

Sub. Code: 23PZO206

Unit II **(15 Hours)**

Hypothesis testing and estimation, Measures of relationship. Correlation- Introduction, Types (simple, partial and multiple) and Merits and Demerits - Regression analysis - Definition, Method of studying regression and uses. Probability- Definition, Types, addition and multiplication theorems.

Unit III **(15 Hours)**

Sampling and sampling errors- Test of significance for small and large samples. Definitions and applications of Chi-square test, Student's -"t" test and Analysis of variance ("F" test) - one way and two way classified data, Application of SPSS in biology.

UNIT IV **(15 Hours)**

Research methods and Methodology. Types of research – Descriptive, Analytical, Applied, Fundamental, Quantitative, Qualitative, Conceptual, Empirical reseacrch. Concept of applied and basic research process andcriteria of good research. Defining and formulating the research problem - Selecting the problem, necessity of defining the problem, importance ofliterature review in defining a problem.

UNIT V **(15 Hours)**

Research database, Interpretation and Hypothesis - Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Different Steps in Writing Report, Types of Reports Presentation of Reports: Oral Presentation, Power point presentation: Poster presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports, Significance of ReportWriting.

***Denotes Self study**

Teaching Methods

Smart ClassRoom /Powerpoint presentation/ Seminar/ Quiz/ Discussion/Flipped Class

Sub. Code: 23PZO206

Text books

1. Palanichamy, S. Manoharan, (1992). Biostatistics for biologist - Paramount Publications, Palani
2. Daniel, W.W. (2012). Biostatistics: A foundation for Analysis in Health sciences (10th edition) John WIley.
3. Gurumani, N. (2011). Research Methodology for Biological Sciences. 5th or later edition; MJP Publishers

Reference Books

2. Zar, J.H. (2013) Biostatistical analysis (5th Edition) Pearson
3. Irfan Ali khan and AtiyaKhanum (2004). Fundamentals of biostatistics, Ukaaz publications, Andrapradesh, India.
4. Anthony, M., Graziano, A.M. and Raulin, M.L. (2009). Research Methods: A Process of Inquiry, Allyn and Bacon.
5. Wadehra, B.L. (2000). Law relating to patents, trademarks, copyright designs and geographical indications. Universal Law Publishing.
6. Kothari, C. R. (2004) Research methodology, Research and Methods (2nd Edition), New Age International (P) Publishers, New Delhi
7. Singh, Y. K. (2006) Fundamentals of Research Methodology and Biostatistics, New Age International (P) Publishers, New Delhi

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	M	H	H	H
CO2	H	H	M	H	H
CO3	M	M	H	S	S
CO4	M	S	H	H	H
CO5	M	S	H	H	H

S – Strong H – High M – Medium L – Low

Sub. Code: 23PZO2CL

Programme Code : 06	**M.Sc., Zoology**		
Core Practical I. Comparative Anatomy of Invertebrates and chordates, Animal Physiology and Cell and Molecular Biology			
Batch 2023-2024	Hours / Week 5	Total Hours 150	Credits 3

Course Objectives

1. To acquire knowledge on the morphological features of Invertebrates and chordates
2. To determine the physiological action in relation to temperature, pH and osmoticpressure.
3. To gain practical knowledge about primary metabolites and its estimation in higher organisms.

Course Outcomes

K3 to K5	**CO1**	Get knowledge about the role of morphological features of invertebrates and chordates.
	CO2	Understand about the physiological changes in relation to temperature, pH and Osmotic Pressure.
	CO3	Apply the practical knowledge on Animal Physiology, Cell and Molecular Biology and Molecular Genetics techniques.
	CO4	Analyze the knowledge on primary metabolites in higher organisms.
	CO5	Evaluate the student's knowledge on physiological and Cell and Molecular Biology parameters.

SYLLABUS

Invertebrata

1. Identification on different types of coelom of Coelenterates, Aschelminthes & Annelids
2. Mounting of Earthworm Setae
3. Dissection of neuro-endocrine complex in Cockroach
4. Exoskeleton in Arthropoda (Prawn/Shrimp/Crab) and Mollusca (snail)

Sub. Code: 23PZO2CL

Chordata

1. Relationship between the structure and function of a) skin and its derivatives (scales, nails and horn)
2. Mounting: Scales of Teleost Fish (Ctenoid and Cycloid types), Placoid scales of shark
3. Relationship between the structure and function of a) Skull of Frog b) Rabbit
4. Relationship between the structure and function of a) Dentition in mammals b) Neuron.

Animal Physiology

1. Determination of the rate of activity of salivary amylase activity (human saliva) in relation to temperature and calculation of Q10 by titration method.
2. Determination of the rate of activity of salivary amylase activity (human saliva) in relation to pH.
3. Biological responses of earthworm in heterosmotic media and changes in body weight.
4. Determination of rate of ammonia excretion by a fish in different media.
5. Effect of temperature on the oxygen consumption of a fish and calculation of Q10.

Cell and Molecular Biology

1. Quantitative estimation of carbohydrates in liver of an animal.
2. Quantitative estimation of proteins in muscles of an animal.
3. Quantitative estimation of lipids in the given animal tissue.
4. Preparation of Haemin crystals from human blood.
5. Quantitative estimation of Hemoglobin in human blood.
6. Determination of RBC count in Human blood.

Sub. Code: 23PZO2CL

Spotters

1. pH meter
2. Haemoglobinometer
3. Spectrophotometer
4. Centrifuge
5. Sphygmomanometer
6. ECG recorded strip

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	H	H	H
CO2	H	H	M	H	H
CO3	M	M	H	S	S
CO4	M	S	H	H	H
CO5	M	S	H	H	H

S – Strong H – High M – Medium L – Low

Sub. Code: 23PZO2CM

Programme Code : 06	**M.Sc., Zoology**		
Core Practical 2. Microbiology and Immunology, Molecular genetics, Biostatistics and Research Methodology			
Batch 2023-2024	Hours / Week 5	Total Hours 150	Credits 3

Course Objectives

1. To gain knowledge on microbial culture techniques and importance of immune system response.
2. To apply the molecular genetic techniques and its applications in biology.
3. To acquire knowledge on the importance of statistics, interpretation of the biological data and report writing.

Course Outcomes (CO)

K3 to K5	**CO1**	To understand knowledge on various microbial cultural techniques.
	CO2	To acquire knowledge on immuno techniques.
	CO3	To apply the practical knowledge on Molecular Genetics techniques.
	CO4	To analyse the knowledge on data collection.
	CO5	To interpret and evaluate the data using statistical tool.

SYLLABUS

Microbiology and Immunology

1. Sterilization techniques
2. Preparation of Media: Broth and Agar media, plates, slants,
3. Pure culture techniques : Streak / spread / Pour plate method, Bacterial and fungal cultivation

4. Staining methods : Gram staining
5. Antibiotic sensitivity and Minimal inhibitory concentration test against microbes
6. Quality of milk by MBR test
7. Agglutination test
8. Extraction of Human PBMCs by Ficoll - Hypaque Overlay method
9. Serology : WIDAL for Enteric Fever
10. Radio Immunoassay
11. ELISA (DEMO)

Spotters

1. Micro titer plate
2. Autoclave
3. Blood agar
4. Inoculation loop
5. Syringe filter
6. Antibiotic sensitive plate
7. Widal slide

Molecular Genetics

1. Isolation of DNA from goat liver
2. Estimation of DNA by Diphenylamine method
3. Estimation of RNA by Orcinol method
4. Mounting of Polytene chromosome from Chironomous larva
5. Barr body identification in buccal cavity of females

Biostatistics and Research Methodology

1. Construction of frequency distribution for a given sample.
2. Construction of Histogram and frequency polygon for the frequency distribution.
3. Calculation of Mean, Median, Mode for the distribution.
4. Calculation of Standard deviation for the frequency distribution.
5. Calculation of given samples by using SPSS.
6. Calculation of F value for the given data (One way method).
7. Steps in Thesis Writing
8. Steps in Article Writing.
9. Collection of Review Article.
10. Interpretation of Results.

Sub. Code: 23PZO2CM

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	H	H	H
CO2	H	H	M	H	H
CO3	H	S	H	H	S
CO4	M	S	H	H	H
CO5	M	S	H	H	H

S – Strong H – High M – Medium L – Low

Subject Code: 23PZO307

Programme code : 06	M. Sc., Zoology		
Core Paper 7. Entomology			
Batch 2023-2024	Hour/Week 5	Total hours 75	Credit 5

Course objectives

1. To enrich information about the taxonomic position of Insects.
2. To inculcate knowledge on morphology, anatomy, and physiology of insects.
3. To upgrade knowledge about the economics of beneficial insects, pests of agriculture, stored grain pests and their control measures.

Course outcomes (CO)

K1 to K5	**COI**	Classify insects up to order
	CO2	Understand the anatomy and physiology of Insects.
	CO3	Apply the knowledge on physiology, reproduction biology and Endocrine system of insects.
	CO4	Analyze the economics of beneficial insects.
	CO5	Provide knowledge about the control and management measures of Insect pests.

SYLLABUS

Unit I: Entomology basics **(15 Hours)**

Introduction to Entomology: Definition, Origin, Evolution, importance of insects, Inter-relationship of insects with other arthropods; Classification of Insects: up-to order, genera and species with example - Morphology: external features and their articulation. Comparative study: Head - antennae, mouth parts; thorax - legs, wings; abdominal appendages, genitalia. Integument, Cuticle - structure, moulting, sclerotization. Diversity of Insects: Terrestrial, aquatic and soil insects.

Sub. Code: 23PZO307

Unit II: Anatomy and physiology (15 Hours)

Digestive system - Structure of alimentary canal and Associated digestive glands and physiology of digestion; Respiratory system - Respiratory structures and mechanism of respiration in terrestrial and aquatic insects; Circulatory system - structure of circulatory organs, Haemolymph - composition and functions, Haemocytes - structure and types, mechanism of circulation; Excretory system - Structure of Malpighian tubules and other excretory structures, Physiology of excretion.

Unit III: Anatomy and physiology (15 Hours)

Nervous system - Central nervous system, Physiology and neurobiochemistry; Sense organs - Compound eyes, Chemoreceptors, Mechanoreceptors; Effector organs - Sound producing organs, Light producing organs; Reproductive system - Male and female reproductive system, fertilization and development; Endocrine system - structure and mode of action of hormones in metamorphosis; Ectohormones – Pheromones, sex pheromones, and defensive secretions.

Unit: IV Economically important Insects (15 Hours)

Sericulture: History of Sericulture, Life cycles of Mulberry and Non-mulberry, Silkworms, Rearing technology of mulberry silkworm, Diseases and pests of Mulberry silkworm, Moriculture and cultural practices, Diseases and pests of Mulberry.

Apiculture: History, Honeybee species, Social organization of honey bees, Life cycle of honey bees, Methods of bee keeping, Enemies and Diseases, maintenance and management of apiary.

Unit VI: Insect Pests and their control (15 Hours)

Insect pests: Insect Pest of Crops and their control measures: Paddy, Coconut, Cotton, Sugarcane and millets. Pests of Stored grains – Rice – *Sitophilus*, Wheat - *Tribolium*, Pest control: Prophylactic, Mechanical, Chemical and Biological Control measures. Insecticidal formulations, Classification of the insecticide, Mode of action of insecticides, Drawback of chemical control. Biological control, Integrated Pest Management (IPM)*, Nano – insecticide control.

*** denotes Self study**

Sub. Code: 23PZO307

Teaching Methods

Smart ClassRoom /Powerpoint presentation/ Seminar/ Quiz/ Discussion /Flipped Class

Text Books

1. D.B. Tembhare, (2009), Modern Entomology, Himalaya Pvt. Ltd., Publishers, New Delhi.
2. D.P. Ambrose D.P, (2004), The Insects: Structure, Function and Biodiversity, Kalyani Publishers, New Delhi.
3. Vasantharaj David, (2002), Elements of economic Entomology, Popular Book House, Publishers, Chennai.

Reference Books

1. R.F. Chapman, (2002), The insects structure and function, Cambridge University press, Publishers, United Kingdom.
2. R.C. Saxena RC and R.C.Srivastava, (2007), Entomology: At a Glance. Agrotech Publishing academy, Publishers, Jodhpur.
3. P.A. Duntson, (2004), The Insects: Structure, Function and Biodiversity. Kalyani Publishers, New Delhi.
4. R.E. Snodgrass, (2004). Principles of Insect Morphology, Anmol publications Pvt. Ltd., Publishers, New Delhi.
5. L.O. Pedigo and M.E.Rice, (2009), Applied Entomology. PHI Learning Pvt. Ltd., Publishers, New Delhi.
6. P.G. Fenemore and A.Prakash, (2002) Applied Entomology. New age international Pvt. Ltd., Publishers, New Delhi.

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	M	H	H	H
CO2	H	H	M	H	H
CO3	M	M	H	S	S
CO4	M	S	H	H	H
CO5	M	S	H	H	H

S-Strong H- High M-Medium L-Low

Sub. Code: 23PZO308

Programme Code : 06	M.Sc., Zoology		
Core Paper 8. Evolution			
Batch 2023-2024	Hours / Week 5	Total Hours 75	Credits 5

Course Objectives

1. To understand the evolutionary significance.
2. To understand the concept and mechanisms of Evolution.
3. To study the various phyletic evolution and adaptive radiation

Course Outcomes (CO)

K1 to K5	**CO1**	Understand the significance of Evolution
	CO2	Knowledge on Evolution process
	CO3	Apply the methods of calculating Zoological Time Scale
	CO4	Analyze the comparative anatomy and physiological systems evolution
	CO5	Evaluate the student's to acquire knowledge on evolution process

SYLLABUS

Unit I: Evidences of Evolution (15 Hours)

The need of evidences for the fact of evolution - evidences from comparative anatomy, embryology, physiology and biochemistry - visual pigments, hemoglobin, protein sequences in phylogeny. Phylogeny of Invertebrates and vertebrates and significance. Evidences for the origin of Lower and higher taxa from the fossil record. Man in the fossil records.

Unit II: Theories of Evolution (15 Hours)

Importance of evolution, A brief history of life, concept of organic evolutionduring pre- and post Darwin era, Direct and indirect evidences of evolution - The development of evolutionary theory Lamarckism, Darwinism, Natural selection, Neo-Darwinism and Mutation theory.

Sub. Code: 23PZO308

Unit III: Origin of Life and Adaptive Radiation (15 Hours)

Evolutionary time scale: eras, periods and epoch, Major events in evolutionary time scale. Evolution and adaptive radiation of elasmobranchs and bony fishes. Origin and salient features of Ostracoderm, Agnatha, Placoderm, Acanthodii, Sarcopterygii, Chondrichthyes, Osteichthyes and Actinopterygii, amphibians, reptiles, birds, mammals. Origin and evolution of primates and human.

Unit IV: Evolutionary Process (15 Hours)

Mechanisms that decrease and increase variations (natural selection, genetic drift, mutation, recombination and gene flow). evolution and molecular biology- a new synthesis; from molecules to life, life originated from RNA, introns as ancient component of genes. The role of polyploidy, isolating mechanisms - premating, post mating - problems of the origin of isolating mechanism. Speciation – species concepts, categories; Modes of speciation – Allopatric, parapatric and sympatric speciation.

Unit V: Functional Anatomy of Vertebrates and Evolutionary significance (15 Hours)

Integumentary system – Integument and its derivatives, Skeletal system,Nervous system – brain, spinal cord and peripheral nerves; sense organs, Respiratory and circulatory system; Digestive and excretory system, Reproductive system – comparison of male and female reproductive systems from fishes to mammals.

*** denotes Self study**

Teaching Methods

Smart ClassRoom /Powerpoint presentation/ Seminar/ Quiz/ Discussion /Flipped Class

Text Books:

1. Darwin, C.R. (2000). On the Origin of species by means of natural selection (revised edition) Collier Books, New York.
2. Colbert. E.H. (1969). Evolution of the vertebrates, wiley eastern, New Delhi.
3. Veer Bala Rastogi (2018). Organic Evolution. Organic Evolution (Evolutionary Biology), 13th Edition.

Sub. Code: 23PZO308

Reference Books:

1. Mayr, E., (2001). What Evolution Is, Basic Books, New York, USA
2. Dobzhanunsky.T. (1976). Genetics and the origin of species. Oxford and IBH,
3. Bajema J. (1971). Natural Selection in Human Population. John Wiley and Son, New York.
4. Barrington EJW, (1974). Invertebrates structure and function, English language food societyand Nelson.
5. Hyman, L.H, (1953). Comparative vertebrate life, The University of Chicago, Illinois.
6. Dodson, E.O. (1990). A Text Book of Evolution, W.B. Saunders, Philadelphia.

MAPPING

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	S	S	H	H
CO2	H	S	H	H	H
CO3	S	H	H	H	H
CO4	H	H	H	S	H
CO5	H	S	H	H	H

S – Strong H – High M – Medium L – Low

Sub. Code: 23PZO309

Programme Code 06	M.Sc., Zoology		
Core Paper 9. Developmental Biology			
Batch 2023-2024	Hour/Week 4	Total hours 60	Credit 5

Course objectives

1. To learn about the developmental stages of an embryo.
2. To obtain the knowledge of fertilization and differentiation of mammals.
3. To understand the organogenesis, nutrition, regeneration and teratogenesis of mammals

Course outcomes (CO)

K1 to K5	**COI**	Explain about the spermatogenesis oogenesis and ovulation in human
	CO2	Assess the knowledge on embryonic nutrition
	CO3	Distinguish various organs and physiology of Human
	CO4	Experiment the mechanism of induction, major events during regeneration and teratogenesis
	CO5	Explain the mechanism of fertilization, metabolic activities and molecular changes in cleavage process in human

SYLLABUS

Unit I **(12 Hours)**

Gametogenesis

Primodial germ cells and their origin – Spermatogenesis – Oogenesis and Vitellogenesis – Comparison of spermatogenesis and oogenesis – *Types of eggs and egg membrane – Role of hormones on oogenesis and ovulation in Insects and Human.

Fertilization

Production of gametes, cell surface molecules in sperm –egg recognition in animals.

Activation of egg - Mechanism of fertilization – Metabolic activities during fertilization.

Sub. Code: 23PZO309

Unit II **(12 Hours)**

Differentiation

Cleavage: Zygote formation Salient features – Theories of cleavage – Cleavage planes & patterns – Types of blastula – Molecular changes during cleavage.

Gastrulation: Salient features – Major events of gastrulation – Mechanism of Gastrulation in frog, chick and Human.

Unit III **(12 Hours)**

Embryonic Nutrition: Types of Placenta – Physiology of Placenta – Endocrine function of placenta – Hormonal control during pregnancy and lactation. Endocrine factors in puberty- changes in male- abnormal puberty in man-Delayed puberty in female and Treatment.

Unit IV **(12 Hours)**

Tissue differenciation and Organogenesis in Mammals:

Neurulation and the formation of neurula - primary differentiation of mesoderm and endoderm **-**Development of Brain, Ear, Heart and Kidney. Speman's experiments- Eye lens induction –competence- limb development and regeneration in vertebrates.

Unit V Human welfare **(12 Hours)**

Aritificial insemination (AI) - *invitro fertilization* (IVF)- Embryo transfer- (ET)- Gamete Intra-fallopian Tranfer (GIFT) and Zygote Intra -fallopian transfer (ZIFT). Cryopreservation of gametes and embryos- Fertility control and regulation.

Teratogenesis: Definition – Chemical agents causing congenital abnormalities - Genetic teratogenesis – Environmental teratogenesis.

*** denotes Self study**

Teaching Methods

Smart ClassRoom /Powerpoint presentation/ Seminar/ Quiz/ Discussion /Flipped Class

Sub. Code: 23PZO309

Text Books :

1. Verma, P.S and V. K. Agarwal, (2014), Chordate Embryology S.Chand Publication company Ltd., New Delhi 2014.
2. Veer Bala Rastogi and M.S. Jayaraj, (2008), Developmental Biology, Keendarnath Ramnath Publication Edition.
3. Balinsky, B. L. (2008), An Introduction to Embryology, W.B. Sounders Company Publication Philadelphia.

Reference Books :

1. Bruce, M (2007), Carlson Foundations of Embryology, McGraw Hill Publishing companies.
2. Scott F. Gilbert Sinaver, (2008), Developmental Biology Amociates Sunderland, .CHR.
3. Banerjee, S (2005), Developmental Biology Dominant Publishers and Distributors, New Delhi
4. MunishKainth, (2013), A Textbook of Chordate Embryology, Wisdom Press,
5. Dominant Book publications.
6. R.S.McEwen,(1969), Vertebrate Embryology Oxford and IBH publishing Co., New Delhi.
7. P.C.Jain, (1998), Elements of Developmental Biology, Vishal Publication, New Delhi.

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	M	H	H	H
CO2	H	H	M	H	H
CO3	M	M	H	S	S
CO4	M	S	H	H	H
CO5	M	S	H	H	H

S – Strong H – High M – Medium L – Low

Sub. Code: 23PZO410

Programme Code: 06	**M.Sc., Zoology**		
Core Paper 10. Environmental Biology and Toxicology			
Batch 2023-2024	Hours / Week 6	Total Hours 75	Credits 5

Course Objectives

1. To create awareness about the environmental quality and monitoring.
2. To obtain information about various toxicants and their impacts in the environment.
3. To enrich the students on environmental quality measures and environmental laws.

Course Outcomes (CO)

K1 to K5	CO1	Explain the biosphere.
	CO2	Understand the various types of pollutants, their impacts on the terrestrial and aquatic environment, animals and human beings, and control and management measures.
	CO3	Explain the energy flow, natural resources and their conservation.
	CO4	Analyse the knowledge in monitoring the quality of the environment and to promote bioremediation. Analyze and evaluate the toxicity of pollutants on living organisms.
	CO5	Evaluate the quality management and awareness of the environment.

SYLLABUS

Unit I: Biosphere **(15 Hours)**

Atmosphere: Composition and structure, climate factors-light, air, temperature, atmospheric pressure, wind, humidity and rainfall. Hydrosphere: water resources, hydrological cycle, physico-chemical and biologicalcharacteristics of ponds, lakes, rivers, (coastal) estuaries, mangroves, coral reefs, sea grass and (marine) pelagic and benthic environment.

Sub. Code: 23PZO410

Lithosphere: Soil formation, components of soil, physico-chemical properties of soil, structure, texture and classification of soil, soil organisms, soil erosion (degradation).

Unit II: Pollution types and Management (15 Hours)

Air Pollution-Air pollutants, sources, effects on environment - acid rain, green house effect and ozone depletion.WaterPollution:water pollutants, sources of water pollution (Organic, pesticidal, heavy metal and oil pollution) both point and non-point sources. Other Types: soil pollutants, noise pollutants, thermal and radioactive pollutants.

Global warming: Climate change and its impact. IPCC. Sources of different pollution (air, water, soil, noise &thermoactive) and their impacts on the environment, and the living resources (plants, animals and human beings. Plastic pollution- microplastic sources. Management and control policies, legal framework, Measures and management of air, water, soil, noise, thermoactive pollution and plastics and their disposal.

Unit III: Energy and Environment & Radiation Ecology (15 Hours)

Energy: Concept of energy, sources of energy, measurements of primary production, Energy flow in ecosystems. Conservation of natural resources: Mineral forests, agriculture, wildlife conservation and management, freshwater, estuary and coastal and marine fish culture.

Radiation Ecology: Radiation biology and environment: Remote sensing, Radio Telemetry as a tool for ecological research, space ecology, exobiology, hazards of space travel, regenerating system.

Unit IV: Toxicology (15 Hours)

Introduction: Scope and significance of toxicology, classification, toxic substances, absorption and excretion of toxicants and toxicity.

Mode of action of toxicants: Toxicity – Acute and chronic toxicity. Impacts of toxicants, Toxicological testing methods: Evaluation of toxicity in organisms – LC_{50} in Aquatic organisms, LD_{50} in Terrestrial organisms. Bioremediation.

Sub. Code: 23PZO410

Unit V: Environmental Quality, Awareness and Management (15 Hours)

Ecoindicators and bioindicators and the environment, Environmental education and Awareness, Environmental monitoring and Environmental Impact Assessment (EIA), Environmental Action Plan, Environmental Auditing, System planning, Sustainable development, Bio-safety regulation and Bio ethics, Environmental Act including CRZ and ICZM. International and National Conventions and Acts/Rules governing Environmental Pollution. Environment (Protection) Act, 1986, Wildlife (Protection Act, 1972), Costal Regulation Zone notifications, Water (prevention and Control of Pollution) Act, 1974 and Air (Prevention and Control of Pollution) Act, 1981.

*** denotes Self study**

Teaching Methods

Smart ClassRoom /Powerpoint presentation/ Seminar/ Quiz/ Discussion /Flipped Class

Text Book

1. Sharma, P.D (2012), Environmental Biology and Toxicology, Rastogi Publications,India.
2. Khitoliya, R. K (2012), Environmental pollution, S. Chand publication.
3. Subramanium, M. A (2004), Toxicology principles and methods, M.J.Publishers, Chennai.

Reference Books

1. Sharma,P.D (2013), Environmental biology and Toxicology, Rastogi publication
2. Goel, P. K (2011), Water pollution, Causes, effects and control, Publishers - New Age International Pvt. Ltd, New Delhi.
3. Voudouris, (2012), Water quality Monitoring and Assessment, Intech Publishers.
4. Katayal, K M. Satake, (2001), Environmental pollution, Anmol Publications Pvt. Ltd., New Delhi.
5. Agarwal, P. P (2006), Environmental pollution; causes, effects and control – Agrobios Publisher, India.
6. Odum, E. P (1971), Fundamentals of Ecology – 3rd edition, W.B.Saunders& Co, Philadelphia
7. Website: Ministry of Environment Forest and Climate Change: http://moef.gov.in/en/

Sub. Code: 23PZO410

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	M	H	H	H
CO2	H	H	M	H	H
CO3	M	M	H	S	S
CO4	M	S	H	H	H
CO5	M	S	H	H	H

S – Strong H – High M – Medium L – Low

Sub. Code: 23PZO411

ProgrammeCode : 06	M.Sc., Zoology		
Core Paper 11. Aquaculture			
Batch 2023-2024	Hour/Week 5	Total hours 75	Credit 5

Course Objectives

1. To explore the aquatic resources of the edible and economically important organisms.
2. To make use of the inland waters and marine potential to substitute the protein requirements by the human population.
3. To provide self employment opportunities and knowledge for students.

Course Outcomes (CO)

K1 to K5	**COI**	Get knowledge about the production of cultivable candidate fish species
	CO2	Understand the global, national, traditional and modern techniques related to fishes for food security
	CO3	Apply practical knowledge into the aquaculture field to enhance production level
	CO4	Analyze students theoretical and technical knowledge useful for teaching, research, extension and entrepreneurship in the field of Aquaculture
	CO5	Evaluate the student's theoretical and technicalknowledge useful for teaching, research, extension and entrepreneurship development.

SYLLABUS

Unit I **(15 Hours)**

Principle of Aquaculture

Principle of Aquaculture- The need for aquaculture, Over view of national and international Aquaculture. Systems of aqua culture –Extensive, Semi-intensive, intensive, and super intensive aquaculture. traditional aquaculture.

Sub. Code: 23PZO411

Unit II **(15 Hours)**

Culture of Fishes

Criteria for selection of candidate species for aquaculture, Types of culture - Monoculture, Polyculture, pond culture, pen culture, cage culture, running water culture, zero water exchange system, culture sewage fish culture, Paddy fish culture, brackish water culture, marine fish culture, integrated fish farming.

Unit III **(15 Hours)**

Aquaculture Engineering

Survey, site selection, design and construction of fish and shrimp hatcheries. Filter techniques in hatcheries. Design and construction of fish and shrimp ponds. Water distribution systems of pond- feeder canals, inlet, outlet and drainage canals.

UNIT IV **(15 Hours)**

Feed Management

Protein, Lipid, Carbohydrates, Vitamins and minerals requirements for candidate fishes.Types of feeds, feed formulation and manufacturing, Feed additives. Culture and Nutritive value of live food: algae, artemia, rotifers, daphnia, moina and copepods. Bio enrichment of live feeds

Unit V **(15 Hours)**

Fish diseases and Management

Significance of fish disease in relation to aquaculture*. Type of disease-causing organisms, sources and treatments for candidate species. Disease diagnosis techniques. Health management in aquaculture- Drugs, chemicals, antibioticsand probiotics. Biosecurity and Quarantine measures, Artificial Intelligence in Fisheries.

*** denotes Self study**

Teaching Methods

Smart ClassRoom /Powerpoint presentation/ Seminar/ Quiz/ Discussion /Flipped Class

Sub. Code: 23PZO411

Text books

1. Kamleshwar Pandey and J.P. Shukla (2005). Fish and fisheries. Rastogi Publications, Meerut, India.
2. Ahilan, B. and N.Felix. (2008). Text book of Aquaculture. Daya Publishing House New Delhi, India.
3. Jhingran, V.G. (1991). Fish and fisheries of India. Hindustan Publish Corporation, Delhi.

Reference books

1. Boyd, C.E. and C.S. Tucker, (1992). Water Quality and Pond Soil Analyses for Aquaculture. Alabama Agricultural Experiment Station, Auburn University, Alabama, 183
2. Pillay TVR and Kutty MN (2005). Aquaculture: Principles and Practices. 2nd ED ISBN: 978-1-405-10532-3, Wiley-Blackwell, 640 pages, Blackwel, Publication.
3. Ayyappan, S. J. K. Jena, A. Gopalakrishnan, A. K. Pandey. (2011). Handbook of fisheries and aquaculture. Indian Council of Agricultural Research. Directorate of Information and Publications on Agriculture, Directorate of Information and Publications of Agriculture, Indian Council of Agricultural Research, New Delhi, India.
4. De Silva SS & Anderson TA. (1995). Fish Nutrition in Aquaculture. Published by Chapman and Hall, United Kingdom.
5. Andrews, C, Excell A and Carrington, N. (1988). The manual of fish health. Salamander Book Ltd. London. pp.209.
6. Shankar, K.M. and C.V. Mohan. (2002). Fish and shellfish health management, UNESCO, New Delhi.

Web Reference

1. https://www.europarl.europa.eu/RegData/etudes/ATAG/2022/699.644/IPOL_ATA(2022)699644_EN.pdf

Sub. Code: 23PZO411

MAPPING

PSO / CO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	S	H	H	H	S
CO2	M	S	M	H	H
CO3	H	M	H	H	H
CO4	H	H	S	M	H
CO5	H	M	H	H	H

S-Strong H- High M-Medium L-Low

Sub. Code: 23PZO412

Programme code : 06	M.Sc., Zoology		
Core Paper 12. Endocrinology			
Batch 2023-2024	Hours/ Week 5	Total Hours 60	Credits 4

Course Objectives

2. To make the students learn the objectives and scope of Endocrine system.
3. To understand the general principles of endocrinology.
4. To get knowledge about the structure and functions of various endocrine glands and its hormones.

Course Outcomes (CO)

K1 to K5	**CO1**	Acquire knowledge of the hormones and its role in coordination of activities in the biological systems.
	CO2	Understand the structure and functions of pituitary glands.
	CO3	Apply the knowledge on physiological mechanism of Thyroid, parathyroid and its role in metabolism.
	CO4	Analyze the hormonal regulation of Adrenal glands and pancreas.
	CO5	Evaluate the hormonal control of reproductive cycles.

Unit I **(12 Hours)**

Endocrine glands and its hormones – classification. Endocrine, Paracrine and Autocrine modes of hormone delivery. Nature of hormones - General and principles of hormone action, Hormonal effects and regulation. Role of hormones in metabolic pathways.

Unit II **(12 Hours)**

Study of hypothalamus – Pituitary gland, pineal gland, thymus - characteristics, structural organization - hormone secretion and its functions – Hypothalamic control. Disorders of pituitary – growth hormone- dwarfism, gigantism, acromegaly, ACTH – Cushing's disease, Vasopressin – diabetes insipedus.

Sub. Code: 23PZO412

Unit III **(12 Hours)**

Thyroid gland - structural organizations, functions and regulations of thyroid glands. Role of thyroid hormone in carbohydrate, protein and lipid metabolisms- parathyroid and its structure and functions. Disorders of thyroid- Goiter, Grave's disease, cretinism, thyroiditis. Disorders of parathyroid
- Osteoporosis, Osteomalacia.

Unit IV **(12 Hours)**

Structure of pancreas, pancreatic hormones and their functions. Disorders of pancreas - Diabetes mellitus.Structural organizations of adrenals,glucocorticoids and mineralocorticoids, functions of cortical and medullary hormones. physiology and regulation of hormones - Disorders of Adrenal cortex
– Addison's disease, hyper aldosteronism.

Unit V **(12 Hours)**

Hormones of testis and ovary - physiology and regulation of hormones. Hormonal control of female reproductive cycles- estrous and menstrual cycle, preganancy, parturition and lactation. Disorders of ovary – amenorrhea, dysmenorrheal, polycystic ovary disease, hirsutism, menopause – hormonal contraceptive agents, hormone replacement therapy (HRT). Disorders of testis - hypogonadism, impotence, gynaecomastia.

*** denotes Self study**

Teaching Methods

Smart ClassRoom /Powerpoint presentation/ Seminar/ Quiz/ Discussion /Flipped Class

Text Books:

1. Nussey, S.S., and Whitehead, S.A (2001). Endocrinology: An Integrated Approach, Oxford: BIOS Scientific Publishers.
2. Dharmalingam M (2010). Text book of Endocrinology., Jaypee Brothers, Jaipur, India
3. Peter J and Bently (2019). Comparative vertebrate Endocrinology 3rd edition. University of Western Australia Perth.

Sub. Code: 23PZO412

Reference books:

1. Melmed, M., Polonsky, K., Larsen, P. R and Kronenberg, H (2015). Williams Textbook of Endocrinology, Thirteenth Edition, Elsevier Publisher.
2. Harrison's Endocrinology by **J.** Larry Jameson 2017. Greenspan's Basic and Clinical Endocrinology, Tenth Edition by David Gardner; Dolores Shoback Reserve WK 140 H323 2017.
3. David Gardner and Dolores Shoback (2017) Greenspan's Basic and Clinical Endocrinology, Tenth Edition (Greenspan's Basic and Clinical Endocrinology) Publisher: McGraw-Hill Education / Medical.
4. Hadley, M.E and Levine J.E (2007). Endocrinology (6th Edition) Pearson Prentice Hall, New Jersey.
5. Turner C.D and **J** T Bangara (1986). General Endocrinology. Saunders International Student edition. Toppan Company Limited, Tokyo.
6. Mac Hadley (2006). Endocrinology, 3rd edition. Prentice- Hall Inc. A Simon and Schuster Company, Englewood Cliffs, New Jersey, USA.

MAPPING

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 4
CO1	H	S	S	M	H
CO2	S	H	M	S	M
CO3	S	H	M	H	S
CO4	H	S	H	H	H
CO5	S	M	H	S	M

S-Strong H- High M-Medium L-Low

Sub. Code: 23PZO4CN

Programme Code : 06	**M.Sc., Zoology**		
Core Practical. 3 - Entomology, Evolution and Developmental Biology			
Batch 2023-2024	Hours / Week 5	Total Hours 150	Credits 3

Course Objectives

1. To learn the morphology, anatomy and physiology of Insects and its role in crop production.
2. To explore and understand the evolutionary significance of different animals.
3. To study the developmental stages of embryos in animals.

Course outcomes (CO)

K3 to K5	**CO1**	To study the taxonomy of Insects and their importance, evolutionary significance in animal kingdom and the basic concepts of embryo development.
	CO2	To familiarise the methods adopted to identify the insects
	CO3	Acquire the knowledge on pest control practices and the importance of beneficial insects in crop production.
	CO4	Analyse the process of embryo development and chromosomal analysis during the development of embryos. Understand the evolution of Human.
	CO5	Evaluate the impact of different insects on crop production and influence of various factors on development of embryos. Exploring the different species of animal group in the museum.

SYLLABUS

ENTOMOLOGY

1. Identification of insects

i. Key to insect identification (10 insects from different orders)

2. Mounting

i. Mouth parts based on their types (5 different types)

ii. Genitalia-male and female (3 pairs)

3. Dissection

i. Digestive System, Nervous System, Reproductive System of Cockroach and Nepa.

4. Physiology of Insects

i. Study of types and Total count of haemocytes and haemolymph of any one Insect

ii. Detection of uric acid as an end product of excretion in any terrestrial insects.

5. Sericulture (Silkworm-*Bombyx mori*)

i. Study of egg, larva, pupa and adult-Life cycle, Pests and Diseases.

ii. **Reeling-** Assessment of Cocoon characters, Denier, Shell ratio and Renditta.

6. Apiculture

i. Bee hive, Honey comb, Types honey bees, Caste differentiation, Pests and diseases of honey bees.

7. Crop pests

i. Identification of pests (one in each) of Paddy, coconut, cotton, sugarcane and millets.

8. Stored grain pests

i. Identification of rice pest - *Sitophilus*; wheat pest – *Tribolium.*

9. **Field visit:** Submit the following:

i. Documentation of Insects (Insects Only Photographic album)

ii. Slides – Whole mounting of 10 small insects.

EVOLUTION

1. Study of Fossils (Ammonoids, Nautiloids & Echinoderm fossils).
2. Animals of evolutionary significance: Peripatus, Archeopteryx, Limulus.
3. Natural selection - experiment using red and white eye Drosophila flies.
4. Demonstration of Hardy-Weinberg equilibrium in human populations by taking examples of MN and ABO blood group systems.
5. Study of Evolution of vertebrate skull.
6. Study of Darwin's finches related to beaks of different species.
7. Study of selected stages in human evolution.
8. Visit to Natural History Museum.

Sub. Code: 23PZO4CN

DEVELOPMENTAL BIOLOGY

1. Types of eggs and cleavage patterns.
2. Chromosome squash preparation from Drosophila larval salivary glands.
3. Studies of whole mount of chick development: 24, 48, 72, 98 hours.

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	M	H	H	H
CO2	H	H	M	H	H
CO3	M	M	H	S	S
CO4	M	S	H	H	H
CO5	M	S	H	H	H

S-Strong H- High M-Medium L-Low

Sub. Code: 23PZO2CO

Programme Code : 06	M.Sc., Zoology		
Core Practical 4 - Environmental Biology and Toxicology, Endocrinology, Aquaculture			
Batch 2023-2024	Hours / Week 5	Total Hours 150	Credits 3

Course Objectives

1. To observe the quality of the water and soil.
2. To study the biological importance of endocrine glands in vertebrates.
3. To know the toxicity testing methods and students to Pollution Control Board and wetlands.

Course Outcomes (CO)

K3 to K5	**CO1**	Get knowledge in determining the physical characteristics of the water and soil.
	CO2	Understand the importance of endocrine glands in vertebrates.
	CO3	Apply the toxicity of pollutants on animals and to expose the students in the field study.
	CO4	Analyse the qualitative analysis of pollution indicator organisms in aquatic environment.
	CO5	Evaluate the water quality parameters in wetlands.

SYLLABUS

Analysis of water – Pond / River water/ Lake water / Tap water

1. *pH*
2. Total dissolved solids (TDS, TSS)
3. Dissolved carbondioxide
4. Dissolved oxygen
5. Hardness (Temporary – carbonates, bicarbonates, Permanent – calcium, magnesium, chlorides, sulphates, phosphates, nitrates and silicate).
6. BOD (Demonstration only)

Sub. Code: 23PZO2CO

Analysis of soil – Clayey soil, Sandy soil, Garden soil and Red soil

1. Soil moisture
2. Soil texture
3. Chlorides
4. Sulphates
5. Nitrates
6. Phosphates

Endocrinology

1. Dissections of endocrine glands in Vertebrates –Fish Demonstration.
2. Spotters – Endocrine glands
    i. Pituitary
    ii. Thyroid
    iii. Adrenal
    iv. Pancrease
    v. Testis
    vi. Ovary

Biological analysis

1. Qualitative analysis of organisms (Pollution indicators) such as diatoms / algae, flagellates, ciliates, annelids, insects, molluscs and fish.
2. Study of fish scales in temporary mounting
3. Estimation of chlorophyll content in the leaves as an indicator of pollution.
4. Collection and identification of Zooplankton

Toxicological Testing methods

1. LC_{50}, LD_{50}

Field Trip

1. Visit to – Drinking water treatment Plant; Sewage water treatment plant and Tamil Nadu Pollution Control Board.

Submission of the following at the time Practical Examination without which the students will not be permitted to write the examination.

1. A minimum of 5 whole mounts of Plankton – 5 Marks
2. Bonafide Record – 10 Marks

Sub. Code: 23PZO2CO

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	H	H	H
CO2	H	H	M	H	H
CO3	H	S	H	H	S
CO4	M	S	H	H	H
CO5	M	S	H	H	H

S – Strong H – High M – Medium L – Low

Sub. Code: 23PZO4Z1

Programme Code : 06	**M.Sc., Zoology**
Project Work and *Viva - Voce*	
Batch 2023-2024	Credit 2

Course Objectives

1. To acquire the basic knowledge about research and carry out research problems in the field of zoology.
2. To explore the ability to plan, carryout innovation in project
3. To improve the knowledge on various research methods in zoology

Course Outcomes

K3 -K5	**CO1**	Use foundational practical knowledge to carry out research in the specified area.
	CO2	Understand the techniques to be used to carry out the specific research work.
	CO3	Apply the learned techniques to carry out the experiments and obtain the result.
	CO4	Analyse the result by using biostatistical tools and interpret the result.
	CO5	Evaluate the analysed result and conclude the study and highlight its significant outcome

Project work Instruction

1. The maximum two students are allotted to the faculty members in the roll number order and the students should do their project individually.
2. The students can design their project title and objectives by discussing with the respective guide
3. Students should engage in their project before and after class hours in the presence of their respective guide.

4. Two reviews will be conducted during the allotted project period and the students should discuss their work in the presence of respective guide and the Head, Department of Zoology and should submit the project review report.
5. Students will be instructed accordingly if there is any change in theirwork during the review meeting.
6. Students and guide should ensure the integrity of the work done.
7. The final project report should be submitted on the date intimate for the submission by the Controller of Examination.
8. The work will be evaluated by the external examiner and the guide during the final *Viva-Voce* which will be scheduled by Controller of Examination
9. Any form of plagiarism will not be entertained in the dissertation and if found it will be considered as malpractice and action will be taken accordingly.

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	M	H	H	H
CO2	H	H	M	H	H
CO3	M	M	H	S	S
CO4	M	S	H	H	H
CO5	M	S	H	H	H

S-Strong H- High M-Medium L-Low

MAJOR ELECTIVE PAPERS

1. Biophysics and Bioinformatics
2. WildLife Ecology and Management
3. Animal Parasitology
4. Poultry Science and Management

Programme Code : 06	M.Sc., Zoology		
Major Elective 1. Biophysics and Bioinformatics			
Batch 2023-2024	Hour/Week 5	Total hours 75	Credit 5

Course Objectives

1. To study the principle of biophysics, principles and working mechanism of bioinstruments.
2. To understand the role of instruments in biological research.
3. To Acquire the knowledge on the Biological databases and learn the impact of bioinformatics tools on molecular structure prediction and drug discovery

Course Outcomes (CO)

K1 to K5	**CO1**	Explain the principles and application of various instruments for biological Science.
	CO2	Understand the Knowledge on applications of instruments
	CO3	Apply the application knowledge on various instruments
	CO4	Analyse the various biological databases and its impact on molecular structure prediction
	CO5	Discuss the significance of Biostatistics and Bioinformatics tools in the biological data analysis and molecular structure prediction and drug discovery

SYLLABUS

Unit I Spectroscopy (15 Hours)

Instrumentation:Spectrophotometer, Biosensors, Atomic Absorption Spectrophotometer and UV and Visible Spectrophotometer. Gas Chromatography –mass Spectrometry (GCMS), Nuclear magnetic Resonance Spectroscopy (NMR), Inductively Coupled Plasma Spectroscopy. (ICP).

Unit II Microscopy and Immunotechniques (15 Hours)

Histological techniques: Preparation of sample, serial sections, Microtome, Staining techniques. Immunological techniques – Radio Immuno Assay & Enzyme Linked Immunosorbent Assay (ELISA) and Flow Cytometry.

Microscopy: Simple and Compound microscopes: Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM), Phase contrast Microscope and Fluorescent Microscope.

Unit III **(15 Hours)**

Chromatography (Column, Gas and High performance Liquid).Electrophoresis - Agarose, Polyacrylamide Gel Electrophoresis – SDS-PAGE and Blotting techgniques - Western blot, Southern blot and Northen blot, DNA Micro array and finger printing –RAPD and RFLP.

Unit IV **(15 Hours)**

Introduction to Bioinformatics, Scope and Application of Bioinformatics, Information technology, systems biology, Introduction to genomics and proteomics databases, Nucleic acids, sequence database, Genbank, EMBL, UCSC, Protein sequence databases, Swiss – port, PDB, BLAST, PSI-BLAST, FASTA, Clustal W.

Unit V **(15 Hours)**

Worldwide biological databases, Database search-data mining, data management and interpretation, protein prediction tools, multiple sequence alignment, genes and primer modeling, protein structure analysis, docking and phylogenetic analysis, molecular modeling, programme languages for biological studies.

*** denotes Self study**

Teaching Methods

Smart ClassRoom /Powerpoint presentation/ Seminar/ Quiz/ Discussion/Flipped Class

Text books

1. Veerakumari, L, (2010). Bioinstrumentation, M J P – Publishers, Chennai.
2. Pranab Kumar Banerjee, (2010). Introduction to Biophysics, S. Chand Publications, New Delhi.
3. Jeremy Ramsden, (2015). Bioinformatics –Springer Publication

Reference books

1. Mahinder Singh (2005). A Text Book of Analytical Chemistry - Instrumental Techniques, Dominant Publishers & Distributors, New Delhi.

2. Currell, Graham, (2008). Analytical Instrumentation- Performance Characteristics and qualities, John Wiley & Sons, New York.
3. Wilson K and Walker J, (2000). Practical Biochemistry Principles and Techniques. Cambridge Univ. Press.
4. Skoog. D. A., J. Holler and T. A. Nieman, (1998). Principles of Instrumental Analysis,Saunders College Publishing, 5th Edition.
5. Rastogi, S.C. (2013) Bioinformatics: Methods and Applications, PHI, NewDelhi.
6. Mount, D.W. (2006) Bioinformatics, Sequence and Genome Analysis (2nd Edition) CSHL Press

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	M	H	H	H
CO2	H	H	M	H	H
CO3	M	M	H	S	S
CO4	M	S	H	H	H
CO5	M	S	H	H	H

S-Strong H- High M-Medium L-Low

Programme Code : 06	M.Sc., Zoology		
Major Elective 2. WildLife Ecology and Management			
Batch 2023-2024	Hour/Week 5	Total hours 75	Credit 5

Course objectives

1. To understand and appreciate biodiversity and the Act to protect the wild species.
2. To learn different techniques to study wildlife and develop knowledge of the benefits of the ecosystem.
3. To get knowledge about various methods to conserve biodiversity.

Course Outcome

K1 - K5	**COI**	Discuss the various components of an ecosystem.
	CO2	Understand the wildlife management in India and National Parks and Sanctuaries.
	CO3	Describe the Biodiversity hotspots, Endangered species and their Protection
	CO4	Analyse the importance of ecosystem swrvices in the environment.
	CO5	Evaluate the Wild life management Techniques and animal plant interaction.

SYLLABUS

Unit I **(15 Hours)**

Ecosystem aquatic ecosystem- Pond, terrestrial ecosystem- forest trophic relations in ecosystems, foodchain, foodweb, ecological pyramids - productivity of ecosystem-primary and secondary production. Energy flow in ecosystem. Biotic community and ecological niche.

Unit II **(15 Hours)**

Wild life of India – Ecological sub regions of India. Endangered flora and fauna. Wild life management in India - Indian board for wild life. Protected areas network. National parks and sanctuaries. Special projects for endangered species.

Unit III **(15 Hours)**

Biodiversity-kinds of biodiversity; Biogeography-continental shift,zoogeography, biodiversity hot spots, endemicity; biodiversity assessment; Endagered species-Indian Wild life protection Actl972 and International Redlist Species Criteria, concept and assessment

Unit IV **(15 Hours)**

Population estimation-concept, line transect, quadrate sampling; Animal Trapping Techniques – Pitfall funnel, Sherman traps; marking and recapture techniques; use of indirect evidences in species inventory; Basic methods in behavioral and food habit studies; Wildlife management techniques.

Unit V **(15 Hours)**

Animal plant interactions-pollinators, seed dispersal, biological pest control, vector; Wildlife products - food, medicine, Germplasm, domestication;Ecological balance - prey predator relationships. herbivory and scavengers.

*** denotes Self study**

Teaching Methods

Smart ClassRoom /Powerpoint presentation/ Seminar/ Quiz/ Discussion /Flipped Class

Text Book:

1. Sharma, P.D. (2009), Tenth Edition, Ecology and Environment Rastrog, i publications. Meerut.
2. Hoselli BB Concepts in Wild Life Management (2008) Daya publishing house New Delhi 110002.
3. Anubha Koushik, C.P. Koushik, (2004). Perspectives in Environmental Studies, (Second Edition), New Age International Publishers, New Delhi.

Reference Books

1. Cody, M.L., J.M. Diamond, (1975). Ecology and evolution of communities. Harvard University Press. Cambridge.
2. Gopal, R. (1992), Fundamentals of Wildlife Management, Justice Home. Allahabad. Biodiversity - Gaston, K.J. 1996.
3. Agarwal V.K. and Gupta, U (2004) A biology of numbers and difference. Blackwell Science, Oxford. Ecology. 1st Ed. S.Chand and Company Ltd.New Delhi.
4. Asthana D.K and Asthana, M (2006), Environmental Studies. 1st Ed. (Reprint 2007). S. Chand and company Ltd. New Delhi.

5. Agarwal, K.C., (2001), Environmental Biology, Nidi Publ. Ltd. Bikaner.
6. Sharma, J.P (2009). Environmental Studies, Third edition, University Science Press, Golden House, New Delhi.

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	H	H	M	S
CO2	S	H	H	H	S
CO3	M	M	M	H	S
CO4	H	M	M	L	M
CO5	S	H	H	M	S

S – Strong H – High M – Medium L – Low

Programme Code : 06	M.Sc., Zoology		
Major Elective 3. Animal Parasitology			
Batch 2023-2024	Hour/Week 5	Total hours 75	Credit 5

Course Objectives

1. To inculcate knowledge about parasitic infectious diseases.
2. To impart knowledge on protozoan and helminth parasitology.
3. To enrich the knowledge on vector biology, immunology, genetics and molecular biology of parasites.

Course Outcomes

K1 TO K5	**CO1**	Discuss the role of parasites and their role in transfer of diseases
	CO2	Understand the common parasitic diseases and life threatening conditions caused by parasites.
	CO3	Apply knowledge to study the common parasitic diseases and life threatening conditions caused by helminths as regards etiology and life cycle of parasites of medical importance.
	CO4	Analyze the common diseases caused by arthropods of medical interest as regards etiology, pathogenesis.
	CO5	Illustrate the immunological and molecular methods used for diagnosis of parasitic infections.

SYLLABUS

Unit I: Introduction to Parasites: (15 Hours)

Introduction to parasites, scope and definition of parasitology, Animal association - types of parasites and Hosts; Inter-relationship between host and parasites responses and host to parasitic infection;Mode of transmission of parasite, host specificity and parasitic adaptation. Ecology of parasites: Ecological niche of parasites, evolution of parasitism: Origin of parasitism, progressive and retrogressive evolution.

Unit II: Protozoan Parasitology (15 Hours)

Geographical distribution, Life-cycle, Transmission, Pathogenecity, Treatment of protozoan parasites of man and domesticated animals: *Entamoeba histolytica*, *Giardia* spp., *Cystoisosporarivolta*, *Trypanosoma gambiense*, *Leishmania donovani*, *Plasmodium vivax.*

Unit III: Helminth Parasitology (15 Hours)

Parasitic adaptations in helminthes. Distribution, life cycle and pathogenecity of medically important helminth parasites of man and domesticated animals **Cestodes:** *Hymenolepis nana*, *Diphyllobothrium latum*; **Trematodes:** *Schistosoma haematobium*, *Paragonimuswestermani*; **Nematodes:** *Trichinella spiralis*, *Wuchereria bancrofti*.

Unit IV: Vectors and Vector Borne Infections (15 Hours)

Dipterans as Vectors – Mosquito-Borne diseases: Dengue, Chikungunya, Control of Mosquitoes; Fleas as Vectors – Flea borne Diseases: Plague, Typhus Fever; Control of Fleas. Human Louse as Vectors – Louse borne disease: Typhus fever; Bugs as Vectors – Bugs borne disease: Chagas Disease, Control and prevention.

Unit V: Immunological and Molecular Parasitology (15 Hours)

Serology – ELISA, Immunoblot for Trypanosoma and Plasmodium, Filariasis; Molecular Based assays – PCR, RT-PCR for Leishmania, Plasmodium, Filariasis, COVID-19; Rapid Antigen Detection System (RDTS) diagnosis of malaria, SARS-CoV-2; Complement fixation test for Plasmodium and Leishmania, Immune reactions and parasitic infection, Pathology of parasite infection*.

*** denotes Self study**

Teaching Methods

Smart ClassRoom /Powerpoint presentation/ Seminar/ Quiz/ Discussion /Flipped Class

Text Books

1. Chakraborty, P. (2004), T.B.Medical parasitology, New Central Book Agency, Publishers, New Delhi.
2. Ananthanarayanan, R and Jayaram Panicker, C.K. (2006). Textbook of Microbiology, OrientLongMan Publishers, New Delhi.

3. Markell, E.K., M.Voge, M and John,D. T (2002), Medical Parasitology. W.B. Saunders Publishers, Philadelphia.USA.

Reference Books

1. Prescott, L.M., J.P. Harley, D.A. Klein (2001), Microbiology.McGraw-Hill publishers, New York.
2. Cox, F.E.G. (2009), Modern Parasitology: A TextBook of Parasitology, John Wiley & Sons, Publishers, Oxford, London.
3. Cheng, T.C. (2012), General Parasitology, Academic press, Publishers, Massachusetts, USA.
4. Bogitsh, C.E.Carter, T.N.Oeltmann, (2005), Human Parasitology, Academic press, Publishers, Massachusetts, USA.
5. Soulsby, E.J.L. (2004), Helminths, Arthropods and Protozoa of Domesticated Animals, Bailliere Tindall and Cassell Pvt. Ltd., Publishers, London.
6. Roberts, L.S., J.Janovy, S.Nadler, (2013), Foundations of Parasitology, McGraw-Hill Publishers, New York.

Mapping

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	M	H	H	H
CO2	H	H	M	H	H
CO3	M	M	H	S	S
CO4	M	S	H	H	H
CO5	M	S	H	H	H

S-Strong H- High M-Medium L-Low

Programme Code : 06	M.Sc., Zoology		
Major Elective 4. Poultry Science and Management			
Batch 2023-2024	Hour/Week 5	Total hours 75	Credit 5

Course objectives

1. Make the students to develop knowledge on the history and the role of poultry in rural development and its structure.
2. Students can learn the methods of rearing, breeding and production of poultry.
3. Get the knowledge about the preparation of feed antibiotics, vaccines and marketing.

Course Outcomes

K1 -K5	**COI**	Get the knowledge about the importance of poultry farming
	CO2	Understand the types of poultry breeding
	CO3	Apply the knowledge in types of incubators for poultry breeding
	CO4	Analyze the importance of poultry marketing
	CO5	Evaluate the advanced methodology in the poultry management

SYLLABUS

Unit I **(15 Hours)**

History and importance of Poultry farming, Role of the Poultry in rural development*, employment potential, Economics and contribution to national productivity, Egg production, Table bird production, manure as by-product. Anatomy and physiology of poultry birds with reference to digestive and reproductive system.

UNIT II **(15 Hours)**

Breeds of poultry birds and scientific methods of breeding Hybrid and cross breed. Indian and exotic selecting chicks and parents for production factors in selection, Hatching, selecting eggs for hatching, Natural and artificialincubations, Types of incubators. Maintenance of temperature and humidity sterilization of room during hatching, separation and selling.

UNIT III **(15 Hours)**

Poultry house and equipment, space requirement, types of house, number birds, equipments for feeding, protection from enemies and adverse conditions.

UNIT IV **(15 Hours)**

Nutrition of Poultry birds, requirement according to age feed formulation, classification of feed stuffs. Milling by products, distilleries and brewery by products. Availability of raw materials and their cost, food grinders and mixtures, use of antibiotics.

UNIT V **(15 Hours)**

Brooding and rearing, sexing, vaccination, natural and artificial breeding, types of brooding, temperature . requirement culling. Debreaking, characters of good layers and broilers caponettes and and capons, rearing of chicks.

*** denotes Self study**

Teaching Methods

Smart ClassRoom /Powerpoint presentation/ Seminar/ Quiz/ Discussion /Flipped Class

Text Books

1. Keith Wilson (2007). A Hand book of poultry practice. 2nd Ed. Agrobios (India), Jodhpur.
2. Norris Elye. (2005). The poultry science L.C.R.. Biotech books.Delhi.35.
3. Sreenivasaiah, P. V. (2015). Text book of Poultry Science, Write & Print Publications

Reference Books

1. Manju Yadav. (2003). Economic Zoology: Discovery publishing house. New Delhi
2. Pande B. V.R. Reddy, V.R. Sadagopen and A.K. Shrinivasan. (1984). Feeding of Poultry. (Reprinted 1997), Indian council of Agricultural research. Power Printers New Delhi.
3. R.Venkatakrishnan, (1995). Poultry farm guide. Balaji publications. Madras.
4. Sharma R.D. (1997). Hand book of Animal Husbandry Indian Council of Agricultural Research, Published by, Director Directorate of Publications and information on Agriculture. New Delhi.

5. Gosh. N. (2015). Poultry Science and Practice 1st Edition, CBS Publishers & Distributors.
6. Vegad J. L (2018). Poultry Diseases A Guide for Farmers and Poultry Professionals, CBS; 2nd edition.

MAPPING

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	H	M	S	H
CO2	M	S	H	M	S
CO3	H	M	S	H	M
CO4	H	S	H	S	M
CO5	M	H	S	S	M

S-Strong H- High M-Medium L-Low

NON-MAJOR ELECTIVE

1. Information Security
2. Clinical Laboratory Techniques
3. Nano-biotechnology
4. Human Genetics and Counselling

SUB CODE:22PGI4N2

ProgrammeCode: 06		**M.Sc., Zoology**		
CourseCode:22PGI4N2		INFORMATION SECURITY		
Batch 2023-2024	Semester IV	Hours/Week 4	Total Hours 60	Credits 4

Course Objectives

1. Students will identify the core concepts of Information security.
2. To examine the concepts of Information Security.
3. To design and implement the security features for IT and Industrial sectors.

Course Outcomes (CO)

K1 - K5	**CO1**	To Learn the principles and fundamentals of information security.
	CO2	To Demonstrate the knowledge of Information security concepts
	CO3	To Understand about Information Security Architecture.
	CO4	To Analyze the various streams of security in IT and Industrial sector.
	CO5	To know about Cyber Laws and Regulations.

Unit I **(12 Hours)**

Information Security basics: Definition of Information Security- History of Information Security- Characteristics of Information Security- Components of Information Security- Security System Development Life Cycle (SDLC).

Information Security for technical administrators: Server Security – Network security- Social Media Security.

UNIT II **(12 Hours**

Cryptography: Basic concepts-plain text- Cipher text-Encryption Principles-CRYPT Analysis-Cryptographic Algorithms - Cryptographic Tools – Authentication-Biometrics*-passwords-Access Control Devices- Physical Security - Security and Personnel.

Language-based Security: Analysis of code for security errors, Safe languageand sandboxing techniques.

SUB. CODE : 22PGI4N2

Unit III **(12 Hours)**

Firewalls, Viruses &Worms & Digital Rights Management: Viruses and Worms-Worms-Digital Rights Management – Firewalls-Application and Circuit Proxies-Stateful Inspection-Design Principles of Firewalls.

Logical Design: Access Control Devices- Physical Security-Security and Personnel - NIST Models-VISA International Security Model- Design of Security Architecture-Planning for Continuity.

Unit IV **(12 Hours)**

Hacking: Introduction – Hacker Hierarchy – Password cracking – Phishing-Network Hacking-Wireless Hacking-Windows Hacking-Web Hacking*-Ethical Hacking.

Security Investigation: Need for Security- Business Needs-Threats- Attacks- IP Addressing and Routing- Social Media

Unit V **(12 Hours)**

Cyber Laws : What is Cyber Law? -Need for Cyber laws - Common Cyber Crimes and Applicable Legal Provisions: A Snapshot - Cyber Law (IT Law) in India – The Information Technology Act of India 2000-Cyber Law and Punishments in India-Cyber Crime Prevention guide to users – Regulatory Authorities.

***Self study questions for examination may be taken from the self-study portions also.**

Teaching Methods:

Chalk and Talk, Power point presentation, Seminar, Brainstorming, Assignment, Google Classroom.

Text Book:

Information Security –Textbook is prepared by KONGUNADU ARTS AND SCIENCE COLLEGE, Coimbatore -29, 2022.

Reference Books:

1. Charles P Pfleeger and Shai Lawrence Pfleeger, **"Security in Computing",** Fourth & Third Edition, Prentice Hall, 2007 & 2011.
2. Ross J. Anderson and Ross Anderson, "Security Engineering: A guide to building Dependable Distributed System", Wiley,2009.
3. Thomas R. Peltier, Justin Peltier and John Bleckley, "Information Security Fundamentals",2nd Edition, Prentice Hall 1996.
4. Gettier, Urs E. Information Security: Strategies for Understanding and Reducing Risks John Wiley & Sons, 2011.

5 “Principles of information security”. Michael Whiteman and Herbert J. Mattord,2012.
6 Information security -Marie wright and John kakalik,2007.
7 Information security Fundamentals- Thomas R. Peltier, Justin Peltier and John Blackley-2005.
8 Information Security theory and practical PHI publication, Dhiren R. Patel-2008.
9 Debby Russell and Sr.G.T. Gangemi,” computer Security Basics,2nd edition, O’Reilly Media,2006.

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	M	H	S	S
CO2	M	H	H	S	H
CO3	H	S	S	M	S
CO4	H	M	H	S	H
CO5	H	S	H	S	H

S–Strong **H** –High **M**– Medium **L**–Low

Programme code : 06	M.Sc., Zoology		
Non Major Elective 2. Clinical Laboratory Techniques			
Batch 2023-2024	Hour/Weeks 4	Total hours 60	Credits 4

Course Objectives

1. Understand about clinical laboratory techniques.
2. To familiarize technical knowledge on various laboratory instruments.
3. To analyze physiochemical parameters of samples by using laboratory instruments.

Course outcomes (CO)

K1 to K5	**CO1**	Describe the clinical laboratory techniques
	CO2	Demonstrate about the various laboratory instruments
	CO3	Understanding sample preservation methods
	CO4	Estimation of samples in the laboratory
	CO5	Prepare report based on the sample analysis

SYLLABUS

Unit I: Introduction (12 Hours)

Human health, medical care in India, organisation of clinical laboratory,functional components of basic needs of a clinical laboratory, common types of laboratory accidents, first aid.

Unit II: Laboratory equipments (12 Hours)

Autoclave, hot air oven, incubator, water bath, centrifuge, spectrophotometer, pH meter, haemoglobinometer, haemocytometer. histological techniques, microtome, tissue preparation, fixation, embedding, sectioning, staining and mounting.

Unit III: Hematology (12 Hours)

Haemotomtry-RBC count; Bulk and micropipette method-WBC count; Bulk and micro pipette method-Platelet count-Esinophil count-retic count-PCV-ESR- red cell indices –MCV, MCH,MCHC Clinical significant of all parameters

Unit IV: Clinical Biochemistry (12 Hours)

Urine sample collection, physiological examination of urine, microscopic examination of organized and unorganized elements, estimation of glucose, protein, creatinine, cholesterol and triglycerides in serum.

Unit V: Laboratory organization (12 Hours)

Reception of organization, dispatch of reports, "Records keeping" coding the lesions of cases Follow up programme, quality control of techniques.

*** denotes Self study**

Teaching Methods

Smart ClassRoom /Powerpoint presentation/ Seminar/ Quiz/ Discussion /Flipped Class

Text Books

1. Agarwal, R.A., Anil K. Srivastava, Kaushal Kumar, (2007), Animal Physiology and Biochemistry, S. Chand and Company Ltd., New Delhi.
2. Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009). Principles of Biochemistry. IVEdition. W.H. Freeman and Co.
3. Praful B, Godkar, Dharsan P, Godkar, (2014), TextBook of Medical Laboratory Technology, Bhalani Publishing House.

Reference Books

1. Bhaskar, H.V, (2008), Animal Physiology, Campus BooksInternational.Mukherjee,(2002), Medical Laboratory Technology, Vol. I, II, III, Tata McGraw Hill Publishing Company Limited, New Delhi.
2. A.C. Guyton, and J.E. Hall, (2011), Textbook of Medical Physiology, XII Edition, HarcourtAsia Pvt. Ltd, W.B. Saunders Company.
3. Ramani Sood, (1996), Laboratory technology (Methods and interpretations) 4th Ed. J.P. Bros, New Delhi.
4. Sobti, R.C., (2008), Animal Physiology, Narosa Publishing House Pvt. Ltd., New Delhi
5. Todd and Sanford, (1969), Clinical diagnosis by laboratory method.
6. L.K .Mukherjee, (2017), Medical Laboratory Technology,Vol.1-3,3rd edition, Tata McgrawHill,India.

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	M	H	H	H
CO2	H	H	M	H	H
CO3	M	M	H	S	S
CO4	M	S	H	H	H
CO5	M	S	H	H	H

S-Strong H- High M-Medium L-Low

Programme Code: 06	M.Sc., Zoology		
Non Major Elective 3 - Nano- Biotechnology			
Batch 2023-2024	Hours / Week 4	Total Hours 60	Credits 4

Course Objectives

1. To enhance the basic knowledge on nanoparticle synthesis and its application in agriculture..
2. To enrich nano-technological knowledge on DNA, Proteins, Nucleic acids, drug delivery and biomedicine.
3. To apply knowledge on risk assessment of nano products in environmental and health issues.

Course Outcomes (CO)

K1 to K5	**CO1**	Outline the fundamentals of nanotechnology and nanoparticles
	CO2	Understand the knowledge about bio-nano-materials, synthesis and its characterizations.
	CO3	Apply the various applications of bio-nano materials in different field applications like agriculture and medicine.
	CO4	Analyze the significance of bio-nano-materials to enhance the treatment of various diseases and enhancement of agriculture through nanomaterial's.
	CO5	Evaluate nano-technological knowledge on environmental and health issues.

SYLLABUS

Unit I **(12 Hours)**

Nanotechnology and Nanoparticle

Nanotechnology- Introduction, Scope, History, Importance and Applications, Sources and types of Nanoparticles.

Unit II **(12 Hours)**

Properties and characterization

Synthesis of nanoparticles- Top down and Bottom up approach, green and microbial synthesis. Characterization of nanoparticles- UV-Vis, X – ray diffraction, EDAX and FTI

Unit III **(12 Hours)**

Applications of Nano – materials in Biosystems

Applications of nano-materials in agriculture, medicine. Effects of nano- materials on organisms, environments and Human (Lungs, gastro and skin).

Unit IV **(12 Hours)**

Nanomaterials and Diagnostics/ Drug delivery and Therapeutic

DNA coupled Nanomaterials and drug delivery system. Metal / metal oxide Nanoparticles (Antimicrobial) Anisotropic and magnetic particles (Hyperthermia) and Nanobiomolecules (Protein, Carbohydrates and lipids)*. Nano Devices.

Unit V **(12 Hours)**

Integrated concept of risk assessment of nanoparticles.Types of toxicity based on route of entry, nature of toxin. Cytotoxicity, Genotoxicity*, Invivotestol assay.

*** denotes Self study**

Teaching Methods

Smart ClassRoom /Powerpoint presentation/ Seminar/ Quiz/ Discussion /Flipped Class

Text Book

1. Thomas E., Twardowski (2007). Introduction to nanocomposite materials. Properties, Processing, characterization. DES tech Publications, USA.
2. Sidharth Baliyan, (2011).“Basics of Nanotechnology” Anmol Publications PVT. Ltd.
3. Niemeyer CM, and C. A. Mirkin. (2004). “Nanobitechnology: Concepts, Applications and Perspectives”, Wiley- VCH.

Reference Books

1. Rajendran, V., Saminathan, K., Paramasivam, P., Geckeler, K.E., (2012). “Nanomaterials Synthesis and Characterization”, Bloomsburry Publishing India PVT. LTD, New Delhi.
2. Vinod Labhasetwar and Diandra L. Leslie, (2007). “Biomedical Applications of nanotechnology”, A john Willy & Son inc, NJ, USA.
3. Challa, S.S.R. Kumar, Josef Hormes, Carola Leushaer, (2005). “Nanofabrication towards biomedical applications, techniques, tools, applications and impact, Wiley- VCH,
4. Houdy. P, Lahmani M. Marano F. (2011). Nano-ethics and Nanotoxicology. Spriger, Verlag Berlin Heidelberg.
5. Simeonova P.P., N. Opopol and M.I. Luster, (2007). “Nanotechnology-Toxicological Issues and Environmental Safety”, Springer.
6. RathyRK,, (2009). “Nanotechnology”, S. Chand Publisher.

MAPPING

PSO CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	M	H	H	H
CO2	H	H	H	H	H
CO3	H	H	S	H	S
CO4	S	M	H	M	H
CO5	M	S	H	H	H

S – Strong H – High M – Medium L – Low

Programme code : 06		M.Sc., Zoology	
Non Major Elective Paper 4 - Human Genetics and Counselling			
Batch 2023-2024	Hour/Week 4	Total hours 60	Credit 4

Course objectives

1. To Understand knowledge on the blood types, transfusion and diseases.
2. Toknow aboutthe role of amniocentesis in Prenatal Diagnosis, dermatoglyphics and Population genetics.
3. To learn the applications of Genetic engineering and Genetic counseling

Course outcomes (CO)

K1 to K5	**CO1**	Describe the types, physiology and genetics of blood groups.
	CO2	Understand the importance of prenatal genetic diagnosis and role of dermatoglyphics in criminology.
	CO3	Apply the Hardy Weinberg principle in human genetics.
	CO4	Analyze the applications of genetic engineering in medicine.
	CO5	Discuss the values of genetic counselling and pedigree chart analysis in human life.

SYLLABUS

Unit I **(12 Hours)**

Blood groups (major types) Blood transfusion, Erythroblastosisfoetalis. Physiology and genetic of blood groups.

Unit II **(12 Hours)**

Aminocentesis, Dermatoglyphics: Terminology, methods of observation and printing, dermatoglyphic features of syndrome.

Unit III **(12 Hours)**

Population genetics, Hardy-Weinberg principle and its application in human population.

Unit IV **(12 Hours)**

Genetic engineering and its applications in human being, Cancer*, AIDS.

Unit V **(12 Hours)**

Genetic counseling, definition, aims, procedure in genetic counseling and its limitation. Pedigree chart and its uses.

*** denotes Self study**

Teaching Methods

Smart ClassRoom /Powerpoint presentation/ Seminar/ Quiz/ Discussion /Flipped Class

Text Books:

1. Rastogi, V.B (2010). A text book of Genetics. Kedarnath Ramnath, New Delhi.
2. Verma, P.S and Agarwal V.K. (2007).Genetics. S.Chand and Company Pvt. Ltd, New Delhi.
3. Lewin B (2003). Genes – VIII, Oxford University Press.

Reference Books:

1. Strachan, T and Read, A. P. (1999), Human Molecular Genetics, 2nd edition, Wiley Publishers.
2. Genome Analysis, A laboratory manual, Vol 2, Detecting Genes, Bruce Birren et al; 1998 Cold Spring Harbour Laboratory Press.
3. Sinnot, E.W. Dunn. L.C. Dobzhausky (2004). Principle of Genetics. McGraw Hill Book Company, New York
4. Robert .H. Lewin (2002), Principles of Genetics. Tata McGraw Hill Publishing Company Ltd., New Delhi.
5. Peter Snustad. D and Michael J. Simmons (2011). Principles of Genetics. Wiley Publishers.
6. Benjamin A. Pierce (2016). Genetics: A Conceptual Approach 6th Edition. W.H. Freeman

MAPPING

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	H	M	S	H
CO2	M	S	H	M	S
CO3	H	M	S	H	M
CO4	H	S	H	S	M
CO5	S	M	H	S	M

S-Strong H- High M-Medium L-Low

Programme Code : 06	M.Sc, Zoology		
EDC- Entrepreneurial Opportunity in Sericulture			
Batch 2023-2024	Hours / Week 2	Total Hours 30	Credits 2

Course Objectives

1. To inculcate the Entrepreneurship and capacity building among the students
2. To train the people from low economic back ground so as to take sericulture as a prosperous avocation
3. To give knowledge about the mulberry cultivation and silk worm rearing techniques. The students will know about the laws and by laws governing keeping silk moth.

Course Outcomes (CO)

K1 to K5	**CO1**	Explore the expert manpower to handle the sericulture units/corporate sector
	CO2	Understand the trained students in silkworm production techniques
	CO3	Apply sustainable rural economy by adapting sericulture for different climate condition
	CO4	Analyze the economics and marketing value of cocoons and silk
	CO5	Evaluate the entrepreneurial opportunities for rural development in Sericulture

SYLLABUS

Unit I **(6 Hours)**

History, concept, scope and significance of Sericulture

Introduction to Sericulture: Origin and history of sericulture. Silk route and map of India and World; Properties and importance of silk fibre. Sericultural practices in tropical and temperate climate. Characteristic features and advantages of sericulture; scope of sericulture in India - employment potential and income generation; Significance of sericulture vis.-a- vis other agricultural crops.

Unit II **(6 Hours)**

Silkworm Biology and Rearing technology

Classification of silkworm races. Host plants of mulberry and non-mulberry silkworms. Life cycle of *Bombyx mori;* Rearing houses and equipments; disinfection and hygiene. Types of silkworms, rearing methods and rearing operations; Physical and commercial characteristics of cocoons; Cocoon stifling; Silk reeling: charaka, cottage basin and multi-end, steps involved in silk reeling.

Unit III **(6 Hours)**

Diseases and Pests of Silkworm

Classification of silkworm diseases; Protozoan disease, Bacterial diseases, Viral diseases, Fungal diseases – causative agents, symptoms, sources, mode of infection and transmission - prevention and control. Silkworm pests - Indian uzifly, Cocoon pests of silkworm, Predators of silkworm - prevention and control measures. Integrated management of silkworm diseases and pests.

Unit IV **(6 Hours)**

Cocoon marketing and Economics

Assessment of cocoon proportion-storage and preservation of cocoon in silk realing units, Properties of mulberry silk; silk testing and grading – objectives; silk exchanges; weaving and dyeing. Sericultural marketing organizations - seed, cocoon, raw silk and silk fabric. Traditional and regulated markets-merits and limitations. Marketing institutions - marketing boards, co-operatives,stabilization of price.

Unit III **(6 Hours)**

Entrepreneurial opportunity in Sericulture

Types of silk produced in India; Silk industries in different states, employment potential in mulberry and non-mulberry sericulture. Sericulture organization in India; role of state departments of Sericulture, Central Silk Board, Universities and NGOs in Sericulture development. Prospects of Sericulture as Self- Employment venture. Role of women in Sericulture, Sericulture as a tool forrural development.

*** denotes Self study**

Teaching Methods

Smart ClassRoom /Powerpoint presentation/ Seminar/ Quiz/ Discussion /Flipped Class

Text Books

1. Ganga. G. Sulochana Chetty, J. (2020), An introduction to sericulture, Second Edition, Oxford & IBH Publishing Company, New Delhi.
2. M. Kichisaburo, (1997) Moriculture – Science of Mulberry Cultivation. Oxford & IBH.
3. M. Madan Mohan Rao, (2019), An Introduction to Sericulture, Second Edition, BS Publications, Hyderabad.

Reference Books

1. Krishnaswami, M.N. Narasimhanna, S.K. Suryanarayan, S. Kumararaj, (1973). Sericulture Manual-2 - Silkworm Rearing, Agriculture Service Bulletin,
2. K. SenGupta, G. Pradeep Kumar, (1991), Diseases and Pests of mulberry and their control. CSR & TI Mysore, India.
3. George N. Agrios, (2000), Plant Pathology, Harcout Asia Pvt Ltd, And Harcout Publishers International Co. Singapore.
4. Manisha Bhattacharyya, (2019), Economics of Sericulture, Rajehs Publications.
5. Silkworm Rearing and Diseases of Silkworm, (1956) Ptd. By Director of Ptg., Stn.& Pub. Govt. Press, Bangalore.
6. P. Kumaresan, G. Srinivasa, (2005), Sericulture Extension Management and Economics. Central Silk Board, Bangalore.

MAPPING

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	H	M	S	H
CO2	M	S	H	M	S
CO3	H	M	S	H	M
CO4	H	S	H	S	M
CO5	S	M	H	S	M

S-Strong H- High M-Medium L-Low

Programme Code : 06	M. Sc, Zoology		
JOC – ANIMAL HUSBANDRY			
Batch 2023-2024	Hour/Week 3	Total hours 45	Credit 2

Course objectives

1. To give an overview on the common breeds of livestock and their breeding habits.
2. To develop ideas about the various management practices and veterinary medicine.
3. To have a basic understanding of veterinary and dairy Science.

Course outcomes (CO)

K1 to K5	**CO1**	Remember the concept about the basic principles and production of livestock.
	CO2	Understand the basic principles of animal genetics and role of reproductive physiology in livestock production.
	CO3	Apply the knowledge to understand the feeding system and role of nutrition in animal production.
	CO4	Analyze the impact of diseases and control measures on animal husbandry practices.
	CO5	Evaluate the technical knowledge for consultancy, marketing and entrepreneurship development in the field of animal husbandry.

SYLLABUS

Unit I: Basics of Animal Husbandry (9 Hours)

Scope and importance;Common breeds of cattle, buffalo, sheep, goat, pig, poultry and rabbits; Animal production systems; Principles of housing for farm animals and routine management practices for various categories of livestock and sick animals. Role of livestock in Indian economy and human health. Socioeconomic aspects of livestock enterprise with special reference to farming community and rural development.

Unit II: Basic Andrology and Artificial Insemination (9 Hours)

Cattle - Sexual behavior of males; Pheromones – Definition, role of pheromones; Study of male genitalia and gonads; Male infertility; Semen collection processing and storage; Artificial insemination; Handling of fresh and frozen semen; Semen evaluation; Diseases transmitted through semen.

Systems and strategies for improvement of livestock for milk, meat, wool production and poultry for eggs and meat. Breeding of resistance varieties.

Unit III: Animal Nutrition (9 Hours)

Principles of animal nutrition; Role of natural and artificial dietary nutrition in animal health and production; Feeds and fodders; Scientific feeding of livestock; Feeding schedule for different categories of livestock; Feed additives; Silage making, Diet formulation for newborn, growing, pregnant, lactating and sick animals. Nutrition deficiencies and their management.

Unit IV: Veterinary Medicine (9 Hours)

Major contagious diseases affecting cattle, buffaloes, sheep and goats, pigs, poultry, rabbits. Etiology, symptoms, pathogenicity, diagnosis, treatment and control of major bacterial, viral, and parasitic infections.

Immunization and vaccination:Methods of immunization; Vaccines and their use in animals. Animal Ethics – Society for the prevention of Cruelty to Animals (SPCA)*.

UNIT – V Dairy Science (9 Hours)

Physico-chemical and nutritional properties of milk. Quality assessment of milk and milk products, Common tests and legal standards.Cleaning and sanitation of dairy equipment. Milk collections, chilling, transportation processing, packaging, storage and distribution. Manufacture of market milk,cream butter, cheese, ice-cream, condensed and dried milk, by products and Indian Milk products – Economic importance; New Entrepreneur cum Enterprise Development – programmes, schemes, agencies in India.

*** denotes Self study**

Teaching Methods

Smart Class Room /Powerpoint presentation/ Seminar/ Quiz/ Discussion /Flipped Class

Text Books:

1. Banerjee, G.C. (2018), Principles of Animal Nutrition and Feeds, Oxford and IBH publishing Co Pvt. Ltd., Publishers, New Delhi.
2. Reddy (2018), Applied Nutrition: Livestock, Poultry, Rabbits and Laboratory Animals, Oxford & IBH publishing Co Pvt. Ltd., Publishers, New Delhi.
3. Singh, C.D.N. (2010), Advanced General Pathology of Animals (PB), International Book Distributing Co., Publishers, New York.

Reference Books:

1. Bansil P.C.and Malhotra, S.P. (2006), Livestock Economy of India, CBS Pvt. Ltd., Publishers, New Delhi.
2. Shukla M.K (2011), Applied veterinary Andrology and frozen semen technology, New India publishing Agency, Publishers, New Delhi.
3. Owen, E., Kitalyi, A.N.Jayasuriya, T.Smith, (2005), Livestock & Wealth Creation: Improving the husbandry of animals kept by resource poor people in developing countries. Nottingham Uni.Press, Publishers, Nottingham.
4. Mohiuddin, S.M. (2007), Infectious Diseases of Domestic Animals, IBDC Publishers, Lucknow.
5. Hui Y.H (2014), Dairy Science and Technology Handbook: Principles and Properties, Wiley India Pvt. Ltd., Publishers, New Delhi.
6. Spreer, P (2018), Milk and Dairy Product Technology (HB), Taylor & Francis Pvt. Ltd., Publishers, London.

Mapping

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	H	H	H	S
CO2	H	S	H	H	H
CO3	H	M	H	H	H
CO4	H	H	S	H	H
CO5	H	H	M	M	S

S-Strong H- High M-Medium L-Low

Programme code : 06	M.Sc, Zoology		
ALC -Eco tourism			
Batch 2023-2024	Hour / Weeks 3	Total hours 45	Credits 2

Course Objectives

1. Learn the importance of tourism.
2. Understand the Laws and policies related to tourism.
2. Understand the benefits of tourism.

Course outcomes (CO)

K1 to K5	**COI**	Get knowledge about the tourism industry
	CO2	Explain the National and International relationships with tourism
	CO3	Apply the knowledge of information technology in the tourism industry
	CO4	Familiarize about the passport and visa formalities
	CO5	Evaluate the natural disasters and their management

SYLLABUS

Unit I **(9 Hours)**

Definition of Tourism - Terminologies Related To Tourism - Elements of Tourism -Growth of Tourism - Basic Patterns of Tourism - Special Patterns of Tourism -Sectors In The Tourism Industry.

Unit II **(9 Hours)**

Definition - Destination of A's Necessary For A Tourist Destination - Learning To Locate Places by Using Latitudes and Longitudes - International, National & Regional Organizations for Tourism.

Unit III **(9 Hours)**

Advent of Information Technology in the Tourism Industry: Impact of Information Technology in the Tourism Industry.

Unit IV **(9Hours)**

Travel Formalities - Passport and Visa Formalities* - HealthDocuments - Health Preventive Measures for Travelers - Travel Insurance.

Unit V **(9Hours)**

Tsunami, Earthquake, Cyclone, Flood, Global warming, Landslides, Soil erosion and volcanoes

*** Denotes Self Study**

Teaching Methods

Smart Class Room / Powerpoint presentation / Seminar/Quiz / Discussion / Flipped Class

Text Books

1. Stefan Gössling,Johan Hultman (CABI, 2006), Ecotourism inScandinavia: Lessons in Theory Volume 4 of Ecotourism book series *and* Practice New Delhi.
2. Vatsala Iyengar and Malathi Ragavan.(2003). South India Tourist Guide-Ecology and Environment -P.D.Sharma, Rastogi Publications, Meerut, India.
3. Roy Ballantyne and Jon Packer (2013), International hand book on Eco tourism. University of Queens land School of tourism, Australia.

Reference books

1. Arul, P.A. (2004). Text book of Environmental Studies. Environmental Agency, Chennai.
2. David, A. (2007). Feennell Ecotourism Brock University, St Catharines, Ontario, Canada.
3. Dieter and Muller, (2007), Department socio economic geography Umea university swedan Tourism in pheripheries perspectives from the far north and south.
4. Glynn Henry J.and Gary W Heinke, Environmental Science and Engineering, Prentice Hall of India Private Ltd., New Delhi – 110 001.
5. Singh, J.S., Gupta, S.R. and Singh, S.P. (2005), Ecology, Environmental science and conservation. S. Chand Publishers, ISBN: 9789383746002.
6. Agarwal, K.C, (2001), Environmental Biology, Nidi Publ. Ltd. Bikaner.

MAPPING

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 4
CO1	S	H	M	S	H
CO2	M	S	H	M	S
CO3	H	M	S	H	M
CO4	H	S	H	S	M
CO5	M	H	H	S	M

S-Strong H- High M-Medium L-Low