



**POPE'S COLLEGE (AUTONOMOUS) Sawyerpuram -628 251**

Accredited by NAAC – II Cycle with 'A' Grade (CGPA:3.28)

**Department of Zoology  
Post Graduate Programmes**



**Vision**

- To emerge as a centre of excellence and prominence education in keeping with global standards, making our students technologically competent and ethically strong so that they can preparing each student to succeed in a rapidly changing world.

**Mission**

- To achieve intellectual brilliance through innovative teaching and learning practices.
- To provide opportunities for critical thinking, communication and collaboration
- To develop employability and entrepreneurship.
- To improve the research proficiency to deal with community needs.
- To encourage a culture that supports and reinforces ethical, specialized behaviours for a pleasant and successful civilization.

**Program Educational Objectives (PEOs)**

The M. Sc. Zoology program describe accomplishments that graduates are expected to attain within five to seven years after graduation	
<b>PEO1</b>	They will be apply fundamental scientific knowledge to create innovative ideas in a multidisciplinary way for the development of the nation.
<b>PEO2</b>	They will be promoted to develop a passion for lifelong learning to develop their individual and team skills for their ever success towards the evolving professional demands in the recent time.
<b>PEO3</b>	They will be motivated for their higher education in highly presumed state and worldwide institutions towards their academic careers.
<b>PEO4</b>	To provided high level of relevant knowledge and expertise in the contemporary area of Zoology which will lead to attractive, considerable, self-regulating, and modern research.
<b>PEO6</b>	They will be realize to techniques and analytical methods in the biological sciences and other related fields.
<b>PEO7</b>	They will be provided skill based programs and encourage for self-employment in applied field of Zoology
<b>PEO8</b>	They will be gain knowledge and skills for better planning, conservation and management of animal resources in the environment.

### Program Outcomes (POs)

On successful completion of the M. Sc. Zoology program	
<b>PO1</b>	Apply the acquired scientific knowledge to face day to day needs in the concerned discipline
<b>PO2</b>	The students gain knowledge and skill in the fundamentals of animal sciences, understands the complex interactions among various living organisms for assessing social, economic, legal and cultural issues and the consequent responsibilities relevant to the present situations.
<b>PO3</b>	The students utilize scientific knowledge to pursue higher studies to create innovation ideas to enhance entrepreneurial skills, professional requirement and become self-dependent.
<b>PO4</b>	The student develop the spirit of cooperation, team work and leadership qualities with the wide awareness of his social responsibility towards the transformation of the community and to nation.
<b>PO5</b>	The students create innovative ideas through laboratory experiments after testing, reasoning, evaluating, problem solving, critical and reflective thinking through the growing demands in the field of life science.
<b>PO6</b>	The students accomplish collection, survive, identified and reporting of such events to apply suitable statistical methods to research studies using computer and relate the results with theoretical expectations.
<b>PO7</b>	The students equipped with technological skills in the field of lifescience developing innovative solutions to real life necessities and pursue diverse career path using novel technology.
<b>PO8</b>	The student realize ethical issues with social responsibility. Apply the knowledge and understanding of Zoology to one's own life and develops empathy and love towards the animals

**Program Specific Outcomes (PSOs):**

After the successful completion of Zoology program, the students are expected to	
<b>PSO1</b>	The students obtaine fundamental knowledge and practiced in the various aspects of life sciences including Biochemistry, Cell and Molecular Biology, Genetics, Evolution, Physiology, Developmental Biology, Ecobiology, Immunology, Microbiology, Endocrinology, Biostatistic and Bioinformatics, Biotechnology, Aquaculture and know the functional aspects of different systems of animals.
<b>PSO2</b>	The students value the concept of cells, biochemical component in the cell and evaluation of living things which leads to apply techniques.to carry out high quality teaching and scientific research
<b>PSO3</b>	The students acquire novel inspiration about our physiological function, important germs diseases and underhanded to promote human immune system and also know to improve the health and hygiene of public.
<b>PSO4</b>	The students gain indepth knowledge of biotechnological methods in gene and signaling molecules for organization of functioning of hormones and learn the mechanism of hormone action in human welfare.
<b>PSO5</b>	Acquire skill in the field of live stock, sericulture, apiculture, fisheries, poultry, and agricultural pests and its management practices to improve the employment opportunities.
<b>PSO6</b>	The students analyze the ethical aspects of research and good laboratory practices of recent bioinstrumentation and biological techniques and evaluate the different methods of scientific writing and reporting
<b>PSO7</b>	Students provide the knowledge on animal's biodiversity and interactions between organisms and their environments to drive the dynamics of populations and communities.
<b>PSO8</b>	Graduates will understand and familiar with good laboratory practices and safety and also do in the field of Biology, Reproduction, Live feed Culture, Conservation Biology, Disease Proteomics and environmental biology.



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**Department of Zoology**

**Post Graduate Programme**

**Learner Outcome Based Curriculum Framework**

**Course Structure of the Curriculum**

(With effect from Academic Year 2021 - 2022 onwards)



Parts of the Curriculum	No. of Courses	Total No. of Credits	Total Marks
<b>Core Theory (I – VI Semester)</b>	11	55	1100
<b>Core Practical</b>	04	10	400
<b>Core Project (IV Semester)</b>	01	05	100
<b>Discipline Specific Elective (I – III Semester)</b>	04	20	400
<b>Self-Study Course (MOOCs) (I Semester)</b>	–	02 *	–
<b>Summer Skill Training (II Semester)</b>	–	02 *	–
<b>Life Skill Training (III Semester)</b>	–	02 *	–
<b>Total</b>	<b>20</b>	<b>90 + 6 = 96</b>	<b>2000</b>

\* Not considered for Grand Total and CGPA



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Accredited by NAAC – II Cycle with 'A' Grade (CGPA:3.28)

**Department of Zoology**

**Post Graduate Programme**

**Learner Outcome Based Curriculum Framework**

**Course Structure for M.Sc. Zoology**

(With effect from Academic Year 2021 - 2022 onwards)



SEM	S.No.	Subject Status	Subject Code	Subject Title	Hrs per Week	Credits
<b>I – SEMESTER</b>	1	Core-1	21PZOM11	Functional Morphology of Invertebrates and Vertebrates	6	5
	2	Core-2	21PZOM12	Cell and Molecular Biology	6	5
	3	Core-3	21PZOM13	Biochemistry	6	5
	4	Elective-1	21PZOE11	Economic Zoology	6	5
			21PZOE12	Health care		
	5	Practical-1	21PZOMP1	Lab-1 Core-1,2&3 (Elective - 1)	3	-
	6	Practical-2	21PZOMP2	Lab-2 Core-4,5&6 (Elective - 2)	3	-
	7			Self Study Course (MOOCs)	-	+2
Subtotal					30	20+2
<b>II – SEMESTER</b>	1	Core-4	21PZOM21	Developmental Biology	6	5
	2	Core-5	21PZOM22	Animal Physiology	6	5
	3	Core-6	21PZOM23	Biotechnology	6	5
	4	Elective-2	21PZOE21	Aquaculture & Fisheries	6	5
			21PZOE22	Entomology		
	5	Practical-1	21PZOMP1	Lab-1 Core-1,2,3 & (Elective-1)	3	2
	6	Practical-2	21PZOMP2	Lab-2 Core-4,5,6 &(Elective-2)	3	3
	7	STP		Biotechnology - Manonmanium Sundaranar University	-	+2
Subtotal					30	25+2
<b>III – SEMESTER</b>	1	Core-7	21PZOM31	Microbiology	6	5
	2	Core-8	21PZOM32	Immunology	6	5
	3	Core-9	21PZOM33	Orangic Evolution	6	5
	4	Elective-3	21PZOE3A	Research Methodology	6	5
	5	Practical-3	21PZOMP3	Lab-3 Core-7,8,9 & (Elective-3)	3	-
	6	Practical-4	21PZOMP4	Lab-4 Core-10,11& (Elective-4)	3	-
	7	LST		First Aid and Emergency Care		+2
Subtotal					30	20+2
<b>IV – SEMESTER</b>	1	Core-10	21PZOM41	Molecular Genetics	6	5
	2	Core-11	21PZOM42	Environmental Biology & Biodiversity conservation	6	5
	3	Elective-4	21PZOE4A	General and Comparative Endocrinology	6	5
			21PZOE4B	Animal Behaviour and Chronobiology		
	4	Project	21PZOM4P	Project	6	5
	5	Practical-3	21PZOMP3	Lab-3 Core-7,8&9 (Elective-3)	3	3
	6	Practical-4	21PZOMP4	Lab-4 Core-10,11& (Elective-4)	3	2
Subtotal					30	25
<b>Total</b>					<b>120</b>	<b>90+6</b>

**PC / 2021 – 2022 / PG / Zoology / Semester – I**

<b>Core</b>	<b>Sub Code</b>	<b>FUNCTIONAL MORPHOLOGY OF INVERTEBRATE AND VERTEBRATES</b>	<b>Hrs./ Week</b>	<b>Credits:</b>
<b>01</b>	<b>21PZOM11</b>		<b>06</b>	<b>05</b>

<b>Objective</b>	:	<p>The main objectives of this course are to:</p> <ol style="list-style-type: none"> <li>1. Know the functional aspects of different systems of invertebrates and vertebrates</li> <li>2. Study the fundamentals classification of invertebrates</li> <li>3. Understand the behavior mechanism of non-chordates</li> <li>4. Study the mechanism of various organ systems of invertebrates and vertebrates</li> <li>5. Learn the integumentary and skeletal systems of animals</li> </ol>
<b>Unit I</b>	:	<p><b>PRINCIPLES OF ANIMAL TAXONOMY</b></p> <p>General characteristics of animal phyla- Classification of animal phyla upto order levels. Species Concept- Habitats of living Invertebrates in Global levels- Organization of coelom: Acoelomates - Pseudocoelomates – Coelomate groups. - Invertebrate monitoring.</p>
<b>Unit II</b>	:	<p><b>LOCOMOTION AND FEEDING HABITS OF ANIMALS</b></p> <p>Locomotion and adaptive mechanism in invertebrates-Flagellar, ciliary movements in Protozoa - Hydrostatic movement in Coelenterata, Annelida, and Echinodermata. Feeding habits: Nutrition and feeding mechanism in invertebrates-Nutrition in protozoa, Types and mode of feeding- Feeding diversity in insects- Filter feeding in Lower metazoans, Crustacean, Mollusca and Echinodermata - functional mechanism. Sponge culture and its importance in industry.</p>
<b>Unit III</b>	:	<p><b>ORGAN SYSTEM OF INVERTEBRATES</b></p> <p>Digestive Systems - Over view of the Circulatory systems, Respiratory systems, Excretory systems, Nervous and sensory system and Reproductive systems of animals.</p>
<b>Unit IV</b>	:	<p><b>FUNCTIONAL SYSTEMS OF VERTEBRATES</b></p> <p>Respiratory Organs-Ventilatory Mechanisms- Phylogeny-Form and Function- Excretory Systems: Urinary System- Structure and function of the Mammalian Kidney- Nervous system: Peripheral Nervous System and Central Nervous Systems- Sensory Organs: Components of a sensory organs- General sensory organs.</p>
<b>Unit V</b>	:	<p><b>INTEGUMENT AND SKELETAL SYSTEMS OF ANIMALS</b></p> <p>General features of the Integument (Dermis and Epidermis); Phylogeny- Specialization of the Integument-Skeletal System: The Skull- Introduction- Overview of Skull Morphology- Overview of Skull Function and Design.</p>
<b>Text Book</b>	:	1. S.K. Kulshrestha - Comparative anatomy of vertebrates - Anmol Publications

		PVT.LTD, New Delhi. 1999 2. Prasad. S. N, A Textbook Of Invertebrate Zoology 3. Mcgraw Hill 1974 Vertebrate History - Stahl(Barbara.J) 4. Prasad. S. N - Textbook of Vertebrate Zoology - Wiley Eastern 1991
<b>References</b>	:	1. Borradile, L.A.- The Invertebrata- Cambridge University Press. 2. Young, J.F.- Life of Vertebrates - Clarendon Press. Oxford. 3. Colbert, E.H.- Evolution of the Vertebrates - John Wiley and Sons Inc. New York. 4. Hegner (Robert.W); Invertebrate Zoology - Engemann (Joseph.G)- Macmilan Publishing Company 1968 5. Hyman (Libbie. Henrietta) - Comparative Vertebrate Anatomy - The University Of Chicago Press 1942 6. Orr(Robert.T) 1971 - Vertebrate Biology - W.B.Saunders Co 7. Vertebrate Adaptations - Readings From Scientific American 8. Pearson(Ronald And Lindsay) - The Vertebrate Brain - Academic Press Comparative Correlative Neuro Anatomy Of The Vertebrate Telencephalon - 9. Schnitzliein. H. N) Ed., - Crosby(Elizabeth.C); Macmilan Publishing Company 1982

### Related Online Contents

1	Systems Biology (NPTEL) web <a href="https://nptel.ac.in/courses/102/106/102106035/">https://nptel.ac.in/courses/102/106/102106035/</a>
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### Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Classify the animal species based on the features	K2
2	Identify the behavior of various invertebrates	K3
3	Explain the similar and different morphology of organs in a functional view	K2
4	Compare the functional morphology of vertebrates and invertebrates	K3
5	Illustrate the process of integument and significance of skeletal system	K4

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

### Mapping with COs, POs and PSOs

Course Outcomes (COs)	Program outcomes (POs)								Program specific outcomes (PSOs)							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
CO1	3	3	3	3	3	3	2	2								
CO2	3	3	3	2	3	3	3	2								
CO3	3	3	2	2	3	2	3	3								
CO4	3	3	3	2	3	3	3	2								
CO5	3	2	2	2	2	2	2	2								
Average	3	2.8	2.6	2.2	2.8	2.6	2.6	2.2								



**PC / 2021 – 2022 / PG / Zoology / Semester – I**

<b>Core</b>	<b>Sub Code</b>	<b>CELL AND MOLECULAR BIOLOGY</b>	<b>Hrs./ Week</b>	<b>Credits:</b>
<b>02</b>	<b>21PZOM12</b>		<b>06</b>	<b>05</b>

<b>Objective</b>	<b>:</b>	<p>The main objectives of this course are to:</p> <ol style="list-style-type: none"> <li>1. Provide students with relevant knowledge, skills and values in contemporary molecular cell biology.</li> <li>2. Apply experimental techniques to carry out high quality teaching and scientific research.</li> <li>3. Acquire advanced knowledge of molecular biology of prokaryotes, and eukaryotes.</li> <li>4. Study principles of cell communication and adhesion</li> <li>5. Study cancer/ oncogenes, virus induced cancer and therapies, Cellular morphology and markers</li> </ol>
<b>Unit I</b>	<b>:</b>	<p><b>BASIC CONCEPTS</b></p> <p>Cell and Cell organization, Sub- cellular structures of prokaryotic and eukaryotic cells Types – Prokaryotes and Eukaryotes. Plasma membrane – structure of membrane models, Membrane transport, membrane potentials – Extracellular space – cell adhesion, intercellular reconnection – intercellular junctions, cellular respiration – Biogenesis.</p>
<b>Unit II</b>	<b>:</b>	<p><b>CELL ORGANELLES</b></p> <p>Ultrastructure of Ribosomes, Endoplasmic reticulum and Golgi complex biosynthesis of secretory proteins on ribosomes and rough endoplasmic reticulum – post – translational modifications of proteins both in the rough endoplasmic reticulum(RER) and smooth endoplasmic reticulum(SER). Golgi Complex – Formation of disulfide bonds – glycosylation. Lysosome – ultrastructure – enzymes – origin and functions of lysosome.</p>
<b>Unit III</b>	<b>:</b>	<p><b>CELL SIGNALING</b></p> <p>Cell signal – signaling mechanisms, signal molecules – signal receptors and form of intracellular signaling – Cell adhesion – calcium dependent &amp; independent. cell matrix adhesion – cell matrix adhesion proteins – integrins – Hemidesmosomes collagen and non-collagen components. Integration of signals and gene controls.</p>
<b>Unit IV</b>	<b>:</b>	<p><b>STRUCTURE AND FUNCTION OF NUCLEUS</b></p> <p>Structure and function Nucleo-cytoplasmic interaction, Nuclear receptors, Nuclear transplantation. Cell fusion –homokaryons, heterokaryons, cytoplasts, karyoplasts-structure and function of chromatin, nucleosome- Euchromatin- Hetero Chromatin, polytene &amp; Lamp brush chromosome.</p>
<b>Unit V</b>	<b>:</b>	<p><b>MECHANISM OF CELL DIVISION</b></p> <p>Mitosis &amp; meiosis – mechanisms for regulating mitotic events – cyclins and their kinases (cdks) cell death and its regulation, Characteristics of cancer cells causes</p>

		and onset & Treatment of cancer.Genetics of cell culture-Types,Application cell lines in cancer
<b>Text Book</b>	:	<ol style="list-style-type: none"> <li>1. Lohar (Prakash S), Cell and Molecular Biology, 1<sup>st</sup> Edition, Mjp Publishers</li> <li>2. De Robertis 2019, Cell Biology, (Edp) &amp; Others, 5<sup>th</sup> Edition</li> <li>3. Cell Biology, Genetics, Evolution and Ecology, Edn.3 Part Ii Verma (P.S), Aul. H) Ed. Nch (James); Agarwal (V.K.)</li> <li>4. Carp Gerald, 1996, Cell and Molecular Biology, John Wiley &amp; Sons Publishers.</li> <li>5. Verma (P S); Agarwal (V K), Concept of Cell Biology, S. Chand &amp; Co Publishers.</li> </ol>
<b>References</b>	:	<ol style="list-style-type: none"> <li>1. Power. C.B, Cell Biology, 3<sup>rd</sup> Edition, Himalaya Publishers.</li> <li>2. Gupta (M L), Cell Biology, Jangir (M L), 1<sup>st</sup> Edition.</li> <li>3. Rastogi. S. C, Cell Biology, 1<sup>st</sup> Edition, New Age International Limited Publishers.</li> <li>4. Shukla. R. M, A Textbook of Cell Biology, 1<sup>st</sup> Edition, Dominant Publishers.</li> <li>5. Swanson Carl. P Cytogenetics, Etc. Prentice Hall Publishers.</li> </ol>

#### Related Online Contents

1	Molecular Cell Biology: <a href="https://nptel.ac.in/courses/102/106/102106025/">https://nptel.ac.in/courses/102/106/102106025/</a>
2	Cell Biology: <a href="https://nptel.ac.in/courses/102/103/102103012/">https://nptel.ac.in/courses/102/103/102103012/</a>
3	Molecular Cell Biology: <a href="https://nptel.ac.in/courses/102/106/102106025/">https://nptel.ac.in/courses/102/106/102106025/</a>

#### Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Explain and discuss how processes are integrated at the molecular level to create a functional eukaryotic cell.	K2
2	Describe the structures and various cellular functions associated with the macromolecules found in cells.	K4
3	Explain the techniques and logic of methods employed in molecular biology research.	K2
4	Explain the molecular basis of human diseases.	K3
5	Design advanced molecular biology research	K3

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

#### Mapping with COs, POs and PSOs

Course Outcomes	Program outcomes (POs)	Program specific outcomes (PSOs)
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(COs)	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
CO1	3	3	3	3	3	3	2	2								
CO2	3	3	3	2	3	3	3	2								
CO3	3	3	2	3	3	2	3	3								
CO4	3	3	3	2	3	3	3	2								
CO5	3	2	2	2	2	2	2	2								
Average	3	2.8	2.6	2.4	2.8	2.6	2.6	2.2								

**PC / 2021 – 2022 / PG / Zoology / Semester – I**

Core	Sub Code	BIOCHEMISTRY	Hrs./ Week	Credits:
03	21PZOM13		06	05

<b>Objective</b>	:	<p>The main objectives of this course are to:</p> <ol style="list-style-type: none"> <li>1. Study the function and structure of biomolecules</li> <li>2. Understand the role of biomolecules in cell membrane</li> <li>3. Realize enzyme metabolism and their importance</li> <li>4. Explain the techniques of vitamins, water and nucleic acid metabolism</li> </ol>
<b>Unit I</b>	:	<p><b>Atom &amp; Biomolecules</b></p> <p>Structure of an atom, molecule – chemical bonds – water and electrolytic dissociation –pH-acid-base balance-Henderson and Hasselbalch equation-acidosis and alkalosis, Buffers-Physiological buffers thermodynamic first and second laws, energy level.</p>
<b>Unit II</b>	:	<p><b>Metabolism of Biomolecules</b></p> <p>Carbohydrates metabolism – glycolysis, Kreb’s cycle, electron transport and oxidative phosphorylation. Energy budget of carbohydrate metabolism. Gluconeogenesis - Protein metabolism – metabolism of tryptophan, phenylalanine, tyrosine and haemoglobin.</p>
<b>Unit III</b>	:	<p><b>Lipid and Enzyme Metabolism</b></p> <p>Lipids metabolism – oxidation of different types of fatty acids ketogenesis-biosynthesis of fatty acids – role of liver in fat metabolism.Enzymes and coenzymes – classification,structure,function Mechanism of enzyme action, factors influencing the enzyme action – isoenzymes, allosteric enzymes - Enzyme inhibition. Coenzymes and its properties. Applications of Enzyme.</p>
<b>Unit IV</b>	:	<p><b>Vitamins, Water and Mineral Metabolism</b></p> <p>Significance of water in metabolism. Dehydration and oedema. Source and significance of calcium and phosphate metabolism. Iodine metabolism and Significance. Vitamins – types, physiological role, deficiency and its role on metabolism.</p>
<b>Unit V</b>	:	<p><b>Nucleic Acid Metabolism</b></p> <p>Introduction to nucleic acid, Difference between nucleotide and nucleoside, composition of DNA &amp; RNA Structure of Nitrogen bases in DNA and RNA along with the nomenclature. · DNA double helix (Watson and crick) model Types of RNA , structure of t – RNA (clover leaf model). Chemical constituents of DNA and RNA. Determining the concentration of DNA and RNA. RNA synthesis from DNA.</p>

<b>Text Book</b>	:	1. Kulkarani, Rathod, Thonte, Ghiware 2013, Biochemistry. Nirali Prakashan, Pune 2. R.H. Garrett and C. M , 2007 Biochemistry, by Grisham, 3 <sup>rd</sup> edition. Saunders Publishers. 3. B. D. Hemes <i>etal.</i> , 1998 Biochemistry V. V Book Pvt. Ltd 4. Deb A. C, 1998 Fundamentals of Biochemistry, New Central Book Agency (P) Ltd. Calcutta
<b>References</b>	:	1. Lehninger Principles of Biochemistry by A David L. Nelson; Michael M. Cox. 2017. 7 <sup>th</sup> edition. W H Freeman & Co Publishers 2. Principles of Biochemistry by Albert L. Lehninger (4th edition) 2004. CBS Publishers & Distributors, New Delhi. 3. Biochemistry by Lubert stryer. 4 <sup>th</sup> , edition, 2000. Freeman International Edition 4. Biochemistry. S. C. Rastogi, 2nd edition. 2003. Tata McGraw Hill Publishing Company Ltd., N. Delhi.

### Related Online Contents

1	Biochemistry: <a href="https://swayam.gov.in/nd1_noc20_cy10/preview">https://swayam.gov.in/nd1_noc20_cy10/preview</a>
2	Biochemistry & Molecular Biology: <a href="https://swayam.gov.in/nd2_cec19_bt02/preview">https://swayam.gov.in/nd2_cec19_bt02/preview</a>

### Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Recalls the structure of atom and biomolecules	K2
2	Understand the chemical structure and functions of various biomolecules	K2
3	Outline the signaling of biomolecules in cell membrane	K4
4	The student realize the nucleic acid and its important for metabolism.	K3
5	Explain the techniques of water and minerals in the biological system.	K4

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

### Mapping with COs, POs and PSOs

Course Outcomes (COs)	Program outcomes (POs)								Program specific outcomes (PSOs)							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
CO1	3	3	3	3	3	3	2	2								
CO2	3	2	3	2	3	3	3	2								
CO3	3	3	3	2	3	2	3	3								
CO4	3	3	3	3	3	3	3	3								
CO5	3	2	2	3	2	2	2	2								
Average	3	2.6	2.8	2.6	2.8	2.6	2.6	2.4								

**PC / 2021 – 2022 / PG / Zoology / Semester – I**

<b>Elective</b>	<b>Sub Code</b>	<b>ECONOMIC ZOOLOGY</b>	<b>Hrs./ Week</b>	<b>Credits:</b>
<b>01</b>	<b>21PZOE11</b>		<b>06</b>	<b>05</b>

<b>Objective</b>	:	<p>The main objectives of this course are to:</p> <ol style="list-style-type: none"> <li>1. Study the economic importance of agricultural entomology</li> <li>2. Learn the communicable and non-communicable diseases in humans</li> <li>3. Study the importance of animal husbandries</li> <li>4. Know culture practice and economic importance aquaculture</li> <li>5. Learn various techniques for food preservation and preparation of value added products</li> </ol>
<b>Unit I</b>	:	<p><b>Agricultural Zoology</b></p> <p>Beneficial insects : Spider, mantis, ladybird beetle, damsel fly, Aphid, Midges, Green lacewings, Ground beetles. Harmful insects : Migratory locust, Colorado potato beetle, boll weevil, rhinoceros beetle, aphids, mosquitoes and cockroach – Pests of major crops, their injuries and control : Paddy, sugarcane and cotton - Economic importance of rodents and bats.</p>
<b>Unit II</b>	:	<p><b>Productive Zoology</b></p> <p>Apiculture – Definition – Kind of Honey bee – Bee Colony – Modern method of Apiculture – Honey bee products. Sericulture – Kinds of silk worm – Sericulture in India – Silk and uses of silk. Central Silk board in India. Lac Culture- Lac insect, Types of Lac, Life cycle, Uses &amp; Enemies of Lac insect.</p>
<b>Unit III</b>	:	<p><b>Veterinary Zoology</b></p> <p>Important livestock – cattle, goat, sheep, dog, deer and rabbit. Live stock farm practices- Livestock diseases – tetanus, anthrax, Ranikhet and avian influenza. Livestock parasites – helminthes, flies, ticks, lice and mites. Benefits of Dairy industries.</p>
<b>Unit IV</b>	:	<p><b>Poultry Farming</b></p> <p>Economics of Poultry keeping: Morphology of different breeds of Chicken- Brooding and Rearing of Chicks- Processing of Egg, Meat and By-Products of Poultry.</p>
<b>Unit V</b>	:	<p><b>Medical Zoology</b></p> <p>Infectious / communicable diseases: small pox, hepatitis AIDS, influenza, SARS, Ebola, tuberculosis, plague, cholera, amoebiasis, malaria, dengue, chikungunya, trypanosomiasis, and elephantiasis. Non communicable diseases: Cancer. Diabetes, Hypertension, Osteoporosis and Alzheimer's Disease, Corona virus disease.</p>
<b>Text Book</b>	:	<p>1. Economic Zoology -Vishwapremi K.K.C. ANMOL PUBLISHING</p>

		2. A Handbook On Economic Zoology- Ahsan(Jawaid); Prasad Sinha(Subhas). S.Chand & Co. 3. Economic Zoology - Dominant Publishers 2003 K.R.Ravindranathan. 4. A Text book Of Economic Zoology-K.R.Ravindranathan. Wisdom press 2013
<b>References</b>	:	1. Animal Bairagi K. Anmol Publications Pvt.Ltd Disease- N. 2014 2. Economic Zoology, G.S. Shukla, V.B. Upadhyay 3. Economic Zoology-Manju Yadav. Discovery Publishing House 2003 4. Insect, The Year Book Of Agriculture, 1952- Oxford Ibh 5. Problems In Prawn Culture - Shigeno(Kunihiko) – Amerind -1978 6. Sericulture In India- Venkatanarasaiah(P) 7. Economics Of Aquaculture - Singh(R.K.P) - Danika Publishing Company 2003 8. Aviculture - Ashok Kumar - Discovery Publishing House 2003 9. Perspectives In Indian Apiculture - Mishra(R C)- Agrobios ( India) 2002

<b>Related Online Contents</b>	
1	Applied and Economic Zoology (SWAYAM) web <a href="https://swayam.gov.in/nd2_cec20_ge23/preview">https://swayam.gov.in/nd2_cec20_ge23/preview</a>
2	Applied Entomology (SWAYAM) web <a href="https://swayam.gov.in/nd2_cec20_bt02/preview">https://swayam.gov.in/nd2_cec20_bt02/preview</a>

<b>Expected Course Outcomes:</b>		
On the successful completion of the course, student will be able to:		
1	Understand the significance of insects in agriculture	K2
2	The students add to create the self-employment opportunities	K6
3	Understand the various food preservations techniques.	K2
4	Distinguish the better platform in poultry-industries	K3
5	The students make known awareness of diseases in humans	K3
<b>K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create</b>		

Mapping with COs, POs and PSOs																
Course Outcomes (COs)	Program outcomes (POs)								Program specific outcomes (PSOs)							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
CO1	3	3	3	3	3	3	2	3								
CO2	3	3	3	2	3	3	3	3								
CO3	3	3	3	2	2	2	3	3								
CO4	3	3	3	3	3	3	3	3								
CO5	3	2	2	3	2	2	2	3								
Average	3	2.8	2.8	2.6	2.6	2.6	2.6	3								



**PC / 2021 – 2022 / PG / Zoology / Semester – I**

<b>Elective</b>	<b>Sub Code</b>	<b>HEALTH CARE</b>	<b>Hrs./ Week</b>	<b>Credits:</b>
<b>01</b>	<b>21PZOE12</b>		<b>06</b>	<b>05</b>

<b>Objective</b>	:	<p>The main objectives of this course are to:</p> <ol style="list-style-type: none"> <li>1. To make the students realize the importance of the health of the body, develop a healthy personality so as to live a healthy and successful life.</li> <li>2. To acquire independent employable skills in voluntary organizations in health sectors.</li> <li>3. Study the important health problems and caring</li> <li>4. Learn the communicable and non-communicable diseases in humans</li> <li>5. Know culture practice and economic importance aquaculture</li> <li>6. The students learn various techniques for used to maintain our body.</li> </ol>
<b>Unit I</b>	:	<p><b>CONCEPT OF HEALTH AND WELL-BEING</b></p> <p>Definition – Physical, mental, social and positive health – Quality of life. Determinants of health: Heredity – Environment – Lifestyle – Socio-economic conditions – Health services. Nutrition and Health: Nutrients that provide energy – Carbohydrates – Lipids – Proteins. Nutrients that regulate: Vitamins – Minerals – Water. Healthy diet – Food guide Pyramid-USDA– Vegetarian diet – Fast food.</p>
<b>Unit II</b>	:	<p><b>PERSONAL HEALTH CARE</b></p> <p>Protecting skin – common skin problems – Dry Skin, Acne, Dermatitis, Psoriasis, skin infections – skin cancer - caring for the skin. Hair – General care, cleaning tips, preventing hair loss, Anti dandruff strategies. Teeth – Common dental problems – General care of teeth – Dental checkup. Eye – Common eye problems – Eye diseases – General care of eyes – Vision checkup. Ear – general care – do's and don'ts.</p>
<b>Unit III</b>	:	<p><b>MATERNAL AND CHILD HEALTH</b></p> <p>Motherhood – pregnancy confirmation test – Prenatal care – Intra natal care – problems during pregnancy – Miscarriage and stillbirth – premature birth – labor and delivery - Family planning. Child health: Care of the newborn – Feeding – Nutritional guidelines - Care of the under-five (Toddler and Preschool).</p>
<b>Unit IV</b>	:	<p><b>ENVIRONMENTAL AND MENTAL HEALTH</b></p> <p>Mental health: Characteristics - Types: Schizophrenia -Manic depressive psychoses - Paranoia - Neurosis - Personality and character disorders. Environmental health: health in the home environment - pollution at home - diseases. Safety at home: Fall - Fires - Poisoning - Electrical hazards - Safety in road (Auto mobile - Pedestrian) - Disaster management (Severe weather condition - Flood- Lightning - Cyclone - Earthquake - Landslides- Tsunami).</p>

<b>Unit V</b>	<b>:</b>	<b>ALTERNATIVE MEDICINE AND FIRST AID</b> Naturopathy - Homeopathy- Ayurveda - Unani - Siddha. First aid: First aid procedures for dehydration – heart attack – fractures and dislocation, burns - bleeding - poisoning - electric shocks - drowning.
<b>Text Book</b>	<b>:</b>	
<b>References</b>	<b>:</b>	<ol style="list-style-type: none"> <li>1. Park, K. (1995). Park's Textbook of preventive and social medicine. Jabalpur: M/S BanarsidasBhanot Publishers</li> <li>2. Getchell, Pippin and Varnes (2006). Perspectives on Health. USA: D C Heath &amp; Co.</li> <li>3. LakshmanaSarma and Swami Nathan. S. (1960). Speaking of nature cure – Regain, retain and improve health the drugless way. New Delhi: Sterling Publications Pvt. Ltd</li> <li>4. Tom Sanders and Peter (2004). Emery Molecular basis of human nutrition. London: Taylor and Francis Publishers</li> <li>5. Eva Roman (2008). First aid. New Delhi: Indiana Publishing House</li> </ol>

<b>Expected Course Outcomes:</b>		
On the successful completion of the course, student will be able to:		
1	outline the concept of health and well-being, personal health care, maternal and child health, environmental and mental health, alternative medicine and first aid.	K2
2	the different aspects of health and well-being in day to day life.	K3
3	examine personal health problems and its remedies	K4
4	Distinguish the better platform for maintaining our body	K3
5	Understand the various techniques use to cure the health issues	K2
<b>K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create</b>		

Mapping with COs, POs and PSOs																
Course Outcomes (COs)	Program outcomes (POs)								Program specific outcomes (PSOs)							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
CO1	3	2	3	3	3	3	2	3								
CO2	3	2	3	3	2	3	3	3								
CO3	3	3	2	2	3	2	3	3								
CO4	3	3	3	3	3	2	3	3								
CO5	3	2	2	3	2	2	2	2								
Average	3	2.4	2.6	2.8	2.6	2.4	2.6	2.8								

**PC / 2021 – 2022 / PG / Zoology / Semester – I**

<b>Core Practical</b>	<b>Sub Code</b>	<b>FUNCTIONAL MORPHOLOGY OF INVERTEBRATE AND VERTEBRATE, CELL &amp; MOLECULAR BIOLOGY, BIOCHEMISTRY AND ECONOMIC ZOOLOGY</b>	<b>Hrs./ Week</b>	<b>Credits:</b>
<b>01</b>	<b>21PZOMP1</b>		<b>03</b>	

**Course Objectives:**

1. Aware about invertebrates and to understand the evolution of different types of coelom
2. Learn about various animal species and their affinities and their adaptive features
3. Study of identification and study of invertebrate and vertebrate fossils
4. Acquire advanced knowledge of molecular biology of prokaryotes, and eukaryotes and Study principles of cell communication and adhesion
5. To realize the chemical constituents of living matter and Understand about the importance and scope of biochemistry pathways regulation of biochemical processes.
6. To study the application of Zoological knowledge for the benefit of mankind and Create the self-employment opportunities to students

**Expected Course Outcomes:**

On the successful completion of the course, student will be able to:

1	The students identify the adaptation of various animal groups in invertebrates and vertebrate	K3
2	Explain and discuss how processes are integrated at the molecular level to create a functional cell and various cellular functions associated with the molecules found in cells	K2
3	Understand the structure and biological significance of biomolecules and their metabolism	K3
4	Realize the Biochemical constituents regulate the body function	K3
5	Understand the diseases, pest, parasites and predators of economic importance	K4

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

## **FUNCTIONAL MORPHOLOGY OF INVERTEBRATE AND VERTEBRATES**

1. Identification and study the selected Protozoans and Helminthes of medical importance.
2. Identification and study the section of certain animals from Coelenterata, Aschelminthes and Annelida to understand the evolution of different types of coelom.
3. Identification and study the larval forms all major phyla of Invertebrates.
4. Study of prepared slides of mouth parts of Honey bee, Housefly, Thrips, Mosquito, Bed bug and Butterfly to relate structure and type.
5. Study of the following specimens to bring out their affinities;  
a). Amphioxus b). Balanoglossus c). Ascidian d). Peteromyzon
6. Study of the following specimens with Reference to their adaptive features for their respective modes of life: a). Echeneis b). Ichthyophis / Uraeotyphlus c). Hyla d). Draco e). Pigeon f). Bat
7. Study of the following skull types with Reference / Books to jaw suspensions:  
a). Fish b). Frog c). Calotes d). Rat / Rabbit

## **CELL & MOLECULAR BIOLOGY**

1. Preparation of onion root tip squash to show mitotic stages.
2. Mounting of giant chromosome of the salivary gland in chironomous larva
3. Preparation of squamous epithelial cells
4. Preparation of human blood smear
5. Observation of blood smear of frog (slide only)
6. Spotters: Microtome, Centrifuge and Ocular Micrometer, Stage Micro meter
7. Separation of RBC, WBC and plasma from human blood (demonstration only)
8. Observation of chromosomal aberrations using standard texts and permanent slides.

## **BIOCHEMISTRY**

1. Salivary amylase activity in relation to temperature.
2. Salivary amylase activity in relation to pH
3. Salivary amylase activity in relation to substrate concentration
4. Salivary amylase activity in relation to enzyme concentration
5. Chromatographic separation of amino acid-Paper chromatography
6. Qualitative analysis of nitrogenous waste products-Ammonia-Urea,Uric acid
7. Qualitative analysis of carbohydrate, protein and fat
8. Preparation of standard graph for carbohydrate.
9. Preparation of standard graph for protein
10. Quantitative estimation of muscle protein by Lowry's method
11. Estimation of RNA

<b>ECONOMIC ZOOLOGY</b>	
1. Parasitic protozoa – Amoeba, Plasmodium and Trypanosoma. 2. Helminthes worms – Liver fluke, Tape worm and Filarial worm. 3 Insect pests – Trips, Nematode, Caterpillar and Rhinoceros beetle. 4. Value added products of dairy, poultry and fishery. 5. Methods for the microbiological examination of water and foods. 6. Predators and parasites in aquaculture. 7. Prawn diseases and their pathology.	
<b>*Practical records to be submitted to the University Practical examination</b>	
<b>Text Book(s)</b>	
1	Advanced Practical Zoology by Sinha, J., Chatterjee A.K., Chattopadhyay P. 2011. Arunabha Sen Publishers.
2	Practical Zoology Invertebrate by H.S. Bhamrah. 2003. Dominant Publishers.
<b>Reference Books</b>	
1	Fundamentals of Biochemistry by Jain J.L, Sunjay Jain, Nitin Jain. 2007.
2	Modern Experimental Zoology by Preeti Guptha and Mridula Chaturvedi. 2000
3	Manual of Practical Zoology: Chordates by Verma.(2000. S. Chand Publishing
4	Cell and Molecular Biology: A Lab Manual by Chaitanya K.V. 2013. Prentice Hall India Learning Private Limited

Mapping with COs, POs and PSOs																	
Course Outcomes (COs)	Program outcomes (POs)								Program specific outcomes (PSOs)								
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	
CO1	3	2	3	3	3	3	2	3									
CO2	3	3	3	3	2	3	3	3									
CO3	3	3	2	3	3	2	3	3									
CO4	3	3	3	3	3	3	3	3									
CO5	3	3	2	3	2	3	2	3									
Average	3	2.8	2.6	3	2.6	2.8	2.6	3									

**PC / 2021 – 2022 / PG / Zoology / Semester – I**

<b>Core Practical</b>	<b>Sub Code</b>	<b>DEVELOPMENTAL BIOLOGY, ANIMAL PHYSIOLOGY, BIOTECHNOLOGY AND AQUACULTURE &amp; FISHERIES</b>	<b>Hrs./ Week</b>	<b>Credits:</b>
<b>02</b>	<b>21PZOMP2</b>		<b>03</b>	

<b>Course Objectives:</b>
The main objectives of this course are to:
<ol style="list-style-type: none"> <li>1. The students show wound healing and regeneration in frog tadpoles and demonstrate developmental stages of chick embryo</li> <li>2. Physiological functions of animals and their parts and to study the digestion and excretion, blood, circulatory system, respiration, nervous system, sense organs and reproduction of Animals</li> <li>3. Undertake research in any aspect of animal physiology in future.</li> <li>4. Fundamental molecular tools and their applications of DNA modification and cloning technique &amp; Learn the accuracy of technique.</li> <li>5. To study the collection, isolation and identification of planktons</li> </ol>
<b>DEVELOPMENTAL BIOLOGY</b>
<ol style="list-style-type: none"> <li>1. Observations of whole mounts of chick embryos – 24, 48, 72 &amp; 96 h – slides / chart</li> <li>2. Spermatogenesis Oogenesis (vertebrate) chart</li> <li>3. Study of different types of eggs – Amphibia, frog, chick, man – Models / chart</li> <li>4. Frog early development – two celled stage, four celled stage, blastula, gastrula with yolk plug stage – slide / model</li> <li>5. Observation of insect metamorphosis –Chart.(Holo,Hemi&amp;ametabolous).</li> <li>6. Larval forms of Invertebrata – redia, cercaria, zoea, mysis, veliger, bipinnaria</li> <li>7. Observations of whole mounts of chick embryos – 24, 48, 72 &amp; 96 h – slides / chart</li> <li>8. Observation different types of placenta : Diffuse placenta of pig, Cotyledonary placenta of goat, zonary placenta of dog, monodiscoidal placenta of man and bidiscoidal placenta of monkey-(Chart/Models).</li> <li>9. The mammalian uterine cycles in a - (Chart/Models).</li> </ol>
<b>ANIMAL PHYSIOLOGY</b>
<ol style="list-style-type: none"> <li>1. Estimation of haemoglobin – Sahlis haemoglobino method</li> <li>2. Determination of ESR – Practical</li> <li>3. Detection of haemin crystals in blood – mammal</li> <li>4. Opercular activity of fish in relation to salinity</li> <li>5. Opercular activity of fish in relation to temperature.</li> <li>6. Qualitative analysis of excretory products in ammonotelic, ureotelic and uricotelic animals.</li> <li>7. ECG, EEG, conditional reflex – Chart.</li> <li>8. Kymograph and Sphygmomanometer-spotters-Demo</li> </ol>
<b>BIOTECHNOLOGY</b>

1. Extraction of genomic DNA from bacteria – by alkaline lysis method 2. Estimation of citric acid in citrus fruits 3. Preparation of wine – Demonstration 4. Preparation of antibiotics – Demonstration 5. Preparation of yoghurt – Demonstration 6. Diagnosis of HIV Antigen using DOT ELISA- Demonstration 7. Southern and Northern, western blotting techniques – charts 8. Spotters pBR322 Lambda phage Dolly RAPD Gene cloning RSLB 9. Preparation of Vermicompost – Field visit	
<b>AQUACULTURE &amp; FISHERIES</b>	
1 Estimation of Dissolved Oxygen and Alkalinity in two water samples. 2 Museum specimens, slides, models and charts: Catla , Rohu, Mrigal, Penaeus, Raft culture, Pinctada, Argulus. Lernaea, 3. Freshwater plankton- Zooplankton, phytoplankton –Culture	
<b>Text Book(s)</b>	
1	Advanced Practical Zoology by Sinha, J., Chatterjee A.K., Chattopadhyay P. 2011. Arunabha Sen Publishers.
2	Manual of Practical Physiology and Endocrinology by Harsh Vardhan Bhask. 2009. Campus Books International
3	Medical Laboratory Technology, Methods and Interpretations by Ramnik Sood. 2006. Jaypee publishers.
<b>Reference Books</b>	
1	Clinical Embryology: A Practical Guide by 1. Zsolt Peter Nagy, Alex C. Varghese, Ashok Agarwal. 2013. Springer-Verlag New York Inc
2	Modern Experimental Zoology by Preeti Guptha and Mridula Chaturvedi. 2000
3	Manual of Practical Physiology and Endocrinology by Harsh Vardhan Bhask. 2009. Campus Books International



<b>Expected Course Outcomes:</b>		
On the successful completion of the course, student will be able to:		
1	Study and understand the different stages in frog	K2
2	Examine their blood pressure and they can identify blood groups, function of kidney, Ear, Eyes and main function of nerves will be easily know ledged	K4
3	Learn the maintenance of laboratory equipments/ tools, safety hazards and precautions	K4
4	Understand the technique of cell and tissue culture. Learn the preparation of solution of given percentage and molarities	K5
5	The students easily get the employment opportunities especially in the Hatchery and Fish farm	K6
<b>K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create</b>		

<b>Mapping with COs, POs and PSOs</b>																
<b>Course Outcomes (COs)</b>	<b>Program outcomes (POs)</b>								<b>Program specific outcomes (PSOs)</b>							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
<b>CO1</b>	3	2	3	3	3	3	2	3								
<b>CO2</b>	3	3	3	3	3	3	3	3								
<b>CO3</b>	3	3	2	3	3	2	3	3								
<b>CO4</b>	3	3	3	3	3	3	3	3								
<b>CO5</b>	3	2	2	3	2	3	3	3								
<b>Average</b>	3	2.6	2.6	3	2.8	2.8	2.8	3								

**PC / 2021 – 2022 / PG / Zoology / Semester – II**

<b>Core</b>	<b>Sub Code</b>	<b>DEVELOPMENTAL BIOLOGY</b>	<b>Hrs./ Week</b>	<b>Credits:</b>
<b>04</b>	<b>21PZOM21</b>		<b>06</b>	<b>05</b>

<b>Objective</b>	<b>:</b>	<p>The main objectives of this course are to:</p> <ol style="list-style-type: none"> <li>1. Enable students to understand the cellular and tissue-based events of gametogenesis, fertilization, cleavage, and gastrulation. stages involved in the developing embryo</li> <li>2. Acquire students with basic knowledge of experimental embryology that leads to understanding embryonic organizer, inductions and differentiation</li> <li>3. Understand organogenesis related to mechanisms of development and differentiation</li> <li>4. Understand the metamorphosis, regeneration, nucleo-cytoplasmic interactions and placenta in animals</li> <li>5. Acquire students with knowledge regarding the cryo preservation techniques and sperm banking utilized in research.</li> </ol>
<b>Unit I</b>	<b>:</b>	<p><b>BASIC CONCEPTS OF DEVELOPMENT</b></p> <p>Introduction, historical perspective (Brief account), theories, preformation, epigenesis, recapitulation and germplasm, Subdivisions of developmental Biology-Gametogenesis – Spermatogenesis, Oogenesis Fertilization (biochemical and molecular aspects), Parthenogenesis.</p>
<b>Unit II</b>	<b>:</b>	<p><b>CELL DIFFERENTIATION</b></p> <p>Cyto differentiation and chemo differentiation. Stem cells-totipotency and pluripotency. Embryonic Stem cells and their applications. Cleavages- patterns of cleavage-radial, spiral and bilateral; Types-meroblastic, holoblastic and superficial, factors affecting cleavage. Blastulation-Types of blastula. Fertilization maps. Presumptive organ forming areas in frog and chick. Morphogenetic movements and gastrulations in frog and chick.</p>
<b>Unit III</b>	<b>:</b>	<p><b>GASTRULATION AND ORGANOGENESIS</b></p> <p>Gastrulation – Morphogenetic movement, Gastrulation in sea urchin. Organogenesis in frog and chick – CNS, eye, skin and its derivatives, heart, kidney, digestive tube and its derivatives. Placentation – its types and function</p>
<b>Unit IV</b>	<b>:</b>	<p><b>REGULATION AND DEVELOPMENT</b></p> <p>Metamorphosis – morphological, biochemical &amp; hormonal control of amphibian metamorphosis. Neuro endocrine control – biochemistry &amp; mechanism of hormones during insect metamorphosis. Nucleo-cytoplasmic interactions in acetabularia. Regeneration – Amphibian limb regeneration-stimulus and suppression of regeneration (planaria and lizards).</p>

<b>Unit V</b>	<b>:</b>	<b>TERATOGENESIS</b> Teratogenic agents. Embryonic induction and differentiation Embryonic induction in vertebrates – types – exogeneous, endogenous. Theories of organizer or inductor. Morphology, chemical basis of neural induction. Differentiation – Characteristics and types of differentiation. Selective action of genes in differentiation. Contributions of teratology to development.
<b>Text Book</b>	<b>:</b>	<ol style="list-style-type: none"> <li>1. Scott F. Gilbert. 2006. Developmental Biology, 8th edition, Sinauer Associates, Inc. Massachusetts, USA</li> <li>2. B. I. Balinsky. 2012. An Introduction to Embryology, 5th edition, Thomson Brooks Cole Publishing, Pvt Ltd.,</li> <li>3. P S Verma &amp; V K Agarwal. 2012. Chordate Embryology, 1<sup>st</sup> edition, S. C. Publishing, India.</li> <li>4. D.R. Khanna, year Advanced Embryology, Discovery Publishing House DPH, India</li> </ol>
<b>References</b>	<b>:</b>	<ol style="list-style-type: none"> <li>1. T. Subramoniam, 2011, Molecular Developmental Biology, Second Edition, Alpha Science International Ltd, UK</li> <li>2. Julian S. Huxley and G. R. de Beer, 2015. The Elements of Experimental Embryology, Cambridge University Press, UK.</li> <li>3. T.H. Morgan, 2010. Embryology and Genetics, 1st edition, Agrobios India publishers, Jodhpur, India</li> <li>4. Bruce Carlson, Human Embryology and Developmental Biology, 2<sup>nd</sup> Edition</li> <li>5. Rm Twyman, 2003, Instant Notes Developmental Biology, Viva Books Private Limited, India</li> </ol>

<b>Expected Course Outcomes:</b>		
On the successful completion of the course, student will be able to:		
1	Understand the molecular, cellular and physiological mechanisms of development of organisms.	<b>K2</b>
2	Acquire skills in working knowledge in developmental biology techniques, experimental design, analysis and interpretation of data.	<b>K3</b>
3	Know various techniques used in experimental embryology of animals and their application in research	<b>K2</b>
4	Develop skill on experimental embryology	<b>K3</b>
5	Understand the importance of experimental embryology in medical field.	<b>K3</b>
<b>K1</b> - Remember; <b>K2</b> - Understand; <b>K3</b> - Apply; <b>K4</b> - Analyze; <b>K5</b> - Evaluate; <b>K6</b> – Create		

Mapping with COs, POs and PSOs																
Course Outcomes (COs)	Program outcomes (POs)								Program specific outcomes (PSOs)							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
CO1	3	2	2	3	2	3	2	3								
CO2	3	3	3	2	2	2	3	2								
CO3	3	3	2	3	3	2	2	3								
CO4	3	3	3	2	3	3	3	3								
CO5	3	2	2	3	2	3	2	2								
Average	3	2.6	2.4	2.6	2.4	2.6	2.4	2.6								

**PC / 2021 – 2022 / PG / Zoology / Semester – II**

<b>Core</b>	<b>Sub Code</b>	<b>ANIMAL PHYSIOLOGY</b>	<b>Hrs./ Week</b>	<b>Credits:</b>
<b>05</b>	<b>21PZOM22</b>		<b>06</b>	<b>05</b>

<b>Objective</b>	:	<p>The main objectives of this course are to:</p> <ol style="list-style-type: none"> <li>1. Understand the internal physical and chemical functions of animals and their parts</li> <li>2. Study the digestion, excretion, blood and circulatory system,</li> <li>3. Understand the respiration and nervous system</li> <li>4. Understand the sense organs and reproductive physiology of Animals</li> </ol>		
<b>Unit I</b>	:	<p><b>NUTRITION AND DIGESTION</b></p> <p>Importance of Carbohydrates, Proteins, Lipids. Vitamins and Minerals with regard to human health. Balanced diet, Malnutrition and BMR. Human digestive tract and functions. Intestinal villi and absorption.</p>		
<b>Unit II</b>	:	<p><b>BLOOD AND CIRCULATION</b></p> <p>Structure of arteries and Veins. Blood Corpuscles. Haemopoiesis and formed elements. Blood volume regulation. Blood grouping. Structure and function of the human heart, Structure and function of coronary arteries and vein. ECG, Cardiac cycle, Heart rate, Blood pressure. Neural and chemical regulation of heart.</p>		
<b>Unit III</b>	:	<p><b>RESPIRATION AND EXCRETION</b></p> <p>Respiration in air and water. Structure and function of human respiratory system. Respiratory pigments. Transport of gases in lungs and tissues. Neural and chemical regulation of respiration. Structure of the human Kidney, Nephron and Urine formation. Renal disorders – Micturition and dialysis. Regulation of water and electrolytes.</p>		
<b>Unit IV</b>	:	<p><b>NERVOUS SYSTEM AND SENSE ORGANS</b></p> <p>Neuron – Structure and function of Neuron, Neuro transmitters, Synapse, Conduction of nerve impulses. Structure and function of brain and Spinal cord, EEG. Muscles – Classification – Ultra structure of skeletal muscle – Mechanism of muscular contraction – Neural control of muscle tone and function. Sense organ of human vision and hearing.</p>		
<b>Unit V</b>	:	<p><b>REPRODUCTIVE PHYSIOLOGY</b></p> <p>Basics mechanism of hormone action. Estrous and endometrial reproductive cycle, Neuro endocrine regulation of reproduction. Menstrual cycle, tubectomy, vasectomy- birth control, birth control pills .</p>		

<b>Text Book</b>	:	<ol style="list-style-type: none"> <li>1. Physiology Edn.5 Part Ii, Verma (P.S) Etc, Aul. H Ed.Nch (James) Himalaya, 2000 (year comes next to name then comes title)</li> <li>2. Chordate Zoology and Animal Physiology, Jordan(El); Verma(P.S), S Chand and Company, 1993</li> <li>3. Animal Introduction to Animal Physiology, Kay(Ian), Bios Scientific Publishers, 1998</li> <li>4. Textbook of Animal Physiology and Endocrinology, Berry (Ak), Emkey Publications, 1993</li> </ol>
<b>References</b>	:	<ol style="list-style-type: none"> <li>1. Textbook of Animal Physiology With Related Biochemistry For B.Sc., and M.Sc., Students Of Zoology of All Indian Universities, Berry (Ak), Emkey Publications, 2002</li> <li>2. Animal Physiology Adaptation and Environment, Nielson (Knut Schmidt), Cambridge University Press, 1994</li> <li>3. Essentials of Animal Physiology, Rastogi(S C), The New Age International 2008</li> <li>4. Animal Physiology Mechanisms and Adaptions, Randall, W.H. Freeman &amp; Co. Ltd, 2002</li> <li>5. Animal Physiology, Schmidt-Nielsen(Knut), Cambridge, 1997</li> <li>6. Animal Physiology, Stewart (Michael ) Ed, Hodder And Stoughton, 1991</li> </ol>

#### Related Online Contents

1	Animal Physiology : <a href="https://swayam.gov.in/nd1_noc20_bt42/preview">https://swayam.gov.in/nd1_noc20_bt42/preview</a>
2	Physiology and Biochemistry: <a href="https://swayam.gov.in/nd2_cec20_bt19/preview">https://swayam.gov.in/nd2_cec20_bt19/preview</a>
4	Animal Physiology : <a href="https://www.classcentral.com/course/swayam-animal-physiology-12894">https://www.classcentral.com/course/swayam-animal-physiology-12894</a>
5	Respiration in the Human Body: <a href="https://www.classcentral.com/course/edx-respiration-in-the-human-body-3050">https://www.classcentral.com/course/edx-respiration-in-the-human-body-3050</a>
6	Introduction to Brain & Behaviour : <a href="https://swayam.gov.in/nd1_noc20_hs33/preview">https://swayam.gov.in/nd1_noc20_hs33/preview</a>

#### Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Monitor their blood pressure and they can identify blood groups	K3
2	Explain the function of heart and blood vessels	K2
3	Describe the function of kidney, Ear, Eyes and main function of nerves	K2
4	Explain the nerve impulse transmission in man	K4
5	Understand the reproductive physiology of animals	K2
<b>K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create</b>		

Mapping with COs, POs and PSOs																
Course Outcomes (COs)	Program outcomes (POs)								Program specific outcomes (PSOs)							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
CO1	3	2	2	3	2	3	2	3								
CO2	3	3	3	3	2	2	3	3								
CO3	3	3	3	2	3	2	3	3								
CO4	3	3	3	3	3	3	3	2								
CO5	3	2	2	3	2	3	2	3								
Average	3	2.6	2.6	2.8	2.4	2.6	2.6	2.8								

**PC / 2021 – 2022 / PG / Zoology / Semester – II**

<b>Core</b>	<b>Sub Code</b>	<b>BIOTECHNOLOGY</b>	<b>Hrs./ Week</b>	<b>Credits:</b>
<b>06</b>	<b>21PZOM23</b>		<b>06</b>	<b>05</b>

<b>Objective</b>	:	<p>The main objectives of this course are</p> <ol style="list-style-type: none"> <li>1. To learn recombinant DNA technology and application of living organism</li> <li>2. Understand the knowledge of vectors for gene cloning</li> <li>3. Acquire advance knowledge of cell culture techniques use for animal biotechnology</li> <li>4. To realize the microbial products in the industrial process</li> <li>5. Understand the important of pharmaceuticals usage like drug designing</li> </ol>
<b>Unit I</b>	:	<p><b>RECOMBINANT DNA TECHNOLOGY</b></p> <p>Gene cloning methods, types of restriction enzymes, ligases, linkers , adaptors and cDNA, Selection of recombinants. Hybridization techniques, chemical synthesis of oligonucleotides, DNA sequence by PCR techniques.</p>
<b>Unit II</b>	:	<p><b>GENE CLONING VECTORS</b></p> <p>Cloning vector of E.coli-PBR 322 and PUC vectors, Ti plasmid, λphage, cloning vector of yeast. Cloning vector of fungai tumefaciens, Simian virus 40. Gene transfer methods – Particle bombardment, micro injection techniques, electrophoresis, liposome fusion.</p>
<b>Unit III</b>	:	<p><b>ANIMAL BIOTECHNOLOGY</b></p> <p>Cell culture : Organ culture, whole embryo culture, embryo transfer – in-vitro fertilization (IVF) technology. Transgenic animals-Dolly, Human gene therapy. Cryobiology. Methods of IVF technology [Endometeriosis statement, PCOD, ICSI and IUI].</p>
<b>Unit IV</b>	:	<p><b>MICROBIAL BIOTECHNOLOGY</b></p> <p>Fermentation : Bioreactor and Microbial Products - Primary and secondary metabolites. Protein engineering Bioremediation of hydrocarbons, industrial wastes and heavy metals. Bio pesticides, Bio fertilizers &amp; Bio weapons.</p>
<b>Unit V</b>	:	<p><b>MEDICAL BIOTECHNOLOGY</b></p> <p>Drug development : Production of pharmaceuticals by genetically engineered rganisms (hormones &amp; interferons), microbial transformation for production of important pharmaceutical (steroids and antibiotics), drug design and targeting.</p>
<b>Text Book</b>	:	<ol style="list-style-type: none"> <li>1. Singh. B. D 1998, biochemistry: Kalyani Publishers, New Delhi</li> <li>2. Kumaresan. V 1994, Biotechnology, Saras Publications, Nagercoil</li> </ol>



<b>References</b>	:	<ol style="list-style-type: none"> <li>1. Satyanarayana, U.2007. Biotechnology. Uppala author-publisher interlinks, Vijayawada, Andrapradesh, India</li> <li>2. Old, R.W and Primrose, S.B. 1993. Principles of Gene manipulation: An introduction to Genetic Engineering. Blackwell Science Publication</li> <li>3. Ingacimuthu, S.2008. Biotechnology: An introduction, Narosa Publishing house, New Delhi.</li> <li>4. Purohit, S.S2008. Biotechnology. Student Edition, Jodhpur. Lee and Savage, L.M Biological Molecules in Nanotechnology.Biological Molecules in Nanotechnology – By Ratner M and Ratner D-Nerosha Publishing house, New Delhi.</li> </ol>
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### Expected Course Outcomes

On the successful completion of the course, student will be able to:

1	Understand the purpose of the technique, its proper use and possible modifications improvement.	K3
2	Develop an understanding of the fundamental molecular tools and their applications	K2
3	Explain the recombinant DNA technology and types of cloning vectors	K2
4	Describe embryo transfer techniques.	K4
5	Understand the applications of Biotechnology methods in medical and microbial fields.	K3
<b>K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create</b>		

### Mapping with COs, POs and PSOs

Course Outcomes (COs)	Program outcomes (POs)								Program specific outcomes (PSOs)							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
<b>CO1</b>	3	3	3	3	2	2	3	3								
<b>CO2</b>	3	3	3	2	2	3	3	3								
<b>CO3</b>	3	2	2	3	3	2	3	3								
<b>CO4</b>	3	3	3	2	3	2	3	2								
<b>CO5</b>	3	2	2	3	3	3	3	3								
<b>Average</b>	3	2.6	2.6	2.6	2.6	2.4	3	2.8								

**PC / 2021 – 2022 / PG / Zoology / Semester – II**

<b>Elective</b>	<b>Sub Code</b>	<b>AQUACULTURE AND FISHERIES</b>	<b>Hrs./ Week</b>	<b>Credits:</b>
<b>02</b>	<b>21PZOE21</b>		<b>06</b>	<b>05</b>

<b>Objective</b>	<b>:</b>	<p>The main objectives of this course are to:</p> <ol style="list-style-type: none"> <li>1. Study the breeding, rearing, and harvesting of aquatic animals.</li> <li>2. Study the recent techniques and application for the practical aquaculture</li> <li>3. Know the methodology for the construction of hatcheries and farms.</li> <li>4. Understand the feed formulation techniques using Artificial Intelligence</li> <li>5. Learn the importance of aquaculture</li> </ol>
<b>Unit I</b>	<b>:</b>	<p><b>BASICS OF AQUACULTURE</b></p> <p>Scope of aquaculture – Aquaculture in India, Role of aquaculture on economic development, constraints in aquaculture, organization related to aquaculture and fisheries, types of aquaculture Freshwater, coastal and marine water aquaculture . Fresh &amp; marine water cultivable fishes.</p>
<b>Unit II</b>	<b>:</b>	<p><b>MANAGEMENT TO FISH FARMS</b></p> <p>Fish Ponds – Definition, breeding ponds, nursery ponds, rearing ponds, culture ponds (stocking ponds). Preparation of pond for fish culture, management of fish ponds, water quality management of fish ponds. Importance and composition of feeds; types of feed, wet and dry feeds, Artificial and live feeds – Artificial, Diatoms, Daphnia and <i>Spirulina</i> cultures.</p>
<b>Unit III</b>	<b>:</b>	<p><b>TYPES OF CULTURE SYSTEMS</b></p> <p>Extensive culture, Intensive culture and semi-intensive culture, monosex culture, monoculture, Polyculture, cage culture and pen culture. Integrated fish farming – paddy cum fish culture, Animal husbandry cum fish culture, sewage fed fish culture. Aquaponics, Culture practices : Major carps, Prawns, Oyster and seaweeds</p>
<b>Unit IV</b>	<b>:</b>	<p><b>BREEDING TECHNIQUES AND FISH DISEASES</b></p> <p>Breeding techniques – Bundh breeding and induced breeding. Collection, preparation and injection of pituitary extract, selection of breeders, mechanism of pituitary action and advantages of induced breed. Fish disease management: Common bacterial, viral, fungal, protozoans and crustaceans diseases, symptoms and their treatment – vaccines of disease.</p>
<b>Unit V</b>	<b>:</b>	<p><b>GENOMIC MANIPULATION AND MARKETING</b></p> <p>Hybridization, Androgenesis, Gynandrogenesis and Polyploidy. Harvesting and transport of fish and its product. Fish preservation and fish processing technology – By products of fish and its uses. Government organization in Aquaculture. ICAR, CMFRI, CIFRI, CCFRI, CIFA, CIBA, CIFT &amp; MPEDA.</p>

<b>Text Book</b>	:	<ol style="list-style-type: none"> <li>1. Introduction to Fish Biology and Fisheries, Khanna Surjeet Publications, 2019( change the format)</li> <li>2. Science of Aquaculture, Arvind N. Shukla, Discovery publishing house Pvt Ltd, 2013</li> <li>3. Aquaculture Management &amp; Technology, Agnihotri s. B., Swastik Publications 2013</li> <li>4. Global Fisheries and Aquaculture, Mirza Akbar Khan, Random Publications, 2013</li> <li>5. Fisheries, Aquaculture and Biotechnology, Shagufta Aph Publishing Corporation, 2012</li> <li>6. Aquaculture, Pandey B N, Aph Publishing Corporation, 2011</li> <li>7. Research Frontiers in Wetlands, Fishery &amp; Aquaculture, Devashish Kar, Dominant Publishers &amp; Distributors (p) ltd 2014</li> </ol>
<b>References</b>	:	<ol style="list-style-type: none"> <li>1. Aquaculture and the Environment, Pillay T. V. R., Wiley, 2013</li> <li>2. Aquaculture Biotechnology, Farah Deebea, Anmol Publications PVT.LTD 2013</li> <li>3. Fish Nutrition in Aquaculture, Chandrasekhar Y.S., Swastik Publications 2013</li> <li>4. Aquaculture, Lucas John S. Wiley-Blackwell 2012</li> <li>5. Fresh Water Fish Culture and Training, Neha Charan, Random Publications, 2012</li> <li>6. Aquaculture and Fisheries Biotechnology, Dunham Rex A., Cabi Publishing, 2011</li> </ol>

<b>Related Online Contents</b>	
1	Aquaculture <a href="https://www.openlearning.com/courses/aquaculture-sta2473-/">https://www.openlearning.com/courses/aquaculture-sta2473-/</a>
2	Indian Agricultural Development : <a href="https://www.classcentral.com/course/swayam-indian-agricultural-development-14119">https://www.classcentral.com/course/swayam-indian-agricultural-development-14119</a>
3	Applied and Economic Zoology : <a href="https://swayam.gov.in/nd2_cec20_ge23/preview">https://swayam.gov.in/nd2_cec20_ge23/preview</a>
4	Food and Nutrition : <a href="https://swayam.gov.in/nd2_cec19_ag02/preview">https://swayam.gov.in/nd2_cec19_ag02/preview</a>

<b>Expected Course Outcomes:</b>		
On the successful completion of the course, student will be able to:		
1	Gain employment opportunities especially in the Hatchery and Fish farm	K3
2	Able to construct and design fish and prawn farm and maintain young ones.	K6
3	Understand the various culture systems.	K3
4	Learn the new breeding techniques in aquaculture including cryopreservation.	K4
5	Understand the fish genetics and breeding.	K2
<b>K1</b> - Remember; <b>K2</b> - Understand; <b>K3</b> - Apply; <b>K4</b> - Analyze; <b>K5</b> - Evaluate; <b>K6</b> - Create		

<b>Mapping with COs, POs and PSOs</b>																
<b>Course Outcomes (COs)</b>	<b>Program outcomes (POs)</b>								<b>Program specific outcomes (PSOs)</b>							
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>
<b>CO1</b>	3	3	2	3	2	3	3	3								
<b>CO2</b>	3	3	3	3	2	2	3	3								
<b>CO3</b>	3	2	3	2	3	2	3	3								
<b>CO4</b>	3	3	3	3	3	3	3	3								
<b>CO5</b>	3	2	2	3	3	3	3	3								
<b>Average</b>	3	2.6	2.6	2.8	2.6	2.6	3	3								

**PC / 2021 – 2022 / PG / Zoology / Semester – II**

<b>Elective</b>	<b>Sub Code</b>	<b>ENTOMOLOGY</b>	<b>Hrs./ Week</b>	<b>Credits:</b>
<b>02</b>	<b>21PZOE22</b>		<b>06</b>	<b>05</b>

<b>Objective</b>	:	<p>The main objectives of this course are to:</p> <ol style="list-style-type: none"> <li>1. Classify insects</li> <li>2. Understand insect pest management techniques</li> <li>3. Understand the pest of various crops such as cotton, sugarcane, paddy, food grains, fruits and pulses.</li> <li>4. Understand insect migration, population fluctuation and medical and veterinary importance</li> <li>5. Provide knowledge on sericulture, apiculture and lac culture</li> </ol>
<b>Unit I</b>	:	<p><b>Insect Classification</b></p> <p>Classification of apterygota upto families- Classification of Pterygota upto orders Orthoptera, Hemiptera, Diptera, Hymenoptera, Lepidoptera and Coleoptera etc. Collection and preservation of insects</p>
<b>Unit II</b>	:	<p><b>Insect Pest-Management</b></p> <p>Insect pest-Management strategies and tools - Biological control -Genetic control – Chemical Control, intergrated pest management.</p>
<b>Unit III</b>	:	<p><b>Pests of Crops and Fruits</b></p> <p>Pests of Cotton - Pests of sugarcane - Pests of paddy - Pests of stored food grains - Pests of citrus fruits and mango - Pests of pulses - Households insect pests</p>
<b>Unit IV</b>	:	<p><b>Ecology and Ethology of insects</b></p> <p>Insect biodiversity – Dynamics of insect population – Aquatic insect, Soil insect and Mycophagous insects. Insect behavior – Social life - Insects migration, population fluctuation and factors.</p>
<b>Unit V</b>	:	<p><b>Applied Entomology</b></p> <p>Insects in relation to forensic science. Insects of medical and veterinary importance - Ecological factors affecting the population and development of Insects. Mulberry and non-mulberry sericulture – Apiculture - Lac culture - Insects as human food for future</p>
<b>Text Book</b>	:	<ol style="list-style-type: none"> <li>1. D. B. Tembhare 2002. Modern Entomology. Himalaya Publishing House, Nagpur</li> <li>2. D. V. David and T. N. Ananthakrishnan 2006. General and applied entomology. Tata Mc Graw Hill Publisher, New Delhi</li> <li>3. E. D. Sanderson et al 1966. Insect pests. John Willey &amp; Son Inc. Newyork</li> <li>4. H. H. Ross 1964. A text book of entomology. John Willey &amp; Son Inc. Newyork</li> </ol>

<b>References</b>	:	<ol style="list-style-type: none"> <li>1. Entomophagous Insect by Curtis Paul Clausen, 2010, McGraw-Hill book Company</li> <li>2. Insect and hygiene by Busvine, J.R. 1951, Published by Methuen &amp; Co, London</li> <li>3. The Insects Structure and Function by R.F. Chapman, 2012, Cambridge University Press.</li> <li>4. Principles of Insect Physiology by V.B. Wigglesworth, 1972, Springer</li> </ol>
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<b>Related Online Contents</b>	
1	Applied Entomology: <a href="https://onlinecourses.swayam2.ac.in/cec20_bt02/preview">https://onlinecourses.swayam2.ac.in/cec20_bt02/preview</a>

<b>Expected Course Outcomes:</b>		
On the successful completion of the course, student will be able to:		
1	Classify insects up to order	K2
2	Explain general insect pest management techniques	K4
3	Understand key pest insects of the major horticultural crops and fruits	K2
4	Explain migration, population and their medical and veterinary importance	K5
5	Students should acquire knowledge on sericulture, apiculture and Lac culture techniques	K6
<b>K1</b> - Remember; <b>K2</b> - Understand; <b>K3</b> - Apply; <b>K4</b> - Analyze; <b>K5</b> - Evaluate; <b>K6</b> – Create		

<b>Mapping with COs, POs and PSOs</b>																
<b>Course Outcomes (COs)</b>	<b>Program outcomes (POs)</b>								<b>Program specific outcomes (PSOs)</b>							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
<b>CO1</b>	3	3	2	3	3	3	2	3								
<b>CO2</b>	3	3	3	3	3	3	3	3								
<b>CO3</b>	3	2	3	3	3	3	2	3								
<b>CO4</b>	3	2	3	3	2	2	3	3								
<b>CO5</b>	3	3	2	3	3	2	3	3								
<b>Average</b>	3	2.6	2.6	3	2.8	2.6	2.6	3								

**PC / 2021 – 2022 / PG / Zoology / Semester – III**

Core	Sub Code	MICROBIOLOGY	Hrs./ Week	Credits:
07	21PZOM31		06	05

<b>Objective</b>	:	<p>The main objectives of this course are to:</p> <ol style="list-style-type: none"> <li>1. Know the structure, functions and classification of bacteria, viruses, fungi and yeast</li> <li>2. Apply knowledge on the Cultivation and control of microorganism</li> <li>3. Understand the distribution of microorganisms</li> <li>4. Learn about the microorganisms and their detection</li> <li>5. Understand the application of microorganisms in microbial technology</li> </ol>
<b>Unit I</b>	:	<p><b>HISTORICAL PERSPECTIVES IN MICROBIOLOGY</b></p> <p>History and Scope of microbiology – Classification of microorganisms – protozoa – algae – fungi – bacteria (Gram Negative and Gram Positive) and virus – Whittaker’s five kingdom concept, Ultra structure of bacteria – capsule, cell wall – Gram negative and Gram positive, Cytoplasmic inclusion.</p>
<b>Unit II</b>	:	<p><b>MICROBIAL GROWTH AND NUTRITION</b></p> <p>Culture medium - requirements , types , growth curve , Culture methods – methods of culturing bacteria and characteristics of bacteria-Methods of preservation and maintenance of culture- culture techniques and culture of E.coli. Microbial nutrition - Autotrophs- photosynthetic and Chemosynthetic, Heterotrophs and mixotrophs.</p>
<b>Unit III</b>	:	<p><b>DAIRY, FOOD AND INDUSTRIAL MICROBIOLOGY</b></p> <p>Microbiology of milk – Pasteurization, Dairy product and fermentation technology. Food: Food spoilage – spoilage of meat – bread –milk, canned food. Food poisoning and food preservation, Industrial production of Penicillin and wine. Source of microorganism found in food- Microbial examination of food- Microbes in food production (Yogurt &amp; cheese).</p>
<b>Unit IV</b>	:	<p><b>MICROBIAL DISEASES AND THEIR CONTROL</b></p> <p>Bacterial diseases - Botulism Soil borne diseases - Tetanus. Sexually transmitted and contact diseases - Syphilis. Viral diseases - Rabies. Fungal diseases - Mycoses. Food and water borne diseases - Typhoid. A Direct Contact Diseases - AIDS.</p>
<b>Unit V</b>	:	<p><b>ENVIRONMENTAL AND AGRICULTURE MICROBIOLOGY ( give importance to habitat bioremediation)</b></p> <p>Potable water: Microbial analysis of water, purification of water. Organic compost, Biogas, mechanism of methane formation, Sewage treatment, treatment of industrial effluents. Microbial leaching and Bio mining. Biodegradation – Petroleum and xenobiotic. Nutrient cycling (Carbon cycle and nitrogen cycle). Role of micro organism in soil formation-micro organism as bio fertilizer-rhizobium-crop response.Azotobacter-beneficial role of Azotobacter, Azospirillum - blue green algae (BGA) Bio fertilizer.</p>
<b>Text Book</b>	:	<p>1. Ananthanarayan and Paniker's 2005. Textbook of Microbiology.The Orient</p>

		<p>Blackswan.</p> <ol style="list-style-type: none"> <li>2. R.C. and Maheshwari, D.K. 2007. A Textbook of Microbiology by Dubey, S. Chand and Company Ltd.</li> <li>3. C. B. Powar and H. F. Dagainawala 1993. General microbiology. Himalaya Publishing house, New Delhi</li> <li>4. P. Chakraborty 2001. A text book of microbiology. New central book agency Pvt. Ltd India</li> <li>5. M. J. Pelczar et al 1996. Microbiology. Tata Mc Graw Hill Publisher co. New Delhi</li> </ol>
<b>References</b>	:	<ol style="list-style-type: none"> <li>1. General Microbiology by Stanier (Roger.Y) and Ingraham (John. L). 1992. Published by Macmillan</li> <li>2. Cellular Microbiology by Cossart (Pascale) and Boquet (Patrice). 2000. ASM Press.</li> <li>3. Medical Microbiology by Rajan S. 2007. MJP Publishers</li> <li>4. Manual of Microbiology by Kanika Sharma. 2007. Anshan Ltd.</li> <li>5. Environmental Molecular Microbiology by Paul Rochelle, A. 2001. Horizon Press</li> <li>6. A Text Book of Soil Microbiology by Agarwal, T.K. 2014. Astha Publishers and Distributors</li> <li>7. Food Microbiology by Frazier, W.C. 1988. McGraw-Hill Inc.,US</li> </ol>

<b>Related Online Contents</b>	
1	Food Microbiology and Food Safety: <a href="https://onlinecourses.swayam2.ac.in/cec20_ag13/preview">https://onlinecourses.swayam2.ac.in/cec20_ag13/preview</a>
2	Food Microbiology: <a href="https://onlinecourses.swayam2.ac.in/cec20_ag09/preview">https://onlinecourses.swayam2.ac.in/cec20_ag09/preview</a>
3	Microbial Physiology and metabolism: <a href="https://onlinecourses.swayam2.ac.in/cec20_bt14/preview">https://onlinecourses.swayam2.ac.in/cec20_bt14/preview</a>
4	Applied Environmental Microbiology: <a href="https://onlinecourses.nptel.ac.in/noc20_ce17/preview">https://onlinecourses.nptel.ac.in/noc20_ce17/preview</a>

<b>Expected Course Outcomes:</b>
On the successful completion of the course, student will be able to:



1	Identify the scope and history of microbiology	K2
2	Acquire the knowledge on cultivation and control of microorganisms	K3
3	Apply knowledge on the role of microorganism in cycling of nutrient	K4
4	Analyze the different applications of microbiology in food industry	K5
5	Understand the application of microbial technology in production of organic acids.	K2
<b>K1</b> - Remember; <b>K2</b> - Understand; <b>K3</b> - Apply; <b>K4</b> - Analyze; <b>K5</b> - Evaluate; <b>K6</b> - Create		

Mapping with COs, POs and PSOs																
Course Outcomes (COs)	Program outcomes (POs)								Program specific outcomes (PSOs)							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
CO1	3	2	3	3	3	2	3	3								
CO2	3	3	3	3	2	2	3	3								
CO3	3	2	3	3	3	3	3	3								
CO4	3	3	3	3	3	2	3	3								
CO5	3	2	3	2	2	3	2	3								
Average	3	2.4	3	2.8	2.6	2.4	2.8	3								

**PC / 2021 – 2022 / PG / Zoology / Semester – III**

<b>Core</b>	<b>Sub Code</b>	<b>IMMUNOLOGY</b>	<b>Hrs./ Week</b>	<b>Credits:</b>
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08	21PZOM32		06	05
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<b>Objective</b>	:	<p>The main objectives of this course are to:</p> <ol style="list-style-type: none"> <li>1. Study the innate and adaptive immunity, antigens and antibodies interactions.</li> <li>2. Understand the host defense mechanism in clinical immunology.</li> <li>3. Learn the immunological disorders.</li> <li>4. Gain knowledge on immunotechniques</li> <li>5. Perceiving information on artificial intelligence in immunodeficiency diseases.</li> </ol>
<b>Unit I</b>	:	<p><b>Immunity and Immune System</b></p> <p>Scope of Immunology- types of immunity, Innate, Acquired Immunity: Innate-First line of defence – Second line of defence – Third line of defence. Inflammatory response. Mechanism of innate immune recognition. Acquired immunity types- Cells of immune system: Lymphoid lineage – Myeloid lineage – Organs of immune system, primary and secondary lymphoid organs.</p>
<b>Unit II</b>	:	<p><b>Antigens and Antibodies</b></p> <p>Antigen-Types of antigen, antigen – antibody interactions. Antibodies (Immunoglobulins):Structure and function &amp; Biosynthesis of antibody. Major Histocompatibility Complex (MHC): Structure and Functions. Hypersensitivity – Type I, II, III, IV and V. Complement- Structure &amp; Complement activation, Classical complement pathway.</p>
<b>Unit III</b>	:	<p><b>Immunological Process</b></p> <p>B-cell types, activation and differentiation , T-cell types, maturation activation and differentiation : Antigen processing and presentation . Effectors responses of cell mediated and humoral immunity.</p>
<b>Unit IV</b>	:	<p><b>Immuno Techniques</b></p> <p>Immuno Techniques: Double &amp; Radial immune diffusion, Immuno electrophoresis, ABO Blood Typing, Coomb's test, HLA Typing &amp; Hybridoma Technology. Auto immune diseases: Characteristics, causes, classification- Rheumatoid Arthritis, Pernicious anaemia, Grave's disease, Hashimoto's Thyroiditis. Immunodeficiency disease: Humoral deficiency-Bruton's Agammaglobulinemia, Cell mediated deficiency-Di-George syndrome. Combined immunodeficiency-SCID.</p>

<b>Unit V</b>	:	<p><b>Immunotechnology</b></p> <p>Transplantation immunology : Classification of grafts, Method of graft rejection, Immunological tolerance – Mechanism of tolerance. Immunology of tumors.Tumor antigens, Immune response to tumor antigens, Immunological surveillance, Immune therapy of cancer. Vaccines : Heat killed, recombinant</p>
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		vaccine.
<b>Text Book</b>	:	<ol style="list-style-type: none"> <li>1. Kuby Immunology, Punt, W. H. Freeman, 2018</li> <li>2. Elements of Immunology, Rastogi. S.C, CBS Publishers and Distributors 2010</li> <li>3. Immunology, Roitt (Ivan); Brostoff (Jonathan), Mosby, 2010</li> <li>4. Immunology , Darla J.Wise; Gordonr.Carter, Wiley-Blackwell; 2010</li> <li>5. Immunology, Dr. Bharat Singh, Pointer Publishers, 2006</li> <li>6. Immunology, Pinchuk George, Tata Mcgraw-Hill Publishing Company Limited , 2002</li> <li>7. Advanced Immunology, Male (David), Mosby, 1991</li> </ol>
<b>References</b>	:	<ol style="list-style-type: none"> <li>1. Roitt's Essential Immunology, Delves, Wiley-Blackwell, 2017</li> <li>2. Immunology Guidebook, Julius M Cruse; Robert E Lewis, Academic Press, 2013</li> <li>3. Fish and Shellfish Immunology, Swain (P); Sahoo(P K), Narendra Publishers, 2012</li> <li>4. Case Studies In Immunology, Fred Rosen; Raif Leha, Taylor &amp; Francis, 2011</li> <li>5. Clinical Laboratory Immunology Connie R. Mahon; Diane Tice Pearson Education, 2011</li> <li>6. Immunology, Hall Angela, Oxford University Press, 2010</li> </ol>

Related Online Contents	
1	Immunology : <a href="https://www.classcentral.com/course/swayam-immunology-14117">https://www.classcentral.com/course/swayam-immunology-14117</a>
2	Immunology : <a href="https://swayam.gov.in/nd2_cec20_bt05/preview">https://swayam.gov.in/nd2_cec20_bt05/preview</a>
3	Fundamentals of Immunology: <a href="https://www.classcentral.com/course/immunologyfundamentalsimmunitybcells-12724">https://www.classcentral.com/course/immunologyfundamentalsimmunitybcells-12724</a>
4	Monoclonal Antibodies : <a href="https://www.coursera.org/lecture/immunologyfundamentalsimmunitybcells/monoclonal-antibodies-KxBvo">https://www.coursera.org/lecture/immunologyfundamentalsimmunitybcells/monoclonal-antibodies-KxBvo</a>

Expected Course Outcomes:		
On the successful completion of the course, student will be able to:		
1	Ellustrate various immunotechniques	K3
2	Recognize the types of hypersensitivity reactions	K4

3	Understand the antigen antibody interaction	K2
4	Explain the role of monoclonal antibodies in clinical immunology.	K5
5	Understand the result of immunodeficiency diseases using Artificial intelligence.	K2
<b>K1</b> - Remember; <b>K2</b> - Understand; <b>K3</b> - Apply; <b>K4</b> - Analyze; <b>K5</b> - Evaluate; <b>K6</b> – Create		

Mapping with COs, POs and PSOs																
Course Outcomes (COs)	Program outcomes (POs)								Program specific outcomes (PSOs)							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
CO1	3	3	3	3	3	2	3	3								
CO2	3	3	3	3	2	2	3	3								
CO3	3	3	3	3	3	2	3	3								
CO4	3	2	3	3	3	2	3	3								
CO5	3	2	3	2	2	3	2	3								
Average	3	2.6	3	2.8	2.6	2.2	2.8	3								

**PC / 2021 – 2022 / PG / Zoology / Semester – III**

Core	Sub Code	ORGANIC EVOLUTION	Hrs./ Week	Credits:
09	21PZOM33		06	05

<b>Objective</b>	:	The main objectives of this course are to: 1. Know the history and concept of evolution
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		<p>2. Understand the mechanisms and factors involving in evolution process</p> <p>3. Understand the process and patterns of natural selection of animals</p> <p>4. Know the evolutionary patterns of various animals at classical level</p> <p>5. Study the interaction and adaptation among species</p>
<b>Unit I</b>	<b>:</b>	<p><b>ORIGIN OF LIFE</b></p> <p>Origin of basic biological molecules, abiogenesis, biogenesis, Biochemical origin of life, biological evolution (protenoids and microsphere coacervates), biogeny of protein and nucleic acid, concept of Oparin and Haldane – Experiment of Urey and Miller.</p>
<b>Unit II</b>	<b>:</b>	<p><b>EVIDENCES AND THEORIES OF EVOLUTION</b></p> <p>Evidences : From Palaeontology – Geological time scales and its major events – Types of fossils and process of fossilization – Evidences from biogeography – Evidences from morphology, comparative anatomy, embryology, biochemistry and physiology. Theories of organic evolution :Lamarkism, Darwinism, Mutation theory, Modern synthetic theory.</p>
<b>Unit III</b>	<b>:</b>	<p><b>MECHANISM OF EVOLUTION</b></p> <p>Population genetics – population, gene pool, gene frequency; Hardy – Weinberg law, Gene frequency and its impacts, natural selection, migration and genetic drift, variations, isolating mechanism and origin of species – Allopatric and sympatric speciation. Gradualism and punctuated equilibrium.</p>
<b>Unit IV</b>	<b>:</b>	<p><b>ORIGIN OF HIGHER TAXA</b></p> <p>Simpson's definition of the higher taxa, Simpson's adaptive grid, pre-adaptations and post - adaptations, patterns of evolution : convergent evolution and parallel evolution, Micro evolution, Macro evolution (adaptive radiation), Mega evolution, Connecting link between vertebrate classes. Rates of Evolution: Horotely, Bradytely and Tachytely, Graduation versus punctuated equilibrium, Extinction and its causes.</p>
<b>Unit V</b>	<b>:</b>	<p><b>MANKIND EVOLUTION</b></p> <p>Phylogenetic tree and stages of primate evolution including Homo sapiens. Place and time of origin, characteristics and ancestors of man. Evolutionary trends of man evolution. Cultural evolution of man, allometry, altruism and kith and kin selection. Advantages of social behaviour.</p>
<b>Text Book</b>	<b>:</b>	<ol style="list-style-type: none"> <li>1. Agarwal (V K); Verma (P S). 2006. Cell Biology Genetics Evolution and Ecology, 3<sup>rd</sup> Edition. S Chand Reprint Edn.</li> <li>2. Th. Dobzhansky et al 1973. Evolution. Surjeet Publications Delhi</li> <li>3. E. D. Colbert 1990. Evolution of the vertebrate. John Willey &amp; Sons, Newyork</li> <li>4. Strickberger. 2007. Strickberger's Evolution, Jones &amp; Bartlett; 4th Revised edition.</li> </ol>
<b>References</b>	<b>:</b>	<ol style="list-style-type: none"> <li>1. Long, M. 2003. Origin and evolution of new gene functions. Kluwar Academic Pub.,</li> <li>2. Yadav (B.N), Kumar (D). 2000. Vertebrates zoology and evolution. Daya</li> </ol>

	<p>Publishing House.</p> <ol style="list-style-type: none"> <li>Sharma, N.S. 2005. Continuity and evolution of animals. International Scientific Publishing Co.</li> <li>Walker Louis J. 2013. Evolutionary ecology of birds life histories, mating systems and extinction. Random Publications</li> <li>Colbert Edwin H. 2012. Colbert's Evolution of the vertebrates. 5<sup>th</sup> edition. Wiley-India</li> <li>Banerjee, S., 2006. Evolutionary Biology, Dominant Publishers</li> <li>Chiarelli (A.B). 1973. Evolution of the primates. Academic Press</li> <li>Carroll (Robert .L). 1997. Patterns and processes of vertebrate evolution. Cambridge University Press.</li> <li>Andrew Cockburn. 2001. An introduction to evolutionary ecology, 2<sup>nd</sup> edition, Wiley-Blackwell.</li> </ol>
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### Related Online Contents

1	Paleontology: Early Vertebrate Evolution : <a href="https://www.classcentral.com/course/early-vertebrate-evolution-5417">https://www.classcentral.com/course/early-vertebrate-evolution-5417</a>
2	Molecular Evolution: <a href="https://www.classcentral.com/course/molecular-evolution-3555">https://www.classcentral.com/course/molecular-evolution-3555</a>
3	Paleontology: Theropod Dinosaurs and the <a href="https://www.classcentral.com/course/theropods-birds-5236">https://www.classcentral.com/course/theropods-birds-5236</a> Origin of Birds:

### Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the theories and concepts of evolution	K2
2	Explain the process of evolution in animals	K5
3	Compare understand the evolution of social life in animals	K4
4	Define the patterns of evolutionary changes in animals	K1
5	Explain the evolutionary trends of man	K5

**K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

### Mapping with COs, POs and PSOs

Course Outcomes (COs)	Program outcomes (POs)								Program specific outcomes (PSOs)							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
CO1	3	3	2	3	3	2	3	3								
CO2	3	3	3	3	2	2	3	3								
CO3	3	3	3	3	3	3	3	3								

<b>CO4</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>3</b>								
<b>CO5</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>								
<b>Average</b>	<b>3</b>	<b>2.8</b>	<b>2.6</b>	<b>2.8</b>	<b>2.8</b>	<b>2.4</b>	<b>2.6</b>	<b>3</b>								

**PC / 2021 – 2022 / PG / Zoology / Semester – III**

<b>Elective</b>	<b>Sub Code</b>	<b>RESEARCH METHODOLOGY</b>	<b>Hrs./ Week</b>	<b>Credits:</b>
<b>03</b>	<b>21PZOE3A</b>		<b>06</b>	<b>05</b>

<b>Objective</b>	:	<p>The main objectives of this course are to:</p> <ol style="list-style-type: none"> <li>1. Acquire basic knowledge on Research</li> <li>2. Acquire knowledge on dissertation writing and publishing of research papers</li> <li>3. Understand the basic principle and application of bio-instruments</li> <li>4. Study the Regulation framework, Good Laboratory Practices and CPCSEA</li> </ol>
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		Guidelines 5. Learn the Intellectual Property Rights and patent filing.
<b>Unit I</b>	<b>:</b>	<b>BASICS OF RESEARCH</b> Research design and Methodology: Research – Characteristics – types of research – steps in research – objectives of research – research report formatting and typing – laboratory safety – intellectual property rights.
<b>Unit II</b>	<b>:</b>	<b>PREPARATIONS, PRESENTATION AND PUBLISHING OF RESEARCH REPORT</b> Literature collection, types of research sources, documentation, Basics of bibliography, citation, different bibliography style, report writing, Dissertation, report and paper writing.
<b>Unit III</b>	<b>:</b>	<b>RESEARCH EVALUATION</b> Computer application and research, Research analysis, Research sorting, Validation of data, Statistical analysis of data using software, Expression of data, tables and graphs, power point presentation.
<b>Unit IV</b>	<b>:</b>	<b>DESCRIPTIVE STATISTICS</b> Types of biological data; frequency distributions; cumulative frequency distributions. Populations; samples from populations; random sampling. Measures of Central Tendency: Mean; median; mode; geometric mean; harmonic mean. Measures of Dispersion: Range; variance; standard deviation, coefficient of variation; standard error.
<b>Unit V</b>	<b>:</b>	<b>GOODNESS OF FIT TESTS, CORRELATION, REGRESSION AND SIGNIFICANCE TESTING</b> Probability Distribution: Normal distribution; binomial distribution and poison distribution. Chi- square test for goodness of fit. Simple linear regression; correlation coefficient – hypothesis testing about correlation coefficients; rank correlation; intraclass correlation. Analysis of variance: One-way classification; two-way classification.
<b>Text Book</b>	<b>:</b>	<ol style="list-style-type: none"> <li>1. Research methodology for biological sciences by Gurumani (N). 2011. MJP Publishers</li> <li>2. Textbook of laboratory techniques by Chinmoy Goswami. 2011. Wisdom Press</li> <li>3. Ethics in animal experimentation by Sood (O.P), Rattan (Ashok). 2004. Ranbaxy science foundation.</li> </ol>
<b>References</b>	<b>:</b>	<ol style="list-style-type: none"> <li>1. Methods in biotechnology by Swarna Latha C D, Digumarti Bhaskar. 2007. Discovery Publishing House.</li> <li>2. Molecular Biotechnology by Mukesh Pasupuleti. 2006. MJP Publishers</li> <li>3. Research techniques in biological sciences by Sandhu (G S). 1991. Anmol Publishing</li> <li>4. Biological techniques by Knudsen (Jens. W). Harper and Row Publishers. 1966</li> </ol>



		5. Notes on Microscopical Technique for zoologists by Pantin(C.F.A). 1960. Cambridge Publishing 6. Guidebook to Microscopical Methods by Grimstone(A.V.), Skaer(R.J.). 1972.Cambridge Publishing 7. Handbook of Laboratory Animals by Abhijit Paintal. 1993. Dominant Publishers
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Related Online Contents	
1	Research Methodology: <a href="https://swayam.gov.in/nd2_cec20_hs17/preview">https://swayam.gov.in/nd2_cec20_hs17/preview</a>
2	Understanding Research Methods: <a href="https://www.mooc-list.com/course/understanding-research-methods-coursera">https://www.mooc-list.com/course/understanding-research-methods-coursera</a>
3	Experimental Biotechnology: <a href="https://swayam.gov.in/nd1_noc20_bt31/preview">https://swayam.gov.in/nd1_noc20_bt31/preview</a>
4	Research Ethics: <a href="https://swayam.gov.in/nd2_ugc19_ge04/preview">https://swayam.gov.in/nd2_ugc19_ge04/preview</a>
5	Patent Law for Engineers and Scientists: <a href="https://swayam.gov.in/nd1_noc19_hs65/preview">https://swayam.gov.in/nd1_noc19_hs65/preview</a>

Expected Course Outcomes:		
On the successful completion of the course, student will be able to:		
1	Explain the basic information on research methods	K2
2	Plan the dissertation writing and publishing of a paper	K3
3	Recall the principle and application of various bio-instruments.	K2
4	Apply the statistical tools for testing biological data	K2
5	Analyze the significant, correlation and testins goodness of fit among the data	K4
<b>K1</b> - Remember; <b>K2</b> - Understand; <b>K3</b> - Apply; <b>K4</b> - Analyze; <b>K5</b> - Evaluate; <b>K6</b> - Create		

<b>Mapping with COs, POs and PSOs</b>
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Course Outcomes (COs)	Program outcomes (POs)								Program specific outcomes (PSOs)							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
CO1	3	3	3	3	3	3	3	3								
CO2	3	3	3	3	3	3	3	3								
CO3	3	3	3	2	2	3	3	3								
CO4	2	2	2	3	3	2	2	3								
CO5	3	2	2	3	2	2	3	2								
Average	3	2.6	2.6	2.8	2.6	2.6	2.8	2.8								

**PC / 2021 – 2022 / PG / Zoology / Semester – III**

Core Practical	Sub Code	MICROBIOLOGY, IMMUNOLOGY, ORGANIC EVOLUTION AND RESEARCH METHODOLOGY	Hrs./ Week	Credits:
03	21PZOMP3		03	

**Course Objectives:**

1. Acquire a basic knowledge of the microbes in general and of the environmental, medical and industrial important microbes in particular in order to have an integrated approach in biology.
2. Gain knowledge on immunology and Perceiving information on artificial intelligence in immunodeficiency diseases.
3. The provides information about the patterns and processes of evolution above the species level. To know how the life originated in our planet and related theories
4. The purpose of research is to discover answers and questions through the application of scientific procedures.

<b>Expected Course Outcomes</b>		
1	Analyze the process of isolation of microorganisms and describe the mechanisms for transmission, virulence and pathogenicity pathogenic micro-organisms	K4
2	The students realize the immunological technique use to improve deficiency diseases	K2
3	Appreciate the complexities and difficulties of various species concepts.	K2
4	Understand the concept of research and different types of research in the context of biology	K3
5	Analyze the ethical aspects of research & Evaluate the different methods of scientific writing and reporting	K5
<b>K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create</b>		
<b>MICROBIOLOGY</b>		
<ol style="list-style-type: none"> <li>1. Safety hygiene in the laboratory with sample handling for microbial studies.</li> <li>2. Cleaning of glasswares and modes of sterilization.</li> <li>3. Preparation of culture media for microorganism and culture of bacteria in agar plates.</li> <li>4. Qualitative analysis of milk - methylene blue redutase test.</li> <li>5. Observation of algae and fungi.</li> </ol>		

<b>IMMUNOLOGY</b>
<ol style="list-style-type: none"> <li>1. ABO blood grouping by haemagglutination technique.</li> <li>2. Immuno - diffusion technique- Demonstration.</li> <li>3. Primary and secondary lymphoid organs in man (chart).</li> <li>4. Lymphoid organs in rat (chart).</li> <li>5. Cells of immune system (slides).</li> <li>6. Immunoglobulin G (chart).</li> <li>7. Monoclonal antibody preparation (chart).</li> <li>8. Lymphoid organs: Primary organs – Thymus, Bone marrow. Secondary organs – Lymph node, Spleen. (slides).</li> </ol> <p>Hyper sensitive – Type I, Type II, Type III</p>

<b>EVOLUTION</b>
<ol style="list-style-type: none"> <li>1. Morphological evidences – fore limbs of vertebrates,</li> <li>2. Mouth parts of insects- Honey bee, Cockroach &amp; Mosquito.</li> <li>3. Fossil evidences – Ammonites, Nautilus, Belemnites and fossil wood.</li> </ol>

4. Tracing the voyage of the H.M.S. beagle on a world map, with dates and important discoveries.		
5. Adaptive radiation – beaks of various birds.		
6. Museum specimens for adaptive coloration – cryptic and warning.		
7. Mimicry – Monarch and viceroy butterfly.		
8. Demonstration of natural selection with coloured beads.		
9. Demonstration of genetic drift with coloured beads. Variations – Fingerprints of the students of the classes		
RESEARCH METHODOLOGY		
1. Collection of reviews		
2. Methods of bibliographic writing and technique		
3. Centrifuge – techniques, types.		
4. Phase contrast microscope – Principle		
5. Micrometry – measurement of cells.		
6. pH meter – principle, measurement of pH in water and soil sample		
7. Chromatography principle – paper, thin layer chromatography		
8. Separation of aminoacid mixture using paper chromatography		
9. Spotters: Spectrophotometer.		
Practical records to be submitted to the University Practical		
	Total Lecture hours	Hours
Text Book(s)		
1	Advanced Practical Zoology by Sinha, J., Chatterjee A.K., Chattopadhyay P. 2011. Arunabha Sen Publishers.	
2	Environmental biology and ecology laboratory manual by Lynn. (2003). Kendall Hunt Publishing	
Reference Books		
1	A Manual of Practical Zoology: Invertebrates by Verma P.S.. 2010. S Chand publication.	
2	A Manual of Practical Zoology by Verma P.S. 2000. S Chand publication.	
3	Clinical Embryology: A Practical Guide by 1. Zsolt Peter Nagy, Alex C. Varghese, Ashok Agarwal. 2013. Springer-Verlag New York Inc	
4	Modern Experimental Zoology by Preeti Gupta and Mridula Chaturvedi. 2000	

<b>Mapping with COs, POs and PSOs</b>																
<b>Course Outcomes (COs)</b>	<b>Program outcomes (POs)</b>								<b>Program specific outcomes (PSOs)</b>							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
<b>CO1</b>	3	2	3	3	3	3	2	3								
<b>CO2</b>	3	3	3	3	3	3	3	3								
<b>CO3</b>	3	3	2	3	3	2	3	3								

<b>CO4</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>								
<b>CO5</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>3</b>								
<b>Average</b>	<b>3</b>	<b>2.6</b>	<b>2.6</b>	<b>3</b>	<b>2.8</b>	<b>2.8</b>	<b>2.8</b>	<b>3</b>								

**PC / 2021 – 2022 / PG / Zoology / Semester – III**

<b>Core Practical</b>	<b>Sub Code</b>	<b>MOLECULAR GENETICS, ENVIRONMENTAL BIOLOGY, BIODIVERSITY CONSERVATION AND ENDOCORINOLOGY</b>	<b>Hrs./ Week</b>	<b>Credits:</b>
<b>03</b>	<b>21PZOMP3</b>		<b>03</b>	

**Course Objectives:**

The main objectives of this course are to:

1. To acquire increased theoretical and practical knowledge of various processes of Molecular Genetics.
2. To study DNA interaction with chemical agents, cancer therapies and immunomodulation
3. The knowledge on environmental conservation and management through a comprehensive understanding of the components of ecosystem, biological cycles, habitat ecology, resource ecology, pollution and its management
4. To study the endocrine hormones and its role in reproduction of animals

**Expected Course Outcomes:**

On the successful completion of the course, student will be able to:

1	To students learn developing biological system's functions and their relation with the environment.	K4
2	Applying laboratory methods and Evaluate the molecular markers used in the genetic characterization of plant and animal species	K2
3	Evaluate the implications of international legislations, policies for environmental protection	K2
4	The students apply the knowledge in the hormonal role in the reproduction	K3
5	The associated hormones and the related disorders will be well known to the students	K5
<b>K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create</b>		
<b>MOLECULAR GENETICS</b>		<b>hours</b>
<ol style="list-style-type: none"> <li>1. Analysis of simple mendelian inheritance in a small population.</li> <li>2. Breeding experiments to be demonstrated with the help of colour beads – Monohybrid cross (using chi-square test).</li> <li>3. Breeding experiments to be demonstrated with the help of colour beads – Dihybrid cross (using chi-square test).</li> <li>4. Estimation of gene and genotype frequencies in the light of Hardy-Weinberg law based on facial traits.</li> <li>5. Estimation of gene and genotype frequencies in the light of Hardy – Weinberg law based on ABO blood groups.</li> <li>6. Charts, models and flash cards pertaining to theory syllabus <ol style="list-style-type: none"> <li>a. DNA replication</li> <li>b. Operon concept</li> <li>c. Transposable elements</li> <li>d. Syndrome</li> <li>e. Inborn errors of metabolism</li> <li>f. Sex-linked inheritance</li> </ol> </li> </ol>		
<b>ENVIRONMENTAL BIOLOGY, BIODIVERSITY CONSERVATION</b>		
<ol style="list-style-type: none"> <li>1. Estimation of CO<sub>2</sub> in different water sample.</li> <li>2. Observation of commensalism and mutualism</li> <li>3. Observation of host – parasite relationship</li> <li>4. Observation of prey – predator relationship.</li> <li>5. Food chain and food web.</li> <li>6. Visit to bird sanctuary and make a report.</li> <li>7. Visit &amp; Record the flora and fauna of a natural ecosystem</li> </ol>		

8. Animal Association - parasitism, mutualism and commensalisms. 9. Collection and preservations of fauna 10. Wildlife photography and documentation. 11. IUCN Red List Exercise 12. Statistical analysis – Shannon wiener index, Simpson’s index, Species richness and evenness.	
<b>ENDOCORINOLOGY</b>	
1. Histological and cytological study of the following endocrine glands with the help of permanent slides pituitary, thyroid, adrenal, pancreas, testis and ovary 2. Dissection of male and female reproductive system of fish. 3. Dissection of neuroendocrine complex in insects. 4. Dissection of reproductive system in any two insects 5. Role of thyroxine in larva of frog tadpole. 6. Spotters (Menstrual cycle)	
<b>Reference Books</b>	
1	Benjamin Lewin, 1997. Genes VI, Oxford University Press, Oxford
2	SandhyaMitra, 1994. Genetics – A blueprint of life. Tata McGraw Hill Publishing Co., New Delhi, Strickberger, M.W., 1996, Genetics, 3 <sup>rd</sup> Edn., Prentice Hall of India, New Delhi
3	Advanced Practical Zoology by Sinha, J., Chatterjee A.K., Chattopadhyay P. 2011. Arunabha Sen Publishers.
4	Environmental biology and ecology laboratory manual by Lynn. (2003). Kendall Hunt Publishing
5	Bently, P.J., Comparative Vertebrate Endocrinology, Cambridge University Press
6	Chandra, S. Negi, Introduction Endocrinology, PHI Learning Pvt. Ltd., New Delhi.
7	William, R.H., Textbook of Endocrinology, W.B. Saunders. Gorbman et al., Mammalian Endocrinology, John Wiley & Sons

Mapping with COs, POs and PSOs																
Course Outcomes (COs)	Program outcomes (POs)								Program specific outcomes (PSOs)							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
CO1	3	3	3	3	3	3	2	3								
CO2	3	3	3	3	3	3	3	3								

<b>CO3</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>3</b>								
<b>CO4</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>								
<b>CO5</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>3</b>								
<b>Average</b>	<b>3</b>	<b>2.8</b>	<b>2.6</b>	<b>2.8</b>	<b>2.8</b>	<b>2.6</b>	<b>2.8</b>	<b>3</b>								

**PC / 2021 – 2022 / PG / Zoology / Semester – III**

<b>LST</b>	<b>Sub Code</b>	<b>FIRST AID AND EMERGENCY CARE</b>	<b>Hrs./ Week</b>	<b>Credits:</b>
				<b>02</b>

<b>Objective</b>	<b>:</b>	<p>The main objectives of this course are to:</p> <ol style="list-style-type: none"> <li>1. Understand the scope of First Aid and role of First Aid and the ways to manage and incident TO. demonstrate the techniques of assessing a casualty</li> <li>2. Explain First Aid management for respiratory problems</li> <li>3. Describe First Aid measures for wounds and circulation problems</li> <li>4. Identify a bone joint and muscle injuries and provide appropriate First Aid measures</li> <li>5. Describe First Aid process for the effects of heat and cold</li> <li>6. Provide First Aid measures for foreign objects, poisoning bits and stings</li> </ol>
<b>Unit I</b>	<b>:</b>	<p><b>BASIC CASUALTY AND RESPIRATORY PROBLEMS</b></p> <p>What is a first aider?, How to prepare yourself, Protection from infection, Action at an emergency, The respiratory system, Hypoxia, Airway obstruction, Choking adult, Choking infant, Choking child, Hanging and strangulation, Inhalation of fumes, Drowning, Hyperventilation, Asthma, Croup, Penetrating chest wound</p>
<b>Unit II</b>	<b>:</b>	<p><b>WOUNDS AND CIRCULATION</b></p> <p>The heart and blood vessels, Bleeding and types of wound. Infected wound, Foreign object in a wound, Scalp and head wounds, Eye wound, Bleeding from</p>



		the ear, Nosebleed, Knocked-out adult tooth, Bleeding from the mouth, Finger wound, Wound to the palm, Wound at a joint crease and Abdominal wound
<b>Unit III</b>	<b>:</b>	<b>BONE, JOINT AND MUSCLE INJURIES</b> The skeleton, Bones, muscles and joints, Fractures, Dislocated joint, Strains and Sprains, The nervous system, Head injury, Facial injury, nose injury, Shoulder injury, Hand and finger injuries, Back pain, Spain injury, Knee injury, Ankle injury, Foot and toe injuries
<b>Unit IV</b>	<b>:</b>	<b>EFFECTS OF HEAT AND COLD</b> The skin, Assessing a burn, Severe burns and scalds, Minor burns and scalds, Burns to the airway, Electrical burn, Chemical burn, Chemical burn to the eye, Flash burn to the eye, Incapacitate spray exposure, Dehydration, Sunburn, Heat exhaustion, Heatstroke, Hypothermia, Frostbite
<b>Unit V</b>	<b>:</b>	<b>FOREIGN OBJECTS, POISONING, BITES &amp; STINGS</b> The sensory organs, Splinter, Embedded fishhook, Swallowed foreign object, Foreign object in the eye, Foreign object in the ear, Foreign object in the nose, How poisons affect the body, Types of poisons, Swallowed poisons, Drug poisoning, Alcohol poisoning, Animal and human bites, Insect sting, Tick bite Other bites and stings, Snake bite, Stings from sea creatures, Marine puncture wound.
<b>Text Book</b>	<b>:</b>	A.K. Marsten. S. C. Moffat and T. L. Royscott1992. First aid manual. A Darling Kindersley Book, London
<b>References</b>	<b>:</b>	<ol style="list-style-type: none"> <li>1. The authorized manual of St. John Ambulance, St. Andrew's Ambulance association and the British red cross society, First Aid manual, 9th edition, Dorling Kindersley, London</li> <li>2. American college of emergency physicians, First Aid manual, 5th edition, Dorling Kindersley, London</li> <li>3. Clement Text book on First Aid &amp; Emergency Nursing, First edition, JP brothers, 2012</li> <li>4. Philip Jevon, Emergency care and First Aid for Nurses, A practical guide, Churchill Living Stone, 2007</li> </ol>

<b>Expected Course Outcomes:</b>		
On the successful completion of the course, student will be able to:		
1	Explain the basic information on primary aids in living things	K2
2	Extend knowledge of biological system and functions in the first aid treatment	K3
3	To connect the social events to awareness to the public	K2
4	Gain Good laboratory Practices and Guidelines for first aids	K2
5	Explain the concept like foreign objects, poisoning, bites and stings	K4
<b>K1</b> - Remember; <b>K2</b> - Understand; <b>K3</b> - Apply; <b>K4</b> - Analyze; <b>K5</b> - Evaluate; <b>K6</b> - Create		

Mapping with COs, POs and PSOs																
Course Outcomes (COs)	Program outcomes (POs)								Program specific outcomes (PSOs)							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
CO1	3	2	3	3	3	2	2	2								
CO2	3	3	3	3	3	2	3	3								
CO3	3	3	3	3	2	3	3	2								
CO4	3	3	3	3	2	2	3	3								
CO5	3	2	2	3	3	2	3	3								
Average	3	2.6	2.8	3	2.6	2.2	2.8	2.6								

**PC / 2021 – 2022 / PG / Zoology / Semester – IV**

Core	Sub Code	MOLECULAR GENETICS	Hrs./ Week	Credits:
10	21PZOM41		06	05

<b>Objective</b>	:	<p>The main objectives of this course are to:</p> <ol style="list-style-type: none"> <li>1. To acquire increased theoretical and practical knowledge of various processes of Molecular Genetics.</li> <li>2. To provide graduates with scientific competencies that will allow them to investigate the molecular mechanisms important for the structure and function of the living cells through modern techniques.</li> <li>3. To study the techniques for obtaining genetically modified organisms</li> <li>4. To study development genetics and cytodifferentiation in normal and pathological conditions</li> <li>5. To study DNA interaction with chemical agents, cancer therapies and immunomodulation.</li> </ol>
<b>Unit I</b>	:	<p><b>STRUCTURE AND FUNCTIONS OF GENETIC MATERIALS</b></p> <p>Principles of genetics : Concepts and definitions – Mendelian principles – Allelic and non-allelic interactions – Pleiotropy – Penetrance and expressivity – Phenocopies – Multiple alleles – Polygenic inheritance – Linkage and Crossing over – tetrad analysis – CIB technique – Sex determination – Sex linked inheritance – Non – disjunction</p>
<b>Unit II</b>	:	<p><b>GENETIC ENGINEERING</b></p> <p>Gene Concept : Fine Structure of gene – Simple and split genes – Intron, Cistron, Muton and Recon – Chemical composition of gene – Genes and protein</p>

		synthesis – Genetic code works of Khorana and Kornberg – Wobble hypothesis –Enzyme regulation of gene action in prokaryotes – Transposons - Gene action related diseases- Inborn error metabolism- Alkaptonuria, phenylketonuria and albinism.
<b>Unit III</b>	<b>:</b>	<b>GENE EXPRESSION</b> Hormones and gene expression-Environment effects and gene expression- DNA fingerprinting -LOD Score–Gene targeting-chromosomes walking and jumping –Gene transfer method-Expression and stability of genetically engineered genes- Genetically modified food.
<b>Unit IV</b>	<b>:</b>	<b>CHROMOSOMAL MAPPING</b> Chromosome Mapping - Haploid mapping, Diploid mapping (Tetrad analysis), determination of linkage groups, determination of map distance, determination of gene order, cytological mapping.
<b>Unit V</b>	<b>:</b>	<b>GENE PATENTING</b> Patenting –an international activity –Patenting the life forms-Selling the sequences-Patenting and agriculture industry-Economic Gains-Impact of patenting on less developed nations- Proposed Amendments On Patents Act,1970.
<b>Text Book</b>	<b>:</b>	<ol style="list-style-type: none"> <li>1. Molecular genetics, Shukla 2001 ,Dominant publishers</li> <li>2. Principles of genetics fifth edition 1985.Published by Tata McGraw-Hill Ltd., New Delhi</li> <li>3. From Genes to Cells, Bolsover (Stephen R); Hyaams (Jeremy S).</li> <li>4. Genetics, Gupta (P.K).</li> <li>5. Concept of Molecular Biology, Verma (P S); Agarwal (V K), S. Chand &amp; Co Publishers.</li> <li>6. Genetics, Jain (H K), Oxford Ibh Publishers.</li> </ol>
<b>References</b>	<b>:</b>	<ol style="list-style-type: none"> <li>1. Molecular Cell Biology, Lodish (Harvey); Berk (Arnold), 5<sup>th</sup> Edition, W H Freeman and Co. Ltd Publishers.</li> <li>2. Genetics, Verma (P S); Aggarwal (V K), 1<sup>st</sup> Edition, S. Chand &amp; Co Publishers.</li> <li>3. Genetics: A Conceptual Approach, Pierce Benjamin A., 3<sup>rd</sup> Edition.</li> <li>4. Biochemistry &amp; Molecular Biology, Elliott William (H)</li> <li>5. Principles of Genetics, Sinnott (Edmund. W), 5<sup>th</sup> Edition, Tata - McGraw Hill Publishers.</li> <li>6. Cell and Molecular Biology, Robertis (De E.D.P); Robertis (De E.M.F), 8<sup>th</sup> Edition.</li> </ol>

**Expected Course Outcomes:**

On the successful completion of the course, student will be able to:

1	Explain the organization and functions of genetic material in the living world.	K2
2	Explain and interpret various processes, phenomena, states and evolutionary tendencies at a biological system level.	K2
3	Develop investigation capacities of gene expression and their relation with the environment.	K3
4	Applying laboratory methods and techniques to study the structures and functions of nucleic acids and proteins.	K3
5	Evaluate the gene patenting used in the agricultural industry and Patenting the life forms.	K5

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

#### Related Online Contents

1	NOC: Human Molecular Genetics: <a href="https://nptel.ac.in/courses/102/104/102104052/">https://nptel.ac.in/courses/102/104/102104052/</a>
2	Human gene: <a href="https://swayam.gov.in/nd2_cec20_bt17/preview">https://swayam.gov.in/nd2_cec20_bt17/preview</a>
3	Tissue engineering: <a href="https://swayam.gov.in/nd1_noc19_bt33/preview">https://swayam.gov.in/nd1_noc19_bt33/preview</a>
4	Genetic Engineering: Theory and Application: <a href="https://swayam.gov.in/nd1_noc19_bt15/preview">https://swayam.gov.in/nd1_noc19_bt15/preview</a>
5	Genes and the Human Condition (From Behavior to Biotechnology): <a href="https://www.coursera.org">https://www.coursera.org</a>

Mapping with COs, POs and PSOs																
Course Outcomes (COs)	Program outcomes (POs)								Program specific outcomes (PSOs)							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
CO1	3	3	3	3	3	2	2	3								
CO2	3	3	3	3	3	2	3	3								
CO3	3	3	2	2	3	2	3	3								
CO4	3	3	3	2	2	3	3	3								
CO5	3	2	2	2	2	3	3	3								
Average	3	2.8	2.6	2.4	2.6	2.4	2.8	3								

**PC / 2021 – 2022 / PG / Zoology / Semester – IV**

<b>Core</b>	<b>Sub Code</b>	<b>ENVIRONMENTAL BIOLOGY &amp; BIODIVERSITY CONSERVATION</b>	<b>Hrs./ Week</b>	<b>Credits:</b>
<b>11</b>	<b>21PZOM42</b>		<b>06</b>	<b>05</b>

<b>Objective</b>	<b>:</b>	<p>The main objectives of this course are to:</p> <ol style="list-style-type: none"> <li>1. Understand the nature of relationships among organisms that comprise functioning of ecosystems</li> <li>2. Provide the knowledge on interactions between organisms and their environments to drive the dynamics of populations and communities.</li> <li>3. Understand different habitat ecology, resource ecology and their management.</li> <li>4. Know the different types of pollution and their management to protect the health and welfare of human population in the world</li> <li>5. Acquire broad knowledge of the field of environmental toxicology.</li> </ol>
<b>Unit I</b>	<b>:</b>	<p><b>ECOSYSTEM AND PRODUCTIVITY</b></p> <p>Ecosystem – concepts, types – terrestrial and aquatic ecosystems, stability, food chain, food web and trophic levels. Energy flow in ecosystem - Primary productivity process – productivity in a fresh water and pond ecosystem. Methods of measurement of primary productivity .Biogeochemical cycles – Hydrological cycle.</p>
<b>Unit II</b>	<b>:</b>	<p><b>POPULATION GROWTH AND POLLUTION</b></p> <p>Human population growth, population explosion in India. Solid waste management. Air, water, soil, noise and thermal pollution – sources, effects and control measures. Nuclear hazards : non – degradable pollutants – biotransformation, biomagnifications, bioremediation and soil issues.</p>
<b>Unit III</b>	<b>:</b>	<p><b>RESOURCE MANAGEMENT</b></p> <p>Natural resources – renewable and non-renewable resources. Concept of conservation and management of natural resources. Forest resources – Ecological and economic importance of forest – types and management – forest</p>

		resources of India – deforestation and its effects. Water resources : distribution of Indian water resources. Mineral resources – uses and exploration of mineral resources. Energy resources – energy resources types – solar, wind, geothermal, hydroelectricity, hydrogen, tidal energy, biomass and nuclear energy.
<b>Unit IV</b>	<b>:</b>	<b>BIODIVERSITY CONCEPT</b> Biodiversity – Concept and values of biodiversity – genetic species and ecosystem diversity. Similarity and Dominance index, Evenness index, Richness index and Association index. Sampling methods, values and use of diversity, loss of animal diversity and endangered wildlife species. Hot spots – red list – endangered and endemic species.
<b>Unit V</b>	<b>:</b>	<b>BIODIVERSITY CONSERVATION</b> Human impact on biological diversity – causes for the loss of biodiversity. Fragmentation of biodiversity – Biogeographic zones in India- Zoogeographical realms – Geography and major biomass, Wildlife of India – values of wildlife. Conservation of wildlife <i>in situ</i> and <i>ex situ</i> . Conservation practices : Wildlife sanctuaries, national parks and biosphere reserves.
<b>Text Book</b>	<b>:</b>	<ol style="list-style-type: none"> <li>1. Eugene P. ODUM 1972, Fundamentals of Ecology, Fifth Edition, Cengage Learning, USA</li> <li>2. P.D. Sharma, 2010, Ecology and Environment, Rastogi Publications, Merrut, India</li> <li>3. Madhab C Dash, 2001. Fundamental of Ecology, Tata McGraw-Hill Education</li> <li>4. R.R. Barthwal, 2012. Environmental Impact Assessment, Private Limited, New Delhi</li> </ol>
<b>References</b>	<b>:</b>	<ol style="list-style-type: none"> <li>1. Phillip L. Williams, 2000. Principles of Toxicology, JOHN WILEY &amp; SONS, INC.</li> <li>2. Michael Reiss and Jenny Chapman, 2000. Environmental Biology, Cambridge University Press, UK</li> <li>3. Peter J. Russel, 2009. Ecology, Cengage Learning</li> <li>4. J.L. Chapman, M.J. Reiss, 2001, 2<sup>nd</sup> edition, Cambridge University Press.</li> <li>5. G. C. Butler, 1978. Principles of Ecotoxicology, JOHN WILEY &amp; SONS, New York</li> <li>6. John C. Dearden, 2006. Computers in Toxicology and Risk Assessment, Computer Applications in Pharmaceutical Research and Development, Edited by Sean Ekins.</li> </ol>

<b>Expected Course Outcomes:</b>		
On the successful completion of the course, student will be able to:		
1	Describe energy transformations across trophic levels and to understand how elements are cycling in the environment	<b>K2</b>

2	Explain the concept of limiting factors and interactions of populations and communities in relation to dynamic environmental processes	<b>K3</b>
3	Describe the habitat ecology and to identify various types of natural resources and their management practice.	<b>K4</b>
4	Describe the types, effects and control of pollution	<b>K2</b>
5	A strong knowledge concerning the fundamentals in the basic areas of toxicology	<b>K3</b>
<b>K1</b> - Remember; <b>K2</b> - Understand; <b>K3</b> - Apply; <b>K4</b> - Analyze; <b>K5</b> - Evaluate; <b>K6</b> - Create		

<b>Related Online Contents:</b>	
1	Ecology and Environment, Prof. Abhijit Deshpande and Prof. R. Ravi Krishna , IIT Madras, <a href="https://swayam.gov.in/nd1_noc19_ge23/preview">https://swayam.gov.in/nd1_noc19_ge23/preview</a>

Mapping with COs, POs and PSOs																
Course Outcomes (COs)	Program outcomes (POs)								Program specific outcomes (PSOs)							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
<b>CO1</b>	3	3	3	3	3	3	3	3								
<b>CO2</b>	3	3	3	3	3	3	3	3								
<b>CO3</b>	3	3	2	2	2	3	3	3								
<b>CO4</b>	3	3	3	3	2	3	3	3								
<b>CO5</b>	3	2	2	2	2	2	2	3								
<b>Average</b>	3	2.8	2.6	2.6	2.4	2.8	2.8	3								

**PC / 2021 – 2022 / PG / Zoology / Semester – IV**

<b>Elective</b>	<b>Sub Code</b>	<b>GENERAL AND COMPARATIVE ENDOCRINOLOGY</b>	<b>Hrs./ Week</b>	<b>Credits:</b>
<b>04</b>	<b>21PZOE4A</b>		<b>06</b>	<b>05</b>

<b>Objective</b>	<b>:</b>	<p>The main objectives of this course are to:</p> <ol style="list-style-type: none"> <li>1. Study the nature, function and classification of hormones.</li> <li>2. Acquire knowledge on the structure of Thyroid gland, Parathyroid, Adrenal, Thymus and Pineal gland</li> <li>3. Acquire knowledge on the synthesis of their hormones.</li> <li>4. Understand the gastrointestinal hormones and sex hormones</li> <li>5. Understand the role of hormones in pregnancy and lactation</li> </ol>
<b>Unit I</b>	<b>:</b>	<p><b>SCOPE OF ENDOCRINOLOGY</b></p> <p>Hormones – Chemical Structure – Synthesis – classification – Characteristic features of hormones – General and principles of hormone action, Cell signaling and hormonal action – Cyclic AMP.</p>
<b>Unit II</b>	<b>:</b>	<p><b>FUNCTION ORGANIZATION OF HORMONES OF ENDOCRINE GLANDS</b></p> <p>Types – pituitary (hypophysis), exocrine glands (Tears and saliva): Adenohypophyseal and Neurohypophyseal hormones – Thyroid – Pancreas – Adrenal – Pineal gland (Epiphysis).</p>
<b>Unit III</b>	<b>:</b>	<p><b>HORMONES AND REPRODUCTION</b></p> <p>Endocrine function of Ovary and Testis – Hormonal control of mammary glands, ovarian cycles, pregnancy and Lactation – Placenta and its endocrine function.</p>
<b>Unit IV</b>	<b>:</b>	<p><b>GASTROINTESTINAL HORMONES AND ITS FUNCTION</b></p> <p>Regulation of hormone metabolism and mineral metabolism – carbohydrate metabolism. Influence of hormones on growth and development – Hormones and calcium – phosphate homeostasis</p>
<b>Unit V</b>	<b>:</b>	<p><b>HORMONAL CONTROL OF OSMOREGULATION</b></p> <p>Thermoregulation – Hormones and behaviours – Role of Hormones in migration</p>



		– Regeneration Metamorphosis – Environmental endocrinology, Biological Clock (Rhythms).
<b>Text Book</b>	:	<ol style="list-style-type: none"> <li>1. Yadav, Text book of Endocrinology, 2009, Sonali Publications, New Delhi</li> <li>2. Williams, R H. 1981. Text book of Endocrinology, Ed. 6<sup>th</sup> W. B. Saunders Company, Philadelphia, London.</li> <li>3. George Griffing, Endocrinology, 2015, Stat Pearls Publishing, USA</li> <li>4. De Groot. 1979. Endocrinology, Vol. 1-3, Grune and Stratton, New York</li> </ol>
<b>References</b>	:	<ol style="list-style-type: none"> <li>1. Mac E. Hadley, Endocrinology. 1996, Prentice Hall</li> <li>2. M.P. Goswami, Endocrinology and Molecular Cell Biology, 2013. Gaurav book centre Pvt Ltd, Delhi</li> <li>3. Stephen Nussey and Saffron Whitehead. 2001. Endocrinology - An Integrated Approach, Oxford: BIOS Scientific Publishers; 2001.</li> <li>4. Bondy P. K. and Rosenberg L.E. 1974. Duncan's disease of Metabolism – Genetics, Metabolism and Endocrinology. W.B. Saunders Co., Philadelphia, London.</li> </ol>

<b>Expected Course Outcomes:</b>		
On the successful completion of the course, student will be able to:		
1	Acquire knowledge on the Nature and functions of hormones and learn the mechanism of hormone action	K3
2	Learn the structure and functions of Thyroid and Parathyroid gland and familiarize on their hormones	K3
3	Understand the hormones secreted by gastrointestinal tracts and adrenal glands and their action on stress management	K2
4	Able to learn the Structure and functions of the adrenal, pineal and thymus glands	K2
5	Know the feedback control of gonadal hormones and their role in the development of male and female gametes	K3
<b>K1</b> - Remember; <b>K2</b> - Understand; <b>K3</b> - Apply; <b>K4</b> - Analyze; <b>K5</b> - Evaluate; <b>K6</b> – Create		
<b>Related Online Contents</b>		
1	Endocrinology: <a href="https://www.classcentral.com/course/swayam-endocrinology-19855">https://www.classcentral.com/course/swayam-endocrinology-19855</a>	

<b>Mapping with COs, POs and PSOs</b>																
<b>Course Outcomes (COs)</b>	<b>Program outcomes (POs)</b>								<b>Program specific outcomes (PSOs)</b>							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
<b>CO1</b>	3	3	2	3	3	3	2	3								
<b>CO2</b>	3	3	2	3	3	3	3	3								

CO3	3	3	2	3	3	2	3	3								
CO4	3	3	3	3	2	3	3	3								
CO5	3	2	3	2	2	2	3	3								
Average	3	2.8	2.4	2.4	2.6	2.6	2.8	3								

**PC / 2021 – 2022 / PG / Zoology / Semester – IV**

Elective	Sub Code	ANIMAL BEHAVIOUR AND CHRONOBIOLOGY	Hrs./ Week	Credits:
04	21PZOE4B		06	05

<b>Objective</b>	:	<ol style="list-style-type: none"> <li>1. To explain students with does understanding of animal behavior and chronobiology</li> <li>2. To develop skills of animals watching and procure jobs in sanctuaries</li> <li>3. Acquired knowledge on social behavior of the animals</li> <li>4. Learn the significance of chronobiology</li> <li>5. To explain the biological rhythms of animal behaviour</li> </ol>
<b>Unit I</b>	:	<b>INTRODUCTION TO ANIMAL BEHAVIOUR</b> Principles of Animal Behaviour, Historical perspectives of ethology, Approaches to animal behaviour. Ethogram - Methods and recording of a behaviour. Innate behavior, Neurological basis of animal behaviour, hormonal control of behaviour.
<b>Unit II</b>	:	<b>PATTERNS OF BEHAVIOUR</b> Reflexes - types, reflex path, characteristics of reflexes. Orientation: Primary and secondary orientation, kinesis - orthokinesis, klinokinesis; taxis – tropotaxis, klinotaxis, menotaxis, mnemotaxis. Learning: Associative learning, classical and operant conditioning, Habituation and Imprinting. Memory - types of memory.
<b>Unit III</b>	:	<b>SOCIAL AND SEXUAL BEHAVIOUR</b> Social Behaviour: Concept of Society; various modes of animal communication. Altruism; Insect's society with Honey bee as example; Foraging in honey bee and bee communication. Nesting behavior in birds. Sexual Behaviour: Mate choice, intra-sexual selection (male rivalry), inter-sexual selection (female choice), sexual conflict in parental care.
<b>Unit IV</b>	:	<b>INTRODUCTION TO CHRONOBIOLOGY</b> Historical developments in chronobiology; Biological oscillation: the concept of average, amplitude, phase and period. Biological clocks: central and peripheral biological clock, adaptive significance of biological clocks, Chronopharmacology, Chronomedicine, Chronotherapy.
<b>Unit V</b>	:	<b>BIOLOGICAL RHYTHM</b>

		Types of biological rhythms: short- and long- term rhythms, Circadian rhythms - molecular biology of the circadian pacemaker system, Tidal rhythms and Lunar rhythms. Circannual rhythms, Photoperiod and regulation of seasonal reproduction of vertebrates, Role of melatonin.
<b>Text Book</b>	:	Agarwal, V.K. (2009). Animal Behaviour (Ethology). New Delhi: S. Chand and Company Ltd.
<b>References</b>	:	<ol style="list-style-type: none"> <li>1. Sanjib Chattopadhyay (2012). LIFE: Evolution, Adaptation and Ethology. Kolkata: Books and Allied (P) Ltd.</li> <li>2. Chandrashekar, M.K. (1985). Biological Rhythms. Madras Science Foundation</li> <li>3. Mohan P. Arora. (2016). Animal Behavior. Chennai: Himalaya Publishing House</li> <li>4. Auprey Manning and Mariam Stamp Dowkins (2012). An Introduction to Animal behavior. UK Cambridge University Press.</li> <li>5. Slatter P. J. B. (1985). An Introduction to Ethology. UK: Cambridge University Press.</li> <li>6. Saha T. K. (2009). An Introduction to Animal behaviour. Delhi: Emkay Publications.</li> <li>7. Machve K. K. (2016). Evolution of Animal Behaviour. Thiruvananthapuram: Manglam</li> </ol>

<b>Expected Course Outcomes:</b>		
On the successful completion of the course, student will be able to:		
1	Describe animal behaviour, reflexes, biological rhythms and Chronobiology.	K3
2	Summarize the history of ethology, social behaviour in animals, organization of circadian system in multicellular animals.	K3
3	Illustrate the developing compassion towards animals, group selection, altruism, predict biological clock system, circadian pacemaker system in vertebrates.	K2
4	Analyse the patterns of animal behaviour and complexity of biological clock system in vertebrates.	K4
5	Assess the relevance of biological clocks for human welfare and taking decisions.	K3
<b>K1</b> - Remember; <b>K2</b> - Understand; <b>K3</b> - Apply; <b>K4</b> - Analyze; <b>K5</b> - Evaluate; <b>K6</b> – Create		
<b>Related Online Contents</b>		
1	<a href="http://www.apiindia.org/pdf/progress_in_medicine_2017/mu75.pdf">http://www.apiindia.org/pdf/progress_in_medicine_2017/mu75.pdf</a>	
2	<a href="https://www.pharmatutor.org/articles/chronopharmacology-overview">https://www.pharmatutor.org/articles/chronopharmacology-overview</a>	

<b>Mapping with COs, POs and PSOs</b>																
<b>Course Outcomes (COs)</b>	<b>Program outcomes (POs)</b>								<b>Program specific outcomes (PSOs)</b>							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
<b>CO1</b>	3	3	3	3	3	3	2	3								
<b>CO2</b>	3	3	2	3	3	3	3	3								

