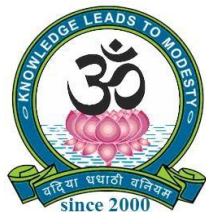


Master of Science



Zoology



**SRI VIDYA MANDIR ARTS & SCIENCE COLLEGE**

**(Autonomous)**

**[An Autonomous College Affiliated to Periyar University, Salem, Tamil Nadu]**

**[Accredited by NAAC with 'A' Grade with CGPA of 3.27]**

**[Recognized 2(f) & 12(B) Status under UGC Act of 1956]**

**Katteri – 636 902, Uthangarai (Tk), Krishnagiri (Dt)**

**Tamil Nadu, India**

**Website: [www.svmcugi.com](http://www.svmcugi.com)**

**Website: [svmzoologyug@gmail.com](mailto:svmzoologyug@gmail.com)**



**DEGREE OF MASTER OF SCIENCE IN ZOOLOGY**  
**CHOICE BASED CREDIT SYSTEM (CBCS)**

**REGULATIONS AND SYLLABUS FOR**  
**M.Sc. ZOOLOGY PROGRAMME**  
**(SEMESTER PATTERN)**



(For Students Admitted in the College from the Academic Year 2020-2021 Onwards)

### Programme Outcomes (POs)

<b>PO1</b>	Students gain knowledge and skill in the fundamentals of animal sciences, Understands the complex interactions among various living organisms.
<b>PO2</b>	Analyse complex interactions among the various animals of different phyla, Their distribution and their relationship with the environment.
<b>PO3</b>	Apply the knowledge of internal structure of cell, its functions in control of Various metabolic functions of organisms.
<b>PO4</b>	Understands the complex evolutionary processes and behavior of animals.
<b>PO5</b>	Apply the knowledge and understanding of Zoology to one's own life and work.

### Programme Specific Outcomes (PSOs)

<b>PSO1</b>	Understand the nature and basic concepts of cell biology, Genetics, Taxonomy, Physiology, Ecology and Applied Zoology.
<b>PSO2</b>	Perform procedures as per laboratory standards in the areas of Taxonomy, Physiology, Ecology, Cell biology, Genetics, Applied Zoology, Clinical science, tools and techniques of Zoology, Toxicology, Entomology, Nematology Sericulture, Biochemistry, Fish biology, Animal biotechnology, Immunology and Research methodology
<b>PSO3</b>	Analyse the relationships among animals, Plants and Microbes.
<b>PSO4</b>	Understand the applications of biological sciences in Apiculture, Aquaculture, and Medicine.
<b>PSO5</b>	Gains knowledge about research methodologies, effective communication and skills of problem solving methods.



## SRI VIDYA MANDIR ARTS & SCIENCE COLLEGE

(Autonomous)

Master of Sciences (M.Sc.) in Zoology

Programme Pattern and Syllabus (CBCS)

(For Students Admitted in the College from the Academic Year 2020-2021 Onwards)

Sl. No.	Nature of the	Course Code	Name of the Course	Hours/Week	Credits	Marks		
<b>SEMESTER III</b>								
13	Core – VII	20PZO3C07	Aquaculture	6	4	25	75	100
14	Core – VIII	20PZO3C08	Immunology	6	4	25	75	100
15	Core – IX	20PZO3C09	Developmental Biology	5	4	25	75	100
16	Core – X	20PZO3C10	Research Methodology	5	4	25	75	100
17	Practical-III	20PZO3P03	Lab Course – III (Covering Core VII–X)	6	5	40	60	100
			Library/Seminar	2	-	-	-	-
<b>Total</b>				<b>30</b>	<b>21</b>	<b>140</b>	<b>360</b>	<b>500</b>
<b>SEMESTER IV</b>								
18	Core – XI	20PZO4C11	Evolution	5	4	25	75	100
19	Core – XII	20PZO4C12	Environmental Biology	5	4	25	75	100
20	Core – XIII	20PZO4C13	Economic Zoology	5	4	25	75	100
21	Practical-IV	20PZO4P04	Lab Course – IV (Covering Core XI-XIII)	4	5	40	60	100
22	Project	20PZO4PR01	Project Work and Viva Voce	11	6	25	75	100
			Library/Seminar	2	-	-	-	-
<b>Total</b>				<b>30</b>	<b>23</b>	<b>140</b>	<b>360</b>	<b>500</b>
<b>Cumulative Total</b>				<b>120</b>	<b>90</b>	<b>610</b>	<b>1590</b>	<b>2200</b>
	Course							
12	Practical-II	20PZO2P02	Lab Course – II (Covering core V–VI)	5	5	40	60	100
			Library/Seminar	2	-	-	-	-
<b>Total</b>				<b>30</b>	<b>22</b>	<b>165</b>	<b>435</b>	<b>600</b>



### Elective Courses

Semester	Course Code	Paper Title	Credits
<b>Group – A</b>			
Semester I	20PZO1E01	Applied Entomology	3
	20PZO1E02	Pathology and Clinical Laboratory Techniques	3
	20PZO1E03	Biological Techniques	3
<b>Group – B</b>			
Semester II	20PZO2E04	Cancer and Stem Cell Biology	3
	20PZO2E05	Microbiology	3
	20PZO2E06	Biotechnology	3

### SUPPORTIVE PAPERS FOR OTHER PG COURSES

Semester	Course Code	Paper Title	Credits
Semester II	20PZOEDC01	Wild Life Biology	4
	20PZOEDC02	Vermitechnology	4

### Note



CBCS – Choice Based Credit system,  
CIA – Continuous Internal Assessment  
ESE – End of Semester Examinations

# PROGRAMME SYLLABUS



Program: M.Sc. Zoology				
Core – I		Course Code: 20PZO1C01		Course Title: Biology of Invertebrates
Semester I	Hours/Week 5	Total Hours 75	Credits 4	Total Marks 100

### Course objectives

1. The students will classify the Invertebrates up to order level.
2. To understand the feeding and Respiratory mechanisms in Invertebrates.
3. To learn the mechanism of chemical coordination and Reproduction in Invertebrates.

### UNIT – I

General Classification of invertebrates up to order level. **Locomotion** Amoeboid Flagella and Ciliary movement in protozoa. Locomotion in Annelida and Echinodermata.

### UNIT – II

**Nutrition:** Nutrition in Protozoan – Sponges – Coelenterates and Platyhelminthes – Filter Feeding in Polychaetes and Mollusca. **Respiration:** Respiratory organs – Gills – Gill book – Book lungs – Parapodia – Trachea - Water vascular system with reference to respiration.

### UNIT – III



**Excretion:** Excretory organs and excretory products in Invertebrates. **Circulatory system:** Circulation in Invertebrates – Open and Closed system. **Receptors:** Mechano reception – Chemoreception – Photoreception.

#### UNIT – IV

**Nervous System:** Primitive types – Coelenterates - Echinoderms and Hemichordates. Advanced types – Metameric nervous system – Giant nerve fibers – Molluscan nervous system and Learning in Cephalopods. Chemical co-ordination – Neurohumors – Neurohormones - Endocrine regulation of moulting in crustaceans and insects Pheromones and Allelochemicals.

#### UNIT – V

**Chemical Co-ordination:** Hormones and neurohormones – Endocrine regulation in Annelids, insects, and Molluscs – Pheromones and Allelochemicals. **Reproduction:** Asexual reproduction in Protozoans and Polychaetes. Unity in the early development of Metazoa – Protostomia and Deuterostomia. Phylogeny of invertebrates.

#### Reference Books

1. Barnes R. D (1982) Invertebrate Zoology. 4<sup>th</sup> Edition, Holt Saunders International Edition.
2. Barrington E.J.W (1979) Invertebrate Structure and Functions. 2<sup>nd</sup> Edition, ELBS and Nelson.
3. Barrington E.J.W (2012) Invertebrate Structure and Function, (2<sup>nd</sup> Ed) Affiliated East West Press Pvt. Ltd. New Delhi.
4. Hyman G.H (1955) The Invertebrates, Vol. I to VII, McGraw Hill Book Co., Inc., New York.
5. Kashya P .V (1997) Life of Invertebrates. Vikas Publishing House Pvt. Ltd., New Delhi.
6. Kotpal R.L (2014) Modern Text Book of Zoology – Invertebrates, (2016 Ed) Rastogi Publications – Meerut, New Delhi.
7. Pechenik J.A. (2005) Biology of the Invertebrates Graw Hill, India.
8. Veer Bala Rastogi (2017) Invertebrate Zoology, Rastogi Publications
9. Waterman A .J (1971) Chordate Structure and Function. The Macmillan Company.

#### Course Outcomes (COs)

On successful completion of the course, the students will be able to



CO Number	CO Statement	Knowledge Level
CO1	Define invertebrates based on their morphology.	K1
CO2	Know the feeding mechanisms of invertebrates.	K2
CO3	Get the knowledge about chemical coordination and reproduction In Invertebrates.	K3

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

### Mapping of Cos with POs

PO \ CO	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	S
CO2	S	S	M	M	M
CO3	M	M	M	M	S

S – Strong

M – Medium

L – Low





Program: M.Sc. Zoology				
Core – II		Course Code: 20PZO1C02		Course Title: Biology of Chordates
Semester	Hours/Week	Total Hours	Credits	Total Marks
I	5	75	4	100

### Course Objectives

1. To motivate the students to learn the classification of chordates.
2. To facilitate the students to know about the salient features of fishes and Reptiles.
3. To make the students to understand the adaptations in Aves and Mammals.

### UNIT – I

**Origin of Chordates and classification of Prochordates:** Geological time scale - Origin of chordates -Vertebrate relationships and Basic structure.

### UNIT – II

**Amphioxus** – Type study

**Pisces:** General characters and Outline classification up to orders with suitable examples. Type study: Shark. **Amphibia:** Characters and Classification of Amphibia up to order level. Origin of Amphibia, External characters of Frog. Biology and Adaptive features of Anura - Urodela and Apoda- Parental care in Amphibia.

**UNIT – III**

**Reptilia:** General characters and outline classification. Morphology of Calotes. Origin and Adaptive radiation in Reptilia – Extinct Reptiles. Identification and study of Poisonous and Non-poisonous snakes of India.

**UNIT – IV**

**Aves:** General characters and outline classification

Type study: Pigeon. *Archaeopteryx* -Significance of *Archaeopteryx*-Migratory Birds.

**UNIT – V**

**Mammalia:** General characters and Outline classification. Type study: Rabbit.Importance of Marsupial Mammals. Exoskeleton structures of birds and mammals - Dentition in Mammals - Ruminant stomach in mammals and Echolocation in Bats.

**Vertebrate Fossils:** *Archaeopteryx* and Mesozoic mammals.

**Reference Books**

1. A.J. Waterman (1971) Chordate Structure and Function, Collier Macmillan Ltd.
2. Ekambaranatha Ayyar, M. and Ananthkrishnan, T.N. (2003). A Manual of Zoology, Part-II (Chordata). Viswanathan Printers and Publishers, Chennai.
3. F. Harvey Pough, Christine M. Janis, John B. Heiser (2012), Vertebrate Life (9<sup>th</sup> Edition) Pearson Publisher
4. J. Z. Young, Marion Nixon (1981) The Life of Vertebrates, Oxford University Press.
5. Jordan, E.L. and Verma, P.S. (2013). Chordate Zoology. 14<sup>th</sup> Edition, S. Chand & Company, New Delhi.
6. Kent, G.C. and Carr, R.K. (2001). Comparative Anatomy of the Vertebrates. 9<sup>th</sup> Edition, McGraw Hill Book Company.
7. Kotpal, R.L. (2015). Modern Textbook of Zoology Vertebrates. 4<sup>th</sup> Edition, Rastogi Publications, Meerut, New Delhi
8. Libbie Henrietta Hyman, 1992, Hyman's Comparative Vertebrate Anatomy, University of Chicago Press.
9. Prasad, S.N. and Kashyap, V. (2012). A Textbook of Vertebrate Zoology. 14<sup>th</sup> Edition, New



Age International Pvt., Limited.

### Course Out Come (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Classify chordates based on their morphology.	K2
CO2	Differentiate fishes and amphibians based on the morphology.	K5
CO3	Select the adaptations of birds and mammals for terrestrial life.	K6

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

### Mapping of Cos with POs

PO \ CO	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	S
CO2	S	S	M	M	M
CO3	M	M	M	M	S

S – Strong

M – Medium

L – Low



Program: M.Sc. Zoology				
Core – III		Course Code: 20PZO1C03		Course Title: Cell and Molecular Biology
Semester	Hours/Week	Total Hours	Credits	Total Marks
I	5	75	4	100

### Course Objectives

1. To enable the students to gain basic and comprehensive knowledge in the multidisciplinary science of eukaryotic cell biology.
2. To develop in-depth knowledge on molecular basis of cell functions.

### UNIT – I

**Discovery of Cell:** Cell theory- Protoplasm theory - Prokaryotic and Eukaryotic cell differentiation - Cell Cycle and regulations. **Cell division:** Mitosis - Meiosis and their significance. **Cytoplasm:** Physical and biological properties of cytoplasmic matrix. **Plasma membrane:** Chemical composition Structure and functions. **Ribosome and Golgi bodies:** Ultrastructure types and functions. **Lysosome:** Chemical composition- Polymorphism and Functions. **Endoplasmic reticulum and plastids:** Ultrastructure - types and functions. **Mitochondria:** Ultrastructure and functions. Micro bodies Peroxisomes and Glyoxisomes

### UNIT – II

**Nucleus:** Ultra-structure of nuclear membrane. Nucleolus- Nucleoplasm and Chromatic fibers.



Microtubules, microfilaments – Cilia and Flagella Signal **Transduction Pathways:** organization signals - Receptors. Ion channel coupled receptors – Secondary messengers. Amplifiers- Integrators and Signal hypothesis.

### UNIT – III

**Nucleic Acid:** DNA as genetic material (direct and indirect evidences) – Structure and types of DNA and RNA. **Eukaryotic Chromosome:** Chromosome structure and organization - C-value paradox DNA – repetitive DNA and Junk DNA.

### UNIT – IV

**DNA Replication:** Semi conservative and rolling circle models - Enzymes involved in replications. **Transcription and Translation:** RNA polymerase – Types- Properties and functions– Transcription process in prokaryotes and Eukaryotes – RNA processing – Capping- polyadenylation –Splicing - Introns and Exons.

### UNIT – V

**Chromosomal Aberration and Simple Mendelian Traits in Man** **Chromosomal Aberration:** Introduction – Types of chromosomal abnormalities –Numerical chromosomal abnormalities – Autosomal abnormalities – Sex chromosome abnormalities. **Simple Mendelian Traits in Man:** Albinism – Taste Blindness for PTC – Eye Colour – Rh Blood group – Phenylketonuria and Sickle cell Anemia.

### Reference Books

1. Alberts B, Johnson A, Lewis J, Raff M, Roberts K and Walter P (2009) Essential Cell Biology. Garland Science, New York.
2. Cooper, GM (2005) The Cell – A Molecular Biological Approaches. ASM Press, Washington.
3. De Robertis E.D.P and De Robertis E.M.F (2001) Cell and Molecular Biology. Lippincott Williams and Wilkins, USA.
4. Gupta P.K (2009) Cell and Molecular Biology. Rastogi Publications, Meerut.
5. Karp G (2010) Cell and Molecular Biology: Concepts and Experiments. 6<sup>th</sup> Edition, John Wiley and Sons Ltd. New York.
6. Lewin B (2010) Genes. Oxford University Press, Oxford.



7. Pavlella P. (1998) Introduction to Molecular Biology, McGraw-Hill Companies Inc., New York.
7. Roy SC and De K.K (2010) Cell Biology, New Central Book Agency, Calcutta.
8. Thorpe NO (2000) Cell Biology, John Wiley and Sons, New York.
9. Turner P.C McLennan A.G Bates A.D and White M.R.H (2007) Instant Notes Molecular Biology. Viva Books Pvt. Ltd., New Delhi.
10. Walker J.M and Gingold E.B (2010) Molecular Biology and Biotechnology. Panima University Press, Oxford Publishing Co., New Delhi.



### Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Describe and discuss the properties and biological significance of the major classes of molecules found in living organisms and the relationship between molecular structure and biological function.	K1
CO2	Cell and molecular biology is platform for the emergency of different fields like genetic engineering, cell culture, biotechnology and molecular biology.	K2
CO3	Explain the structure of membranes and intracellular compartments and relate these to function.	K4
CO4	Describe the processes that control eukaryotic cell cycle and cell death.	K5
CO5	Link the rapid advances in cell and molecular biology to a better understanding of diseases, including cancer	K6

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

### Mapping of COs with POs

PO \ CO	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	S	S
CO2	M	S	M	M	M
CO3	S	M	S	S	S
CO4	M	S	M	S	M
CO5	S	M	S	M	S

**S – Strong**

**M – Medium**

**L – Low**



Program: M.Sc. Zoology				
Core – IV		Course Code: 20PZO1C04	Course Title: Biochemistry	
Semester	Hours/Week	Total Hours	Credits	Total Marks
I	5	75	4	100

### Course Objectives

1. To enable the students to learn the biological phenomena at the molecular level.
2. To provide a basic and advanced understanding of the principles of Biochemistry.
3. To acquire knowledge on the fundamental chemical principles that governs complex biological systems.

#### UNIT – I

**Bio macro molecules and their physiological significance :** Structure of atoms- Molecules and chemical bonds- Properties of water. Classification- Composition- structure and Function of biomolecules - Carbohydrates- Lipids- Amino acids- Proteins-Nucleic acids and Vitamins.

#### UNIT – II

**Metabolism of biomolecules Metabolism of Carbohydrates:** Glycolysis- Pyruvate oxidation-Citric acid cycle- Glycogen metabolism- Gluconeogenesis and Pentose phosphate pathway. **Metabolism of Protein:** Deamination- Transamination and Decarboxylation. Urea cycle. **Lipid Metabolism:** Bioenergetics oxidation and Reduction reactions  $\beta$  Oxidation

#### UNIT – III

**Enzymology Enzymes:** Definition- Classification of enzymes and Enzyme kinetics - Enzyme regulation- Principle and Mechanism of enzyme catalysis - Isozymes. **Types of Inhibition:** Feedback and allosteric – Competitive - Uncompetitive and Non- competitive.

#### UNIT – IV

**Porphyryns:** Hemoglobin synthesis and Sickle cell anemia- Nucleoside and Nucleotide. **Nucleic acids:** Free nucleotides – Structure - Properties and Functions of RNA and DNA. Synthesis and Degradation of purine and Pyrimidine (De novo and salvage pathways). **Syndromes associated with nucleic acid metabolism:** Aicardi-Goutières syndrome (AGS), Lesch- Nyhan syndrome and GOUT Disease.





## UNIT – V

**Signal transduction:** Hormones and their receptors - Steroid hormone receptor and Gene action. Peptide hormone receptor (cell surface receptors) - signaling through G-protein coupled receptors - Signal transduction pathways- Camp- cGMP - phosphatidyl inositol and Calcium as second messengers and Regulation of signaling pathways.

### Reference Books

1. Ambika Shanmugam (2012) Fundamentals of Biochemistry for medical students, 7<sup>th</sup> Edition, Lippincott Williams and Wilkins.
2. Lehninger A.L, Nelson D.L and Cox MM (2013) The Principles of Biochemistry. CBS Publishers, New Delhi.
3. Lehninger, A.L., Nelson, D.K., and Cox, M.M. (2015) Principles of Biochemistry. CBS Publishers and distributors, New Delhi.
4. Moat A.G and Foster J.E (2008) Microbial Physiology. John Wiley and Sons, New York.
5. Murray, R.K., Granner, D.K., Mayes, P.A., Rodwell, V.W. (2017) Harper's Biochemistry. Prentice Hall International Inc.
6. Satyanarayanan, U (2015). Essentials of Biochemistry, Uppala Author – Publisher Interlinks, Vijayawada.
7. Stryer L (2010) Biochemistry. 4<sup>th</sup> Edition, W. H. Freeman and Company, New York.
8. Stryer, L. (2016) Biochemistry. W.H. Freeman and Company, New York.
9. Voet D and Voet J.G (2012) Biochemistry. 4<sup>th</sup> Edition, John Wiley and Sons, New York.
10. Voet. D. Judith, G. Voet, Charlotte W. Pratt. (2014) Fundamentals of Biochemistry, John Wiley & Sons Inc. New York.



### Course Out comes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Describe the chemistry of carbohydrates, lipids, proteins and amino acids	K1
CO2	classification and structural organization of proteins	K2
CO3	Explain the mechanism of enzyme action and identify the classes of enzymes and factors affecting action	K3
CO4	Identify the class and functions of secondary metabolites	K4
CO5	Select the significance of Biochemistry	K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

### Mapping of COs with POS

PO CO	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	S
CO2	S	M	M	S	S
CO3	M	S	M	S	S
CO4	M	M	S	S	M
CO5	M	S	M	M	M

S – Strong

M – Medium

L – Low



Program: M.Sc. Zoology				
Elective – I		Course Code: 20PZO1E01		Course Title: Applied Entomology
Semester	Hours/Week	Total Hours	Credits	Total Marks
I	4	60	3	100

### Course Objectives

1. To know taxonomical position and collection aspects of insects
2. To inculcate knowledge of morphology and physiology of insects
3. To impart knowledge about the growth and metamorphosis in insects.

### UNIT – I

**Taxonomy and Insect Collection:** Classification of Insects up to order with examples for each order-Identification of Insects using Insect keys. **Insect Collection:** Methods- Preservation and Significance.

### UNIT – II

**Comparative Morphology:** Mouth parts of insects – Head- Thorax- Abdomen- Genitalia and Appendages Integument structure.

### UNIT – III

**Anatomy and Physiology:** Digestive system- Respiratory system- Circulatory system-



Excretory system and Reproductive system.

#### UNIT – IV

**Insect culture practice:** Apiculture – Sericulture and Lac culture. **Veterinary Entomology:** House flies- Mosquito and Bugs. **Vectors:** Cattles vectors – Social life of insects – Hibernation and Aestivation insects.

#### UNIT – V

**Agriculture entomology:** Pests of Vegetables – Pest of fruits – Pest of stored products and Pest of paddy- Pest of sugarcane – Pest ground nut – Biology and Control measures. **Integrated pest management (IPM):** Mechanical- Biological-Chemical and Legislative methods.

#### Reference Books

1. Chapman R.F (2002) The Insects Structure and Function, 4<sup>th</sup> Edition, Cambridge University Press, United Kingdom.
2. Fenemore P.G. & A. Prakash (2002) Applied Entomology. New Age International (P) Publishers, New Delhi.
3. Imms, A.D (1972) Text Book of Entomology. Vol. I & II Ed. by Richard & Owen. ELBS.
4. Mani S (1968) General Eentomology. Oxford & IBH Publishing. New Delhi.
5. Nayar K.K. and T.N. Anathakrishnan and B.V. David. (1983), General and Applied Entomology, Tata McGraw Hill publishing Co. Ltd., New Delhi.
6. Tembhare D.B. (2009) Modern Entomology, Himalaya Publishing House, Delhi.
7. Vasantharaj David B and T. Kumarasami (2011). Elements of Economic Entomology, Popular Book depot, Madras – 15.
8. Wigglesworth V.B. (1979). The principles of insect physiology, ELBS and Chapman and Hall. U.K.



### Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Get knowledge about the taxonomical position, collection, Identification and preservation of insects.	K1
CO2	Understand the morphology, structure and chemistry of integument.	K2
CO3	Apply knowledge in studying the behavior and physiology of Insects.	K3
CO4	Analyze the role of endocrine glands and their hormones in insect metamorphosis.	K4

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

### Mapping of COs with POs

PO \ CO	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	S
CO2	S	M	S	S	S
CO3	S	M	M	S	S
CO4	S	S	S	M	S

**S – Strong**

**M – Medium**

**L – Low**



Program: M.Sc. Zoology				
<b>Elective – I</b>		<b>Course Code: 20PZO1E02</b>		<b>Course Title: Pathology and Clinical Laboratory Techniques</b>
<b>Semester</b>	<b>Hours/Week</b>	<b>Total Hours</b>	<b>Credits</b>	<b>Total Marks</b>
I	4	60	3	100

### Course Objectives

1. To understand fundamental analytical principles and processes used in clinical laboratory testing.
2. To understand the practical and theoretical basis for laboratory test selection and interpretation.
3. To respond appropriately and effectively to situations commonly encountered when taking call.
4. To begin learning the body of knowledge needed for board exams
5. To obtain an understanding of the elements that contribute to professional competence, including patient care, medical knowledge, practice-based learning, interpersonal and communications skills, professionalism, and systems-based practice.

### **UNIT – I**

Basic Laboratory Equipments- Microscopy- Resolution, Magnification & Contrast- Light Microscopy-types- Electron Microscopy – Incubator - Hot Air Oven -Laminar Air flow- Water Bath –Centrifuge - Autoclave - Haemocytometer- Flame Photometer- Microtome – Glassware – Description of Glassware, its use, handling and Care

### **UNIT – II**

Organization of clinical laboratory – Safety measures – Chemical, fire & Electrical – Lab Technician Duties and Responsibilities – Clinic borne infection and personnel hygiene Clinical Laboratory records – Quality control: Accuracy, Precision and Reference values, use of



chemicals and their interactions - Danger signs, production techniques and Disposal methods.

### UNIT – III

**Cytology:** Blood Smear preparation cytology – Fixation of smears – Staining – Fluid cytology – Urine- Sputum - Spinal fluid -Pleural fluid - Scrape or brush cytology - Testing biopsy and Cytology specimens for cancer

### UNIT – IV

**Body fluids:** Characteristics of Cerebrospinal Fluid – Synovial fluid – Pleural fluid – Pericardial fluids – Peritoneal fluids – Semen analysis- Physical, chemical & microscopic examination- Sperm count – Motility and Stool analysis.

### UNIT – V

Urine – Composition, collection and Preservation, changes in composition of urine in relation to various diseases – Complete urine analysis – Physical - Chemical – Glucose - Protein, reducing substances- Ketone bodies -Blood pigments and Bile Sediments.

### Reference Books

1. Fischbach, (2005). Manual of Lab and diagnostic tests, Lippincott Williams Wilkins, New York.
2. Gradwohls, (2000). Clinical laboratory methods and diagnosis. (Ed) Ales C. Sonnenwirth and Leonard Jarret, M.D.B.I., New Delhi
3. Ochei.J and Kolhatkar, (2002). Medical Laboratory Science Theory and Practice, Tata McGraw -Hill, New Delhi.
4. Kanai L. Mukherjee, (2007), Medical Laboratory Technology Vol.1.Tata McGraw Hill, New Delhi.
5. Sood.R(2014) Laboratory Technology (Methods and interpretation) 4<sup>th</sup> Ed. J.P. Bros, New Delhi.
6. Shirley Mitchell Lewis, Barbara J. Bain, Imelda Bates (2006) Dacie and Lewis Practical Haematology, 10<sup>th</sup> Ed, Churchill Livingstone/Elsevier.



### Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	To understand fundamental analytical principles and processes used in clinical laboratory testing.	K2
CO2	To apply the practical and theoretical basis for laboratory test selection and interpretation.	K3
CO3	To analyse clinical, public health and management skill.	K5
CO4	Investigate the principles and uses of bioinstrumentation in medical laboratory.	K6

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

### Mapping of COs with POs

PO \ CO	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	M	S
CO2	S	S	S	M	S
CO3	M	S	M	S	M
CO4	S	M	S	M	S

S – Strong

M – Medium

L – Low





Program: M.Sc. Zoology				
Elective-I		Course Code: 20PZO1E03		Course Title: Biological Techniques
Semester	Hours/Week	Total Hours	Credits	Total Marks
I	4	60	3	100

### Course Objectives

1. To learn where things are in the lab.
2. To learn what the things in the lab are. This includes learning what things do, what they do not do, and where they should be used (if applicable).
3. To learn how to care for things in the lab.
4. To learn how to order and store supplies.
5. To learn some of the basic, most often used, most generally applicable: Tools, techniques, methodologies and methods of analysis used in biological research.

### UNIT – I

**Cytological Techniques:** Microscopy – Optical and electron microscopy – Phase contrast microscopy – Interference microscopy – Dark field- Polarization - Fluorescence and X-ray microscopy. Micrometry – Measurements using ocular and Stage micrometers – Measurements of cells from any prepared slide.

### UNIT – II

**Separation Techniques:** Chromatography – Thin layer and Column chromatography – HPLC - GC and GCMS; Principles and Applications; AGE and PAGE; PCR and Blotting techniques; Centrifugation Principles and Types (differential and density gradient).

### UNIT – III

**Analytical Techniques:** pH meter - Colorimeter -Visible and UV spectrophotometer- NMR- XRD – SEM - TEM bomb colorimeter and Atomic absorption spectrophotometer



#### UNIT – IV

**Molecular Biology Techniques:** Isolation and purification of RNA - DNA (genomic and plasmid) and Proteins, different separation methods. Isolation, separation and Analysis of carbohydrate and Lipid molecules –RFLP - RAPD and AFLP techniques.

#### UNIT – V

**Applications of Bioinformatics in various fields:** Drug designing - Medicine (molecular, personalized, preventive) - Gene therapy-Design of microbes for various applications (waste cleanup-forensic studies - Bio-weapons) – Bioengineering - Biological Computer, Computational methods of phylogenetic and Molecular evolutionary analysis

#### Reference Books

1. Boyer Rodney (2000). Modern Experimental Biochemistry, Person Education Asia, Delhi.
2. David, S.K. (1991). Handbook of histological and histochemical techniques, CBS Publishers and Distributors, Delhi.
3. Kannan S, Krishnan M, Thirumurugan R and Achiraman S (2012) Methods in Molecular Biology, UVN Publishers, India.
4. Santosh Kumar Mondal, (2017). Manual of Histological Techniques, Jaypee Brothers Medical Publishers, PP.180.
5. Veerakumari, L. (2009). Bioinstrumentation, MJP Publications, Chennai.
6. Wilson, K. and Walker, J. (2000). Practical Biochemistry, Cambridge University Press, Cambridge.



### Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Students will demonstrate proper and safe, proper use of equipment, and the ability to use basic techniques in several areas and advanced techniques in at least one area.	K2
CO2	Apply the concepts of bio analytical techniques in biotechnology research.	K3
CO3	Learn the principles, methods and working mechanisms of microscopy.	K4
CO4	Handle these bio analytical techniques in industry.	K5
CO5	Operate and optimize the experimental conditions of different analytic techniques	K6

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

### Mapping of COs with POs

PO CO	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	S	S
CO2	S	S	M	M	S
CO3	S	M	S	S	M
CO4	M	S	M	S	M
CO5	S	M	S	M	S

S – Strong

M – Medium

L – Low



Program: M.Sc. Zoology				
<b>Lab Course – I</b>		<b>Course Code: 20PZO1P01</b>		<b>Course Title:</b> Biology of Invertebrate and Vertebrates Cell and Molecular Biology and Biochemistry
<b>Semester</b> I	<b>Hours/Week</b> 4	<b>Total Hours</b> 60	<b>Credits</b> 5	<b>Total Marks</b> 100

### Course Objectives

1. To observe various Invertebrate specimens by using Microscope.
2. To impart the practical knowledge on haematological studies
3. To understand the working principles and applications.
4. To learn how to quantify the biochemical substances and heritable traits.
5. To know the role of fauna in and around our ecosystem.

### **Invertebrates and Chordates**

1. Structure and function of Major Mammalian Organs (Rat-heart, Pancreas, Liver, Kidney and Gonads) – Voucher Specimen
2. Spotters and Slides (For *Plasmodium sp.*- *Paramecium sp.*- Sponges- Hydra- Liver fluke- Tape worm and Peripatus.)

### **Cell and Molecular Biology**

1. Micrometry for cell measurement
2. Identification of different types of cells in blood
3. Observation of Mitosis (onion root tip) and Meiosis (Grasshopper – Voucher Specimen)
4. Assessment of Cell division at various soil pH

### **Biochemistry**

1. Qualitative analysis of Carbohydrate-Protein and Lipids
2. Estimation of glucose level in blood



3. Effect of Temperature on salivary amylase activity
4. Identification of amino acids by paper chromatography

### Reference Books

1. Plumer H.T (2012) Practical: Biochemistry, Wiley Publication, India.
2. Borah D (2012) Biotechnology Lab Practices, Global Academic Publisher, India.
3. Kannan S, Krishnan M, Thirumurugan R and Achiraman S (2012) Methods in Molecular Biology, UVN Publishers, India.
4. Lal S.S (2009) Practical Zoology, Rastogi Publications, New Delhi.

### Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand and study the section of certain animals from Coelenterata, Aschelminthes and Annelida to understand the evolution of different types of coelom.	K2
CO2	Evalute of prepared slides of mouth parts of Honey bee, Housefly, Thrips, Mosquito, Bed bug and Butterfly to relate structure and type	K5
CO3	Study of the following specimens: Amphioxus, Balanoglossus, Ascidian, Peteromyzon, Ichthyophis, Draco, Pigeon and Bat.	K6

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

**Mapping of COS with POs**

<b>PO CO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>
<b>CO1</b>	S	S	M	M	S
<b>CO2</b>	M	S	S	S	M
<b>CO3</b>	S	S	S	S	M

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



Program: M.Sc. Zoology				
Core – V		Course Code: 20PZO2C05		Course Title: Animal Physiology and Endocrinology
Semester	Hours/Week	Total Hours	Credits	Total Marks
II	6	90	4	100

### 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 fiber.
3. To study the structure and functions of endocrine glands.
4. To gain basic understanding about endocrinology.

#### UNIT – I

**Nutrition and Digestion Metabolism:** Types – Anabolism and Catabolism. Basal metabolic rate (BMR); Nutritive Requirements – Carbohydrates – Proteins - Lipids Vitamins and Minerals; **Physiology of Digestion:** Role of salivary glands - Liver Pancreas and Intestinal glands in digestion. Symbiotic digestion – Cellulose digestion. Absorption and Assimilation – Hormonal control of digestion.

#### UNIT – II

##### **Respiration and Circulation**

**Respiration:** Respiratory system of man – O<sub>2</sub> and CO<sub>2</sub> transport in the blood of human – Types, Haemoglobin – structure and function – Respiratory pigments in animals. Chemical regulation of respiration. **Circulation:** Blood – Composition of blood structure of human heart working mechanism of heart-peace maker and Conduction of heart beat – Blood coagulation. Lymph: composition, Dynamics and Haemostasis.

#### UNIT – III

**Excretion, Osmoregulation and Thermoregulation Excretion: Types of Excretion:** Structure of mammalian kidney – Urine formation and Role of hormones in excretion.



**Osmoregulation:** Osmotic and ionic regulation in freshwater and Marine fishes – osmoregulation in terrestrial animals. **Thermoregulation:** Thermoregulation in homeotherms and Poikilotherms. Comfort zone- body temperature – Physical, chemical, neural regulation and Acclimatization.

#### UNIT – IV

**Muscle and Nerve Co-ordination Muscles:** Types of muscles – Chemistry of muscles – Ultra structure of skeletal muscles. Mechanism of muscle contraction. **Nervous system:** Types of nervous system – Structure of Neuron – Types of Neuron conduction and transmission nerves impulses – Reflex action and Synapses action. **Receptor:** Structure and physiology of photoreceptor (Human eye) and Phonoreceptor (Human Ear).

#### UNIT – V

**Endocrinology and reproduction Arthropod endocrines:** Role of hormones in growth and Metamorphosis of Insects and Prawn. **Reproductive system:** Structure of Human reproductive organs – Sexual cycle in mammals - Hormonal role in ovulation and Birth control. **Endocrine glands:** Chemical structure and function hormones hypothalamus -Pituitary- Thyroid - Pancreas adrenal – Testes Ovary and Placenta. Hormones – Functions of hormone.

#### Reference Books

1. Schmidt-Nielsen K (1997) Animal Physiology, Cambridge University Press.
2. Randall D, Burggren W and French K (2002) Eckrett Animal Physiology, W. H. Freeman Publications.
3. Sherwood L, Klandorf H and Yancey P (2012) Animal Physiology: From genes to organisms, Cengage Learning.
4. Prosser, C.L. and Brown (1985) Comparative Animal Physiology III Ed. W.B. Saunders Company, Philadelphia
5. Prosser C.L (1991) Comparative Animal Physiology, Environmental and Metabolic Animal Physiology, John Wiley and Sons.
6. Robert, H. Williams, M.D. (1981). Text book of Endocrinology, 6<sup>th</sup> Edition, Igakv Shoin, Aaunders International Edition. Tokyo, Japan.





7. Manning A and Dawkins M.S (2012) An Introduction to Animal Behavior, Cambridge University Press.
8. Breed, M.D and Moore J (2011) Animal Behavior, Academic Press, New York.
9. Gordon, M. S., Bartholomew, G. A., Grinnel, A. D., Jorgensen, C. B. White, F.N., (1971) Animal Function - Principles and Adaptations. Macmillan Co. London.
10. Goodenough J, McGuire B and Jakob E (2009) Perspectives on Animal Behavior, John Wiley and Sons.
11. Halliday T (1994) Animal Behavior, University of Oklahoma press, USA
12. Nussey S.S and Whitehead S.A (2013) Endocrinology: an integrated approach, CRC Press.
13. Hadley, M.E and Levine J.E (2007) Endocrinology, Prentice Hall.

### Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Know the importance of nutrients and digestion.	K1
CO2	Understand the physiology of respiration, circulation and muscle.	K2
CO3	Impart knowledge on the role of renal organs in excretion.	K3
CO4	Describe the endocrine glands and their secretions.	K4
CO5	Evaluate the basic control processes of the nervous systems and explain how this drives muscle movement and sensory perception associated endocrine system.	K5

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

### Mapping of COs with POs



PO CO	PO1	PO2	PO3	PO4	PO5
C01	S	S	S	M	S
C02	S	S	M	M	S
C03	S	S	S	M	S
C04	M	S	S	S	M
C05	M	S	S	M	S

S – Strong

M – Medium

L – Low



Program: M.Sc. Zoology				
Core – VI		Course Code: 20PZO2C06		Course Title: Molecular Genetics
Semester II	Hours/Week 6	Total Hours 90	Credits 4	Total Marks 100

### Course objectives

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

#### UNIT – I

**Introduction to principles of Genetics:** Dominant and Recessive Epitasis Multiples factor inheritance – Skin colour in Man. Co-dominance – Pleotropism – Lethal genes in Man and Mice.

#### UNIT – II

ABO and Rh type of Blood groups – Erythroblastosis foetalis - Haemophilia - Linkage and crossing over and Mapping of chromosome - Non-disjunction-Free Martin- Sex linked inheritance in Drosophilae and Man - Y-linked inheritance – Barr body- Extra chromosomal inheritance – Kappa particles – Coiling in Snail – Mirablis and Episome.

#### UNIT – III

**Mutation** – Types (lethal, conditional and biochemical) causes and Detection – Loss of function- Gain of function-Germinal verses somatic mutants- Insertional mutagenesis – Inborn errors of metabolism Sickle cell anemia and Phenylketonuria.

**Chromosomal Abreaction:** Molecular basis of mutation – Polygenic inheritance – Crossing over – Mutation and Mutagenesis; Transition and Transversion – Spontaneous and Induced mutations- Single Nucleotide polymorphism and Genetic disorders.

**UNIT – IV**

Heredity and variation Linkage maps- Tetrad analysis-Mapping with molecular markers- Mapping by using somatic cell hybrids - Lod score for linkage testing-Karyotyping- Pedigree analysis. Heritability and its measurements- QTL mapping.

**UNIT – V**

Viral oncogenes- Activation of proto-oncogenes- Tumor suppressor genes- Regulation of gene expression by oncoproteins- Signal transduction by oncoproteins- Cell cycle check points and Cell line.

**Reference Books**

1. Dale J.W and Park S.F (2004) Molecular Genetics of Bacteria. 4<sup>th</sup> Edition, John Wiley and Sons Ltd., New York.
2. Gupta P.K. (2005) Genetics. III Ed. Rastogi Publication, India.
3. Karp G (2010) Cell and Molecular Biology: Concepts and Experiments. 6<sup>th</sup> Edition, John Wiley and Sons Ltd., New York.
4. Singh B.D (2009) Genetics, Kalyani Publishers, New Delhi.
5. Snustad D.P and Simmons M.J (2008) Principles of Genetics. John Wiley and Sons Ltd., New York.
6. Tamarin R.H (2001) Principles of Genetics (2001) 7<sup>th</sup> Edition, McGraw-Hill, New York.
7. Verma, P.S. and V.K. Agarwal. (2010) Genetics, 21<sup>st</sup> Ed. S Chand Publishers, New Delhi.



### Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Get knowledge about the structure, organization and functions of genetic materials.	K1
CO2	Understand the expression, regulation and mutation of gene.	K2
CO3	Apply the knowledge on the role of genes in heritability and its measurements.	K3
CO4	Analyze the importance of viral oncogenes, regulation of gene expression and signal transduction by oncoproteins.	K4

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

### Mapping of COs with POs

PO CO	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	S	S
CO2	S	S	M	S	S
CO3	S	S	S	M	S
CO4	M	S	S	S	M

**S – Strong**

**M – Medium**

**L – Low**



Program: M.Sc. Zoology				
EDC-I		Course Code: 20PZO2EDC01		Course Title: Wild Life Management
Semester	Hours/Week	Total Hours	Credits	Total Marks
II	4	60	4	100

### Course Objectives

1. To know the wild life – Tourism foreign exchange. Important wildlife sanctuaries of the world.
2. To know the wild life in India such as wild life resources and sanctuaries.
3. To know the behavior of grazers (Elephants) carnivores (Lion) and primates (Orange, chimps and Gorillas).
4. To study the behavior and migration of Birds – various Bird sanctuaries Bird watching, fishing etc..

### UNIT – I

**Wild Life:** Introduction Scope for the study of wildlife resources and forestry. Wild life Tourism. Foreign exchange and Revenue from Wildlife Tourism – Employment prospects. Important wildlife sanctuaries of the world. Need for the production and Conservation and conservation of wildlife and endangered species- Red data book.

### UNIT – II

**Wild Life In India:** Important wildlife game reserves and sanctuaries in India, Gir Lion forest, Jim Carbett Tiger reserve- Kasiranga Sanctuary- Point Calimere - Bharatpur Kaleodeo bird sanctuaries - Rann of Kutch - Mudumalai- Karkudi and Wynad sanctuaries and their wildlife species and Endangered species.

### UNIT – III



**Ethology of Animal Behaviour:** Grazers – Elephant – herds, their behaviour, family hierarchy, feeding, reproduction, and Migration, Carnivores –Lions –family life, hunting behavior and Feeding, mating and Reproduction, hierarchy, Primates – Larger primates – Orange, Chimps and Gorillas and Group behavior.

#### UNIT – IV

Bird Watching as hobby – Equipment needed for Bird watching, - Important migratory birds of India, check list of birds, Migratory behavior and Influencing factors. Fishing and sport / game fishes. Point Calimere- Vedanthagal – Muthupert - Bharatpur and other bird sanctuaries.

#### UNIT – V

Wildlife watching and tours as hobby and research. Wildlife filming. Videography and documentation. Silent Valley Project, Wildlife parks. Zoos, Treatment of animals in captivity and circuses. Wildlife conservation measures – Wildlife Protection Acts and Laws, World Wildlife conservation and funding agencies and programmes (WWF). Tiger projects (UNEP), ICUN (International Union for conservation of Nature and Natural Productively).

#### Reference Books

1. Charlie – Pye Smith., (1982) Insearch of Wild India, North, South Productions. Publishers, Boxtree Ltd.
2. Terry Vaughan, A., W.B. (1972), Mammalogy, Saunders Company. London.
3. Encyclopedia of Animal World. Vol. I-XX, By Smith, North, South Productions, Publishers, Boxtree Ltd.
4. Salim Ali, (1978), Birds of India and Pakistan, By, Hindustan Publishers, New York.
5. Animal Behaviour, Times Illustrated World of Science, Time Life Asia.
6. Encyclopedia of Animal World, Vol.I-XX, by stargazers – Tatis, Bay Books, Sydney.



### Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Describe the wildlife management in India and National Parks and Sanctuaries.	K2
CO2	Analyze the Biodiversity hot spots, Endangered species and their Protection	K4
CO3	Evaluate the Wild life management Techniques and animal plant interaction.	K6

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

### Mapping of COs with POs

PO CO	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	M	M	S
CO3	M	S	S	S	S

**S – Strong**

**M – Medium**

**L – Low**





Program: M.Sc. Zoology				
EDC-I		Course Code: 20PZO2EDC02		Course Title: Vermitechnology
Semester	Hours/Week	Total Hours	Credits	Total Marks
II	4	60	4	100

### Course Objectives

1. To impart training on Earthworm culture technology.
2. To create knowledge on Self - Employment opportunity.

### UNIT – I

**Scope and importance of Vermitechnology:** Classification of earthworm. Earthworm – External features, Digestive system, excretory system, reproductive system and Life cycle- Economic importance of Earthworm.

### UNIT – II

**Vermiculture:** Methods of collection of earthworms. Steps involved in vermiculture. Factors influencing the culture of earthworms. Vermicomposting; steps of vermicomposting mechanism of vermicomposting and Changes in during vermicomposting.

### UNIT – III

**Methods of vermicomposting:** Small scale or Indoor vermicomposting – Pit method. Heap method. Large scale or outdoor vermicomposting – Bed method, Window method vermitech 200. Vermiwash – preparation, composition and Application of vermiwash.

### UNIT – IV

**Vermicompost:** Physical, chemical and biological characteristics of vermicompost. Nutritive value of vermicompost advantages and Economic importance of vermicompost. Use of vermicompost for crop production. Use of vermicompost in Land improvement and Reclamation.

**UNIT – V**

**Role of earthworm in waste management:** Solid waste management, Sewage waste management (Vermifilter), Faecal waste management, Industrial waste management. Role of earthworm in soil fertility earthworm as Farmer's friend.

**Reference Books**

1. Sultan Ismail (1997). Vermicology-The Biology of Earthworm, Orient Longman Limited, Chennai.
2. Edwards C .A and Lofty J .R (1977). Biology of Earthworms Chapman and Hall Ltd., London.
3. Lee K E (1985). Earthworms: Their ecology and Relationship with Soils and Land Use, Academic Press, Sydney.
4. Satchel J. E (1983). Earthworm Ecology, Chapman Hall, London.

**Course Outcomes (COs)**

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Knowledge about sustainable agriculture, organic farming and waste management using vermitechnology.	K1
CO2	Understand the Earthworm- types, classification, organization and lifecycle.	K2
CO3	Apply the rearing and harvesting techniques in sericulture.	K3
CO4	Analyse the all aspects related to Vermicomposting and the economics of Vermiculture	K4

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

**Mapping of COs with POs**

<b>PO CO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>
<b>C01</b>	S	S	S	M	S
<b>C02</b>	M	S	M	S	M
<b>C03</b>	M	S	S	M	S
<b>C04</b>	S	S	M	S	M

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



Program: M.Sc. Zoology				
Elective – II		Course Code: 20PZO2E04		Course Title: Cancer and Stem Cell Biology
Semester	Hours/Week	Total Hours	Credits	Total Marks
II	5	75	3	100

### Course Objectives

1. To motivate students to learn the fundamentals of cancer
2. To enable the students to know how the stem cells are functioning
3. To get knowledge about different types of molecular techniques.

#### **UNIT – I**

Regulation of the Eukaryotic cell cycle- Cancer biomarkers - Primary and established cell lines, Kinetics of Cancer cell growth- Genetics of cancer biology. Cancer stem cell culture and their applications. Cell culture-based vaccines and Cancer proteomics at a glance

#### **UNIT – II**

Cell Signaling in Cancer Cells and Signaling at the cell surface level- Types of signaling pathways that control gene activity in normal and cancer cells - Endocytotic and Exocytotic proteins in membranes and Organelles - Vascular traffic - Metabolism and Movement of lipids.

#### **UNIT – III**

Etiology- Epidemiology Diagnosis and Treatment of Breast, Lung, and Colo-rectal, cancers. Current scenario of micro-RNA technology in cancer medicine. Role of DNA vaccination in cancer treatment.

#### **UNIT – IV**

Introduction to Stem cells– Stem cell definition, origin and Hierarchy; stem cell properties, Identification and Characterization- Potency and Differentiation; niche of stem cell; overview of different stem cell types (Embryonic stem cell, Adult stem cell and Induced pluripotent stem cells)

#### **UNIT – V**



Characterization and properties of ES cells -Pluripotency and self-renewal of ES; molecular mechanisms regulating pluripotency Mesenchymal stem cell (MSC), Haematopoietic stem cell (HSC) pluripotent stem cell (iPSC), Gene therapy – Therapeutic cloning. Ethical and Social consideration of Stem cell research.

### Reference Books

1. Committee R (2004) Stem Cells and the Future of Regenerative Medicine by on the Biological and Biomedical Application of Stem Cell Research.
2. Kiessling, A.A. (2006). Human Embryonic Stem Cells (Second Ed.) Jones & Barlett Publishers.
3. Korobkin R and Munzer SR (2007) Stem Cell Century, Law and Policy for a Breakthrough Technology, Yale University Press.
4. Lanza R (2004) Hand Book of Stem Cells Volume 1and2, Elsevier press.
5. Lanza, R. (2005). Essentials of Stem Cell Biology. Academic Press.
6. Lodish H, Kaiser C.A, Brasher A, Amon A, Berk A, Kreger M, Ploegh H and Scott M.P (2012) Molecular Cell Biology, 7<sup>th</sup> edition, Garland Publishing, Inc. New York.
7. Robertis E.D.P and De Robertis E.M.F (2005) Cell and Molecular Biology, (8<sup>th</sup> Edn), De, B.I. Waverly Pvt. Ltd., New Delhi.
8. Turksen K (2002) Embryonic Stem Cells Method and Protocols. Humana press.

### Course Outcomes (COs)



On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand key theoretical aspects of the regulation of cellular signalling, proliferation and differentiation in the context of embryonic development, stem cells and diseases such as cancer.	K1
CO2	This course work provides chance to work in stem cells and cancer stem cells.	K2

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

#### Mapping of COS with POs

PO \ CO	PO1	PO2	PO3	PO4	PO5
CO1	M	M	M	M	S
CO2	M	S	S	M	M

S – Strong

M – Medium

L – Low



Program: M.Sc. Zoology				
Elective – II		Course Code: 20PZO2E05		Course Title: Microbiology
Semester	Hours/Week	Total Hours	Credits	Total Marks
II	5	75	3	100

### Course Objectives

1. To provide students with the latest information in microbiological methods.
2. To provide advanced knowledge, understanding, and critical judgment about the profession in microbiology.
3. To update basic knowledge on microorganisms.
4. To understand the economic importance of microbes in relation to agriculture, industry and medicine.

### UNIT-I

**History and Scope of Microbiology:** Wittaker's Five Kingdom concept - General features of prokaryotes. Morphology and Ultra-structure of viruses. Mycology: Classification of bio medically important fungal species.

### UNIT-II

**Culture and Characterization:** Isolation and identification of bacteria. Techniques of pure culture methods. Phases of growth. Methods of sterilization and Disinfection –. Staining: Simple and Differential staining-Gram staining- Acid fast staining Endospore staining- Capsule staining and Flagella staining.

### UNIT-III

Microbial genetics: Methods of genetic transfers – transformation, conjugation, transduction. Microbial Genomics: Genome project of Escherichia coli and Yeast. Metagenomics concepts and Significance. Microbial control – Physical and chemical agents

### UNIT-IV



**Host parasite interaction:** Principles of Disease and Epidemiology –Microbial Mechanisms of Pathogenicity Innate Immunity: Nonspecific Defenses of the Host Adaptive Immunity: Specific Defenses of the Host

### UNIT-V

**Industrial Microbiology:** Microbial fermentation Microbial production of Antibiotics: Penicillin-Streptomycin - Vaccines - Genetic recombinant vaccines. Bioremediation Principles and Applications.

### References Books

1. Atlas R.M. (2001) Principles of Microbiology. 2<sup>nd</sup> Edition, Tata McGraw-Hill, New Delhi.
2. Dubey R.C and Maheswari D.K (2014) Textbook of Microbiology. S. Chand and Co. New Delhi, Edition, Macmillan Press.
3. Gerard J. Tortora, Berdell R. Funke, Christine L. (2017) Case, Microbiology: An Introduction, 12<sup>th</sup> Edition Pearson publishers, USA
4. Pelczar M. J, Chan E.C.S and Kreig N.R (2015) Microbiology. Tata-McGraw Hill, New Delhi.
5. Prescott L.M (2016) Microbiology. 6<sup>th</sup> Edition. McGraw-Hill, New Delhi.

### Course Outcomes (COs)





On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Apply the knowledge on microorganisms classification, importance and application	K1
CO2	Observe the role of microorganisms on food processing, environment, microflora on human health and disinfection methods	K2
CO3	To develop a heightened sense of understanding in students about the microscopic world around them.	K3

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

#### Mapping of COs with POs

PO \ CO	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	M	S
CO2	S	S	S	S	M
CO3	S	M	M	S	M

**S – Strong**

**M – Medium**

**L – Low**

**Program: M.Sc. Zoology**



<b>Elective – II</b>		<b>Course Code: 20PZO2E06</b>		<b>Course Title: Biotechnology</b>	
<b>Semester</b> II	<b>Hours/Week</b> 5	<b>Total Hours</b> 75	<b>Credits</b> 3	<b>Total Marks</b> 100	

### Course Objectives

1. To understand the basic knowledge of Nano-Biotechnology.
2. To enhance the synthesis and application of Nano-materials in medicine and agriculture.
3. To apply Nano-Technological knowledge on the DNA, Proteins, Nucleic acids, drug delivery and biomedicine.

#### **UNIT-I**

Concepts and scope of Biotechnology – Gene cloning the basic steps – various types of restriction enzymes – Ligase – linkers and Adapters – cDNA – Transformation – Selection of recombinants. Gene probe – Molecular finger printing (DNA finger printing) – RFLP –PCR techniques – Genomic library.

#### **UNIT-II**

Plasmid biology – Cloning vector based on *E. coli*-PBR322 and Bacteriophage. Cloning vector for yeast. Cloning vector for Agro Bacterium *Tumefaciens*. Cloning vector for mammalian cells – Simian virus 40 – Gene transfer technologies.

#### **UNIT-III**

Cell culture – Organ culture – Whole embryo culture- Embryo transfer – *In vitro* fertilization (IVF) technology – Dolly – Embryo transfer in human. Transgenic animal. Human gene therapy and Cryobiology

#### **UNIT-IV**

**Bioinformatics:** Basic concepts of Bioinformatics - Sequence Databases - Sequence formats – Gene basic - Networking – Network access- Internet, E.mail servers – Use of databases biology - Sequence databases - Sequence Analysis – Protein and Nucleic acids- Structural



comparisons

## UNIT-V

**Nanotechnology:** Basic principles and scope of Nanotechnology – Structural and Brownian assembly – Important characteristics – Molecular manufacturing – Decisive military capabilities – Molecular mills in the fields of agriculture – Medicine - Future perspectives of Nanotechnology in Life Sciences and Applications of Nanotechnology.

### Reference Books

1. Challa, S.S.R. Kumar, Josef Hormes, Carola Leushaer, (2005). Nanofabrication towards Biomedical Applications, Techniques, Tools, Applications and Impact, Wiley-VCH.
2. Houdy. P, Lahmani M. Marano F. (2011). Nano-ethics and Nanotoxicology. Springer Verlag Berlin Heidelberg.
3. Niemeyer CM, and C. A. Mirkin. (2004). Nanobiotechnology: Concepts, Applications and Perspectives, Wiley-VCH.
4. Rajendran, V., Saminathan, K., Paramasivam, P., Geckeler, K.E., (2012). Nanomaterials Synthesis and Charecterization”, Bloomsburry Publishing India PVT. LTD, New Delhi.
5. Rathy R.K, (2009). Nanotechnology, S. Chand Publisher.
6. Sidharth Baliyan, (2011). Basics of Nanotechnology, Anmol Publications Pvt. Ltd.
7. Simeonova P.P., N. Opopol and M.I. Luster, (2007). Nanotechnology – Toxicological Issues and Environmental Safety, Springer.
8. Thomas E., Twardowski (2007). Introduction to nanocomposite materials. Properties, Processing, Characterization. DES Tech Publications, USA.
9. Vinod Labhassetwar and Diandra L. Leslie, (2007). Biomedical Applications of Nanotechnology, A john Willy & Son Inc., NJ, USA.

### Course Outcomes (COs)



On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand the various Applications of Biotechnology.	K2
CO2	Apply and Understand the Hybridoma technology as well as Enzyme biotechnology.	K3
CO3	Analyse the DNA Recombinant technology.	K4
CO4	Understand the industrial and environmental biotechnology.	K5
CO5	Create the Stem cell biotechnology.	K6

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

#### Mapping of COs with POs

PO CO	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	M
CO2	M	S	S	M	S
CO3	S	S	M	S	M
CO4	S	M	S	M	S
CO5	S	M	M	S	M

**S – Strong**

**M – Medium**

**L – Low**



Program: M.Sc. Zoology				
Lab Course – II		Course Code: 20PZO2P02		Course Title: Animal Physiology and Endocrinology and Molecular Genetics
Semester II	Hours/Week 5	Total Hours 60	Credits 5	Total Marks 100

### Course Objectives

1. To determine the physiological action in relation to temperature, PH and osmotic pressure.
2. To acquire the practical knowledge about primary metabolites and its estimation in higher organisms.
3. To inculcate knowledge on aquaculture.

### Animal Physiology and Endocrinology

1. Salt loss and salt gain in a fresh water fish.
2. Preparation of Haemin crystal in human blood.
3. Estimation of O<sub>2</sub> consumption of fresh water fish.

### Human Molecular Genetics

1. ABO Blood group in human
2. Study of Polytene chromosome in the Drosophila larva

### Spotters

Ciliated epithelium - Cardiac muscle T.S-Bone tissue T.S -Simple squamous Epithelium- Nervous tissue. Transverse section of Pituitary - Thyroid- Pancreas - Adrenal- Thymus-Ovary and Testis

### Reference Books

1. Nigam S.C and Omkar (2006) Experimental Animal Physiology and Biochemistry, New Age International
2. Zsolt Peter Nagy, Alex C. Varghese, Ashok Agarwal, (2013) Clinical Embryology: A Practical Guide, Springer-Verlag New York.

**Course Outcomes (COs)**

On successful completion of the course, the students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
<b>CO1</b>	To Gain knowledge about the molecular genetics.	K1
<b>CO2</b>	Understand the role of primary metabolites.	K2
<b>CO3</b>	Apply the knowledge on the physiological changes in relation to Temperature, PH and Osmotic Pressure.	K3
<b>CO4</b>	Evaluate the physiological and biomedical parameters.	K5

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

**Mapping of COs with POs**

<b>PO \ CO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>
<b>CO1</b>	S	S	M	S	M
<b>CO2</b>	M	S	S	S	S
<b>CO3</b>	S	M	M	S	M
<b>CO4</b>	S	S	S	M	S

**S – Strong**

**M – Medium**

**L – Low**



Program: M.Sc. Zoology				
Core – VII		Course Code: 20PZO3C07		Course Title: Aquaculture
Semester	Hours/Week	Total Hours	Credits	Total Marks
III	6	90	4	100

### 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.

#### **UNIT – I**

**Historical background and present status of aquaculture:** Purpose and importance of aquaculture.

**Types of culture systems:** Traditional- Extensive-semi-intensive-Intensive-super-intensive. Characteristic features of cultivable species (Indian major carps- Murrels- Catfish and Tilapia). Selection criteria of cultivable species.

#### **UNIT – II**

**Types of aquaculture:** Freshwater aquaculture-Brackish water Aquaculture and mariculture merits and demerits- Design construction of pond management – Types of ponds. Control of aquatic weeds and Predators.

#### **UNIT – III**

**Composite fish culture:** Mono sex culture - Culture of air-Breathing fishes- Sewage fed fish culture- Fish-cum duck culture: Induced breeding of carps and Brood stock management.

#### **UNIT – IV**

**Fish diseases:** Parasitic- Protozoan- Bacterial- Fungal and viral diseases and their control measures. Fish processing and preservation-fishery by-products.

#### **UNIT – V**

**Inland fisheries:** Fresh water- Riverine – Reservoir -Pond and Cold-water fisheries. Estuarine and Brackish water fisheries and their economics. Fish gears and crafts used



in South Indian Fisheries.

**Marine Fisheries:** Sardine- Mackerel- Bombay duck- Sciaenids- Ribbonfish- Silver bellies- Pomfrets- Carangids- Sharks-Shrimps- Prawns- Crabs- Lobsters and Molluscs (Mussels, clams and scallops).

### Reference Books

1. Biswas S.P (1993) Manual of Methods in Fish Biology, International Book Co., Absecon Highlands, New Jersey.
2. Bose A.N, Yang C.T and Misra A (1991) Coastal Aquaculture Engineering. Oxford and IBH Publishing Co., Pvt. Ltd., New Delhi.
3. Jhingran V.G (1991) Fish and fisheries of India. Hindustan Publishing Corporation, New Delhi.
4. Pillai T.V.R (1993) Aquaculture Principles and Practices. Fishing News Agency, London.

### Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Get knowledge about the production of cultivable candidate fish species	K1
CO2	Understand the global, national, traditional and modern techniques related to fishes for food security	K3
CO3	Apply practical knowledge into the aquaculture field to enhance production level	K4
CO4	Analyze students theoretical and technical knowledge useful for teaching, research, extension and entrepreneurship in the field of Aquaculture	K5
CO5	Learn the scientific method of setting an aquarium.	K6

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**



**Mapping of COs with POs**

PO CO	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	M	M
CO2	M	S	M	S	S
CO3	S	M	S	M	S
CO4	S	S	M	S	M
CO5	M	S	S	S	M

S – Strong

M – Medium

L – Low



Program: M.Sc. Zoology				
Core – VIII		Course Code: 20PZO3C08		Course Title: Immunology
Semester	Hours/Week	Total Hours	Credits	Total Marks
III	6	90	4	100

### Course Objectives

1. To motivate students to learn the lymphoid organs of our body.
2. To make them understand the different types of immune globulins.
3. To get knowledge about different types of techniques used in immunology.
4. The objective of this course is to make students understand the existence of microbial world and diversity along with their origin and scope in present day life.

#### UNIT – I

**Immunity:** Kinds of immunity – Natural and acquired. Primary lymphoid organs – Thymus, Bursa of Fabricus- Bone marrow. Secondary Lymphoid organs – Spleen- Lymphnodes- Payer’s Patches.

#### UNIT – II

**Antigens and Antibodies:** Antigen Types, properties - Haptens, Adjuvants – vaccine types. Immunoglobulin- Structure, types and properties. Theories of antibody production. Complement system- Structure, properties, function of complement component and Pathways.

#### UNIT – III

**Antigen – Antibody Interactions:** Characteristics feature of Ag – Ab reaction - Precipitation, Agglutination-Opsonisation - Cytolysis-Flocculation-Complement fixation. Major Histocompatibility complex – Autoimmuno disease -Hybridoma technology (MCA)

#### UNIT – IV

**Hypersensitivity:** Hypersensitivity and this types, Type I – Anaphylactic Hypersensitivity Type II – Antibody dependent hypersensitivity. Type III – Immune complex mediated hypersensitivity - IV – Cell mediated hypersensitivity - V- Stimulated hypersensitivity and Tolerance.



**Vaccines:** Vaccine and Types of vaccine – Vaccination schedule and immunization schedule

#### UNIT – V

#### Principles and applications of immune techniques

**Blotting Techniques:** Southern Blotting-Northern Blotting- Western Blotting – ELISA – RIA Immunofluorescence technique – Microarray as a tool for detection of human genetic disorders. Immunodiagnostics and Immunotherapy for tumor.

#### Reference Books

1. Abbas, A.K., and A.H. Lichtman (2017) Cellular and Molecular Immunology, First South Asia Edition, Elsevier.
2. Delves, P., S. Martin, D. Burton and I. M. Roitt, (2017), Roitt's Essential Immunology, 13<sup>th</sup> Edition, Wiley – Blackwell Publications, USA.
3. Murphy, K.M., and Weaver, C (2017) Janeway's Immunology, 9<sup>th</sup> Edition, W.W. Norton & Company, USA.
4. Paul, W.E. (2012) Fundamental Immunology, 7<sup>th</sup> Edition, Lippincott Williams and Wilkins, USA.
5. Punt. J., Stranford, S., Jones, P., W. A. Owen (2018). Kuby Immunology 8<sup>th</sup> Edition, W.H. Freeman & Company, New York.
6. Tizard, I.R. (1995) Immunology-An introduction IV Ed. Saunders College Publications, Philadelphia, USA.

#### Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	The students will get more knowledge about lymphoid organs.	K1
CO2	The students are Understand differentiate the immunoglobulin based on their structures.	K2
CO3	Students get overview knowledge about immunology.	K3
CO4	Analyse the Immunological instrument and its applications.	K4

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

**Mapping of COs with POs**

PO CO	PO1	PO2	PO3	PO4	PO5
CO1	M	S	S	M	M
CO2	S	M	M	S	M
CO3	S	S	M	S	S
CO4	S	S	M	M	S

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



Program: M.Sc. Zoology				
Core – IX		Course Code: 20PZO3C09		Course Title: Developmental Biology
Semester III	Hours/Week 5	Total Hours 75	Credits 4	Total Marks 100

### 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.
4. To familiarize the student with the principle of developmental biology and provide him a bird's eye view of sophisticated embryological techniques.

#### **UNIT – I**

**Scope of embryology - Gametogenesis:** Spermatogenesis – Oogenesis. Polarity and symmetry of an egg – Physico-Chemical changes during fertilization. Parthenogenesis – Natural and Artificial.

#### **UNIT – II**

**Cleavage:** Salient features – Planes of Cleavage – Patterns of cleavage – Types of blastula **Gastrulation:** Morphogenetic movements – Gastrulation in frog- Calotes and Man and Molecular changes during gastrulation.

#### **UNIT – III**

**Organogenesis:** Development of Brain, Eye and Heart Extra embryonic membranes in Chick.

**Placenta:** Types placenta – Placenta of Mammals.

**Regeneration:** Types of regeneration – Regeneration in animal.

#### **UNIT – IV**

**Organizer:** Spemann's experiments and conclusions – Types of embryonic Induction (Primary, Secondary, chain of induction) – Experiments on Chemical nature of inducing substance – Mechanism of induction.

**Transplantation:** Types of transplantation – Nuclear transplantation.

**UNIT – V**

Fertility- Antifertility and Infertility defects and Treatments. Assisted reproductive Technology (ART) in man – Artificial insemination (AI), *In vitro* Fertilization (IVF) - Embryo Transfer (ET) - Gamete Intra-fallopian Transfer (GIFT) and Zygote Intra-fallopian Transfer (ZIFT). Immuno - contraction Cryopreservation of gametes and Embryo.

**Reference Books**

1. Balinsky B.L. (2008) An Introduction to Embryology W.B. Saunders Company Publication, Philadelphia.
2. Bruce M (2007). Carlson Foundations of Embryology, McGraw Hill Publishing Companies.
3. Jain, P.C (1998) Elements of Developmental Biology Vishal Publication, New Delhi.
4. McEwen, R.S. (1969) Vertebrate Embryology Oxford and IBH Publishing Co., New DelhiPublication.
5. Munish Kainth (2013) A Textbook of Chordate Embryology, Wisdom Press, Dominant Book Publications.
6. S.Banerjee (2005) Developmental Biology Dominant Publishers and Distributers, New Delhi.
7. Scott F. Gilbert Sinaver (2008) Developmental Biology, Amociates Sunderland
8. Veer Bala Rastogi and M.S. Jayaraj (2008) Developmental Biology, Keendarnath Ramnath
9. Verma P.S and V.K. Agarwal (2014) Chordate Embryology S. Chand Publication Company Ltd., New Delhi.

**Course Outcomes (Cos)**

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Get knowledge about the spermatogenesis oogenesis and ovulation in Human.	K1
CO2	Understand the mechanism of fertilization, metabolic activities and molecular changes in cleavage process in human.	K2
CO3	Study the development of various organs and physiology of Human.	K3
CO4	Study the mechanism of induction, major events during regeneration and Teratogenesis.	K4

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

**Mapping of COs with POs**

PO \ CO	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	M	S

**S – Strong**

**M – Medium**

**L – Low**



Program: M.Sc. Zoology				
Core – X	Course Code: 20PZO3C10	Course Title: Research Methodology		
Semester III	Hours/Week 5	Total Hours 75	Credits 4	Total Marks 100

### Objective

1. To familiarize participants with basic of research and the research process.
2. To enable the participants in conducting research work and formulating research synopsis and report.
3. To familiarize participants with Statistical packages such as SPSS/EXCEL.
4. To impart knowledge for enabling students to develop data analytics skills and meaningful interpretation to the data sets so as to solve the business/Research problem.

### UNIT – I

**Data:** Types of data – Methods of data collections. **Sampling** – Types of sampling  
Measures of Central Tendency: Mean- Median and mode (single and grouped data)  
Measures of Dispersion: Range- standard deviation (SD) and standard error (SE).

### UNIT – II

**Correlation:** Types of correlation – coefficient of correlation. **Regression:** Types  
Regression co efficient Regression Probability Distribution: Normal distribution- Binomial  
distribution and poison distribution.

### UNIT – III

**Analysis of variance:** One-way classification - Two-way classification.

**Goodness of Fit Tests:** Chi-square test for goodness of fit. Student's t-Test.

### UNIT – IV

**Thesis writing:** Research formulations: Basic concepts of research- meaning-





Objectives - motivation and approaches. Defining and formulation of research problem – Literature review – Importance.

**Hypothesis:** null and alternate hypothesis and testing of hypothesis – Theory, principles- Law and Canon. Data collection technique. Selection of problem – Stages in execution of research-Preparation of Manuscript – Thesis format.

#### UNIT – V

**Scientific Documentation and Communication:** Project proposal writing Research report writing: thesis and dissertation; preparation of manuscript. Standard of Research journals: Peer review – Impact factor –Citation index. Choice of journals for publication.

**Information retrieval:** Archives, Databases and search Engines: Google- PubMed -Online database library and Gene Bank.

**Research paper:** Oral and poster presentation. Synopsis- facing *viva-voce* using LCD. Latex and Science direct.

#### Reference Books

1. Gupta, S.P., (2006). Statistical Methods. Sultan Chand and Sons, Daryagans, New Delhi.
2. Gurumani, N. (2003) Biostatistics. Tamilnadu Book House.
3. Kumar, B.P, (2007). Introduction to Bio-Statistics. S Chand & Company; 3rd Rev. Edt.. New Delhi, India
4. Milton, J.S. (1992) Statistical Methods in Biological and Health Sciences. McGraw – Hill Inc., New York.
5. Scheffler, W.C. (1968) Statistics for Biological sciences. Addison - Wesley Publication Co., London.
6. Snedecor, G.W. and Cochran, W.G. (1967) Statistical Methods. Oxford & IBH Publication Co., New Delhi.
7. Sokal, R.R. and Rohlf, F.J. (1969) Biometry. The principles and Practice of Statistics in Biological Research. W.H. Freeman and Co., San Francisco.



### Courses Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Basic knowledge on qualitative research techniques	K1
CO2	Understand adequate knowledge on measurement & scaling techniques as well as the quantitative data analysis	K2
CO3	To learn awareness of data analysis-and hypothesis testing procedures	K2
CO4	Develop understanding on various kinds of research, objectives of doing research, research process, research designs and sampling	K6

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

### Mapping of COs with POs

PO \ CO	PO1	PO2	PO3	PO4	PO5
CO1	M	M	M	S	S
CO2	M	S	M	S	S
CO3	S	S	S	S	M
CO4	M	S	M	S	S

S – Strong

M – Medium

L – Low



Program: M.Sc. Zoology				
<b>Lab Course – III</b>		<b>Course Code: 20PZO3P03</b>		<b>Course Title: Aquaculture, Immunology Developmental Biology and Research Methodology</b>
<b>Semester</b> III	<b>Hours/Week</b> 6	<b>Total Hours</b> 90	<b>Credits</b> 5	<b>Total Marks</b> 100

### Course Objectives

1. To Analyse and inculcate the fundamental knowledge on immune system and immunological responses to antigens.
2. To provide the fundamental knowledge on instruments, statistical methods and Applications.
3. To know the fundamental principles computer Applications.

### **Aquaculture**

1. Effect of salinity on opercula movement of a freshwater fish
2. Aquaculture farm visit
3. List of cultivable fresh water fish
4. Estimation O<sub>2</sub> fresh water
5. Estimation of Co<sub>2</sub> fresh water

### **Immunology**

1. Widal test – Quantitative and Qualitative Method.
2. Immuno electrophoresis.
3. Blood Group Testing

### **Research Methodology**

1. Calculation of Mean, Median, Mode for the distribution.
2. Calculation of Standard deviation for the frequency distribution.

**Developmental Biology**

1. Blastoderm Mounting of Chick/Duck embryo.
2. Amphibia - Identification of developmental stages.
3. Preparation of sperm suspension and observation of Spermatozoa in Bulls Semen.  
Study of rate of motility of sperm in Bulls Semen (Demonstration Only)

**Spotters**

Slymphoid organs – Thymus- Spleen Lymph node Bursa of fabricius - Peyer's patches-  
Macrophages – HIV - Bacteriophage- Key board – Mouse – CPU- Hard disk and  
Printer

**Course Outcomes (COs)**

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	To gain knowledge on microbes of biosphere.	K1
CO2	Understand more knowledge in the operations of advanced Immunological equipment.	K2
CO3	Analyse the role of computer applications and bioinformatics tools in Biological data interpretation.	K4
CO4	Evalute the ecological significance and their management.	K5

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**



**Mapping of COs with POs**

PO CO	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	S
CO2	S	M	S	S	S
CO3	M	S	S	M	M
CO4	S	M	M	S	S

**S – Strong**

**M – Medium**

**L – Low**



Program: M.Sc. Zoology				
Core – XI		Course Code: 20PZO4C11		Course Title: Evolution
Semester	Hours/Week	Total Hours	Credits	Total Marks
IV	5	75	4	100

### Course Objectives

1. To provide comprehensive overview of concept of evolution
2. To explain origin of life especially prokaryotes as well as Eukaryotes in detail
3. To explore salient features of various theories of evolution comprising of Lamarckism- Darwinism and Neo-Darwinism
4. To provide adequate information about Geological time scale and Natural theory of Molecular Evolution
5. To provide glimpse of Phylogenetic Trees and highlight their construction along with interpretation

### UNIT – I

**Introduction:** Origins of evolutionary thought- Origin of Life – Principles of Lamarckism – Neo-Lamarckism - Darwinism –Neo- Darwinism – Speciation and Types of speciation.

### UNIT – II

**Hardy-Weinberg Law:** Gene pool – Gene frequency - Hardy-Weinberg equilibrium and Application of Hardy Weinberg law.

**Mutation:** Mutation and Gene flow with reference to Rates of evolutionary change - Genetic drift and Non-random breeding – Reproductive.

**Isolating mechanisms:** Various types Isolation mechanism

### UNIT – III

**Phenotypic variation:** Polygenic traits; Heritability and Variation over geography- The "Niche" concept.



**Natural selection:** Stabilizing-Directional and Disruptive selection – Natural selection II: The general selection model – Group selection - Kin selection and sociobiology.

**Ecogeographic rules:** Subspecies concepts – Clines and Hybrid zones.

#### UNIT – IV

**Mimicry and coloration:** Mimicry types of mimicry – Coloration and types of coloration Evolutionary trends and Laws: Gradualism and Punctuated equilibria – Adaptation and adaptive radiation with reference to convergent and divergent evolution and Evolution of horse.

#### UNIT – V

Evolutionary innovations and the origin of higher taxa- Evolution of *Homo sapiens* and molecular biological and immunological evidences for evolution. Impact of DNA bar coding in modern Evolutionary studies. Cultural evolution of man.

#### Reference Books

1. Dobzhansky T (1970) Genetics of the evolutionary process, Columbia University Press.
2. Futuyma D.J (2013) Evolution, Sinauer Associates, USA.
3. Hall B.K and Hallgrimsson B (2011) Strickberger's Evolution, Jones and Bartlett Publishers.
4. Minelli A (2009) Perspectives in Animal Phylogeny and Evolution, Oxford University Press, UK.
5. Wilson E.O (2000) Sociobiology: The new synthesis, Harvard University.



### Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Define Geological Time Scale and describe zoogeographical Realm	K1
CO2	Describe the barriers, dispersals and their impact on animal Distribution	K2
CO3	Describe the adaptive features of desert reptile and mammals	K3
CO4	Describe the Theory of Evolution considering Darwinism and Modern Synthetic Theory	K4
CO5	Write down the adaptive significance of coloration and mimicry	K5

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

### Mapping of COs with POs

PO \ CO	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	S
CO2	S	S	M	S	S
CO3	S	M	S	S	M
CO4	S	S	S	M	S
CO5	S	S	M	S	S

**S – Strong**

**M – Medium**

**L – Low**





Program: M.Sc. Zoology				
Core – XII		Course Code: 20PZO4C12		Course Title: Environmental Biology
Semester IV	Hours/Week 5	Total Hours 75	Credits 4	Total Marks 100

### Course Objectives

1. To obtain knowledge about the biosphere and their characteristics.
2. To know the energy, natural resources and their conservations.
3. To get information about the space ecology.

#### **UNIT – I**

**Environment:** Abiotic and Biotic factors – Atmosphere - Light - Temperature - Atmospheric Pressure – Wind - Humidity and Rainfall. Structure and function of ecosystem - Pond as an Ecosystem.

#### **UNIT – II**

Soil formation, components of soil -Physico-chemical properties of soil - Structure texture and Classification of soil- Soil organisms-Soil erosion (degradation).

#### **UNIT – III**

Water Resources- Hydrological cycle – Characteristics of Ponds – Lakes – Rivers- Estuaries - Mangroves and their conservations – Fauna and flora of Mangroves.

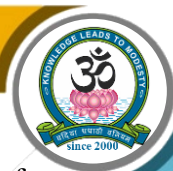
#### **UNIT – IV**

**Community Ecology:** Food web – Food chain - Ecological pyramids - Energy flow in Ecosystem – Concept of community ecology and Ecological Niches.

**Environmental Pollution:** Types of environmental pollution and their biological effects. Air pollution – Water pollution and Noise pollution – causes, effects and control.

#### **UNIT – V**

**Population Ecology:** Wild life management – Radiation Ecology: Radiation environment – Remote sensing - Radio Telemetry as a tool for ecological research - Space ecology –



Exobiology and Hazards of space travel.

### Reference Books

1. Agarwal K.C. (1989), Environmental Biology, Agro Botanical Publishers (India).
2. Biswarup Mukerjee (1997), Environmental Biology, Tata McGraw Hill Publishing Company Ltd., New Delhi.
3. Charles R. Goldman, Alexander J. Horsno Mcgraw (1983), Limnology – Hill International Book Company, New Delhi.
4. Dilip Kumar (2010), Introduction to Soil Science, Das Kalyani Publishers, New Delhi.
5. Edward John Kormandy (1969), Concept of Ecology, Prentice Hall Publishers New Delhi.
6. Joseph M. Moran, Michael, P. Morgan, James, H. Wiesma (1991), Introduction to Environmental Science, W.H. Freeman and Company, Sanfrancisco.
7. Odum E.P. (1971), Fundamentals of Ecology, 3<sup>rd</sup> Edition, W.B. Saunders & Co., Philadelphia.
8. Sharma P.D., (2012), Ecology and Environment, Rastogi Publications, India.
9. Singh J.P., Singh S.P and S.R. Gupta (2014), Ecology Environmental Science and Conservation, S. Chand Publishers, New Delhi

### Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Expertise knowledge about the biosphere.	K1
CO2	Understand the physical, chemical and biological characteristics of the biosphere.	K2
CO3	Apply the knowledge in measuring the energy resources and the conservation of natural resources.	K3
CO4	Analyze the techniques of the remote sensing and space travel.	K4

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**



**Mapping of COs with POs**

PO \ CO	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	M	S
CO2	S	S	M	S	S
CO3	M	M	M	S	S
CO4	S	S	M	M	S

**S – Strong**

**M – Medium**

**L – Low**



Program: M.Sc. Zoology				
Core – XIII		Course Code: 20PZO4C13		Course Title: Economic Zoology
Semester IV	Hours/Week	Total Hours	Credits	Total Marks
	5	75	4	100

### Course Objective

1. To understand the significance of sustainable agriculture, medical, veterinary, aquaculture and food processing.

#### **UNIT – I**

**Apiculture:** Types of Honey bee – Life history of Honey bee – Bee colony – Collection of Honey – Medicinal value of Honey and Bee wax artificial Bee hive – Enemies and disease of honey bees and their control methods.

#### **UNIT – II**

**Sericulture:** Scope of Economics of Sericulture – Central silk Board – Types of culture (Eri, Tasar- Muga and Mulberry silk worm) – Mulberry cultivation – Life cycle of *Bombyx mori* – Disease and pest of Silkworm – Prevention and control measures

#### **UNIT – III**

**Aquaculture:** Economics of aquaculture – Water quality Management – Carp – Composite fish culture – Integrated fish farming – Hypophysation Techniques – Prawn culture – Economic of Prawn culture – Aquaculture Institution in India.

#### **UNIT – IV**

**Vermiculture:** Vermiculture and composting – Types of earthworm – Rearing technology; Types of Vermicomposting: Small scale and Large-scale method – Economic importance.

#### **UNIT – V**

**Poultry farming:** Important breeds of poultry – Construction of poultry house – Cage



house and Deep litter system – Poultry nutrition – Diseases and their prevention – Economics of poultry production.

### Reference Books

1. Bremner, H.A. (2002) Fish as Food, Vol 1 & 2, Elsevier
2. Mishra, R.C., (1985), Honey Bees and their Management in India, ICAR.
3. Sastry, N.S.R Thomas, C.K. and Singh, R.A. Farm Animal Management and Poultry Production, Vikas Publishing House Private Ltd., Delhi.
4. Stadelman, W.J., Olson, V.M., Shemwell, G.A and Pasch S (1988) Egg and Poultry Meat Processing.

### Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Explain the importance of animal husbandries.	K1
CO2	Understand the economic importance of agricultural entomology.	K2
CO3	Describe the communicable and non-communicable diseases in humans.	K3
CO4	Analyse the culture practice and economic importance of aquaculture.	K4
CO5	Create various techniques for food preservation and preparation of value added products.	K6

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**



**Mapping of COs with POs**

PO CO	PO1	PO2	PO3	PO4	PO5
CO1	S	M	M	S	M
CO2	S	S	M	S	M
CO3	S	M	S	M	M
CO4	S	S	S	M	S
CO5	S	S	M	M	S

**S – Strong**

**M – Medium**

**L – Low**



Program: M.Sc. Zoology				
Lab Course – IV	Course Code: 20PZO4P04	Course Title: Evolution, Environmental Biology and Economic Zoology		
Semester IV	Hours/Week 4	Total Hours 60	Credits 5	Total Marks 100

### Course Objectives

1. To enable the students to understand how living systems evolved.
2. To understand the mechanism of evolutionary changes through adaptation, natural selection, speciation and the history of life.
3. To support to do experiments on Environmental Biology
4. To learn how do we enhance the productivity in Economic Zoology

### **Evolution**

1. Study of Fossils (Ammonoids, Nautiloids & Echinoderm fossils).

### **Environmental Biology**

1. Estimation of pH in water samples
2. Estimation of phosphate
3. Estimation of Dissolved Oxygen
4. Estimation of sulphate
5. Identification of plankton in different water samples

### **Economic Zoology**

1. Identification of pests and diseases of mulberry.
2. Identification of various types of silkworms and silk moths and their external morphology.
3. Various stages of larva and their identification in *Bombyx mori*.
4. Identification of important pest and diseases of silkworm *Bombyx mori*.
5. Dissection and display of silk gland of *Bombyx mori* (V instar larva).

### **Spotters**

Animal inter relationship, (Parasitism, parasitic castration, Commensalism, Mutualism)  
 – Food chain and food web, energy flow, fossil any two -Rain cage- Fossils- Mulberry  
 Pests any two.



### Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Get knowledge about the mulberry and non-mulberry silkworms	K1
CO2	Apply knowledge on control measures of silkworm diseases	K3
CO3	Analyse the ecological significance and their management	K4

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

### Mapping of COs with POs

PO CO	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	S
CO2	M	S	M	M	M
CO3	M	M	S	S	M

**S – Strong**

**M – Medium**

**L – Low**





Program: M.Sc. Zoology				
Project		Course Code: 20PZO4PR01		Course Title: Project Work and Viva Voce
Semester IV	Hours/Week 11	Total Hours 165	Credits 6	Total Marks 100

### Course Objectives

1. To acquire the basic knowledge about research and carryout 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 (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Use foundational practical knowledge to carry out research in the specified area.	K1
CO2	Analyze the results and to collect the basic information in the field of zoology.	K4
CO3	Evaluate the research findings and present them in written and oral.	K5
CO4	Implement the research findings for the pollution free environment upliftment of mankind.	K6

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**  
Mapping of COs with POs

PO \ CO	PO1	PO2	PO3	PO4	PO5
CO1	M	S	M	S	S
CO2	S	S	S	M	S
CO3	S	S	S	S	S
CO4	S	M	S	S	S

S – Strong

M – Medium

L – Low

**Guidelines to the Distribution of Marks:**

<b>IA</b>	Project Review	15	25
	Regularity	10	
<b>ESE</b>	Project Report Present	50	75
	Viva – Voce	25	
<b>Grand Total</b>			<b>100</b>