

**SRI PADMAVATI MAHILA VISVAVIDYALAYAM  
(WOMEN'S UNIVERSITY)**

**DEPARTMENT OF BIOSCIENCES & SERICULTURE**



**SYLLABUS FOR  
M.Sc. ZOOLOGY  
CHOICE BASED CREDIT SYSTEM  
2020-2022**

**CURRICULUM**  
**M. Sc. Zoology- (4 SEMESTERS)**  
**2020 - 2022**  
**Credit Based Choice System (CBCS) Pattern**

SEMESTER	Subject code	Title of the Paper	Course Type
<b>I SEMESTER</b>			
<b>Theory</b>	Zool 1.1	Biosystematics and Functional Anatomy of Invertebrates	CC
	Zool 1.2	Cell Biology	CC
	Zool 1.3	Biochemistry	CC
	Zool 1.4	Comparative Animal Physiology	CC
	<b>Foundation Course-01</b>	Communicative English	FC
<b>Practicals</b>	Zool 1.1	Biosystematics and Functional Anatomy of Invertebrates	CC
	Zool 1.2	Cell Biology	CC
	Zool 1.3	Biochemistry	CC
	Zool 1.4	Comparative Animal Physiology	CC
<b>II SEMESTER</b>			
<b>Theory</b>	Zool 2.1	Functional Anatomy of Chordates	CC
	Zool 2.2	Genetics, Biostatistics and Bioinformatics	SBC
	Zool 2.3	Wildlife Conservation and Ecotourism	SBC
	Zool 2.4	Developmental Biology	CC
	<b>Foundation course –02</b>	Foundation course in computer applications	FC
<b>Practicals</b>	Zool 2.1	Functional Anatomy of Chordates	CC
	Zool 2.2	Genetics, Biostatistics and Bioinformatics	SBC
	Zool 2.3	Wildlife Conservation & Ecotourism	SBC
	Zool 2.4	Developmental Biology	CC
<b>III SEMESTER</b>			
<b>Theory</b>	Zool 3.1 IE-I	<b>Internal Elective – (IE-I)</b> MOOCs (Courses available on Swayam platform) a) b) c)	
	Zool 3.2	Research Methodology	CC
	Zool 3.3	Immunology	CC
	Zool 3.4	Molecular Biology	CC
	Zool EE	<b>External Elective</b> Wildlife Conservation and Ecotourism	SBC
	<b>Foundation course –03</b>	Gender studies and Self Defence	FC

<b>Practicals</b>	Zool 3.3	Immunology	CC
	Zool 3.4	Molecular Biology	CC
<b>IV SEMESTER</b>			
<b>Theory</b>	Zool 4.1 IE-II	<b>Internal Electives – (IE-II)</b> a) Animal Biotechnology or b) Neurobiology and Endocrinology or c) Silkworm Biology and Physiology	
	Zool 4.2	Ecology and Environmental Biology	CC
<b>Practicals</b>	Zool 4.1 IE-II	<b>Internal Electives –(IE-II)</b> a) Animal Biotechnology or b) Neurobiology and Endocrinology or c) Silkworm Biology and Physiology	SBC
	Zool 4.2	Ecology and Environmental Biology	CC
<b>Research Project &amp; Industrial Training</b>	Zool 4.3 RP	Research Project and submission of Dissertation Research Project Presentation and Viva- Voce	SBC
	Zool 4.4 IT	Industrial Training and submission of report Presentation and Viva- Voce	SBC

**Note:**

- **Zool 3.1IE-I a), Zool 3.1IE-I b) , Zool 3.1IE-I c),** are Internal Elective papers of MOOCs Courses for the Students of M.Sc. Zoology
- **Zool EE** is External Elective paper for the students of other PG Courses of the University.
- **Zool 4.1 IE-II a), 4.1 IE b), 4.1IE c),** are Internal elective papers for the Students of M.Sc. Zoology.
- FC- Foundation Course; CC-Core Course; SBC- Skill Based Course

**M.Sc. ZOOLOGY (4 SEMESTERS): 2020-2022****SCHEME OF EXAMINATION UNDER SEMESTER PATTERN****Choice Based Credit System (CBCS)**

Subject Code	Title of the Paper	Exam: Maximum Marks			Total Marks for each Semester
		Internal	External	Total	
I Semester					600
Theory					
Zool 1.1	Biosystematics and Functional Anatomy of Invertebrates	20	80	100	
Zool 1.2	Cell Biology	20	80	100	
Zool 1.3	Biochemistry	20	80	100	
Zool 1.4	Comparative Animal Physiology	20	80	100	
Practicals					
Zool P1 (Zool1.1 & Zool 1.2)	Biosystematics and Functional Anatomy of Invertebrates & Cell Biology	-	100	100	
Zool P2 (Zool 1.3 & Zool 1.4)	Biochemistry &Comparative Animal Physiology	-	100	100	
II Semester					600
Theory					
Zool 2.1	Functional Anatomy of Chordates	20	80	100	
Zool 2.2	Genetics, Biostatistics and Bioinformatics	20	80	100	
Zool 2.3	Wildlife Conservation and Ecotourism	20	80	100	
Zool 2.4	Developmental Biology	20	80	100	
Practicals					
Zool P1 (Zool 2.1 & Zool 2.2)	Functional Anatomy of Chordates& Genetics, Biostatistics and Bioinformatics	-	100	100	
Zool P2 (Zool 2.3 & Zool 2.4)	Wildlife Conservation and Ecotourism & Developmental Biology	-	100	100	
III Semester					600
Theory					
Zool 3.1 IE-1	Internal Electives (IE-I) MOOCS (Courses available on Swayam platform) a) b) c)	30	70	100	
Zool 3.2	Research Methodology	20	80	100	
Zool 3.3	Immunology	20	80	100	
Zool 3.4	Molecular Biology	20	80	100	

Zool EE	<b>External Elective</b> Wildlife Conservation and Ecotourism	20	80	100	
<b>Practicals</b>					
Zool P (Zool 3.3 & Zool 3.4)	Immunology and Molecular Biology	-	100	100	
<b>IV Semester</b>					600
<b>Theory</b>					
Zool 4.1 IE-II	<b>Internal Electives (IE-II)</b> a)Animal Biotechnology or b)Neurobiology and Endocrinology or c)Silkworm Biology and Physiology	20	80	100	
Zool 4.2	Ecology and Environmental Biology	20	80	100	
<b>Practicals</b>					
Zool P ( Zool 4.1 & Zool 4.2)	<b>Internal Electives</b> a)Animal Biotechnology or b)Neurobiology and Endocrinology or c)Silkworm Biology and Physiology & Ecology and Environmental Biology	-	100	100	
<b>Research Project &amp; Industrial Training</b>					
Zool 4.3 RP	Research Project and Submission of Dissertation	100		150	
	Project Presentation and Viva- Voce	50			
Zool 4.4 IT	Industrial Training and submission of report	100		150	
	Presentation and Viva- Voce	50			
<b>TOTAL MARKS OF ALL SEMESTERS</b>					<b>2400</b>

**Note:**

- **Zool 3.1IE-I a), Zool 3.1IE-I b), Zool 3.1IE-I c),** are Internal Elective papers of MOOCs Courses for the Students of M.Sc. Zoology
- **Zool EE** is External Elective paper for the students of other PG Courses of the University.
- **Zool 4.1 IE-II a), 4.1 IE b), 4.1IE c),** are Internal elective papers for the Students of M.Sc. Zoology.

**THE DETAILS OF CREDITS FOR THE COURSES**  
**M.Sc Zoology (4 Semesters) 2020-2022**

Seme sters	Subject code	Titles of papers	No. of Theory hrs	No. of Practical Hrs	No. of Credits (Theory)	No. of Credits (Practicals)	Total Credits	
I	Zool 1.1	Biosystematics and Functional Anatomy of Invertebrates	4	4	4	2	24	
	Zool 1.2	Cell Biology	4	4	4	2		
	Zool 1.3	Biochemistry	4	4	4	2		
	Zool 1.4	Comparative Animal Physiology	4	4	4	2		
II	Zool 2.1	Functional Anatomy of Chordates	4	4	4	2	24	
	Zool 2.2	Genetics, Biostatistics and Bioinformatics	4	4	4	2		
	Zool 2.3	Wildlife Conservation and Ecotourism	4	4	4	2		
	Zool 2.4	Developmental Biology	4	4	4	2		
III	Zool 3.1 IE-I	<b>Internal Elective - (IE-I)</b> MOOCS (Courses available on Swayam platform) a) b) c)	4	-	4	-	24	
	Zool 3.2	Research Methodology	4	-	4	-		
	Zool 3.3	Immunology	4	4	4	2		
	Zool 3.4	Molecular Biology	4	4	4	2		
	Zool E.E	<b>External Elective</b> Wildlife Conservation and Ecotourism	4	-	4	-		
IV	Zool 4.1 IE-II	<b>Internal Electives- (IE-II)</b> a)Animal Biotechnology or b)Neurobiology and Endocrinology or c) Silkworm Biology & Physiology	4	4	4	2	24	
	Zool 4.2	Ecology and Environmental Biology	4	4	4	2		
	Zool 4.3 RP	Research Project and Submission of Dissertation	4					
		Project Presentation and Viva- Voce	2					
	Zool 4.4 IT	Industrial Training and submission of report	4					
		Presentation and Viva- Voce	2					
	Total Credits							96

**SRI PADMAVATI MAHILA VISVAVIDYALAYAM, TIRUPATI**  
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**DEPARTMENT OF BIOSCIENCES AND SERICULTURE**

**M.SC. ZOOLOGY**

**PROGRAM EDUCATIONAL OBJECTIVES**

- ❖ M.Sc. Zoology Program is a two-year post-graduate program which deals with animals and animal life including the study of the structure, physiology, development, habits and classification of the animals.
- ❖ To apply the theoretical knowledge gained during the program to the actual practice of laboratory in the field of animal sciences.
- ❖ To develop problem solving skills in students and encourage them to carry out innovative research projects thereby inculcating in them the spirit of knowledge creation.
- ❖ To equip the students to perform functions that demand higher competence in National/International organizations.

**PROGRAM OUTCOMES (POs)**

**After completion of the two year postgraduate program the students will be able to:**

**PO 1. Disciplinary knowledge:** Demonstrate comprehensive knowledge and understanding of major concepts, theoretical principles in Zoology and its different subfields. Able to demonstrate experimental findings related to structure and function at organ and/ or organism level, important communication principles and processes of cell biology and how they are regulated.

**PO 2. Scientific reasoning:** Maintain a high degree of scientific attitude with special attention on conceptual understanding of subject matter, scientific reasoning skills and laboratory skills while identifying the importance and functions of animals in different phyla.

**PO 3. Critical thinking:** Capability to apply thought of knowledge; analyse and evaluate evidence, arguments, claims, benefits on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach for knowledge development in different fields of Zoology.

**PO4. Problem solving:** Identify, formulate, review research literature, and analyze fauna related problems reaching substantiated conclusions using principles of different interdisciplinary knowledge.

**PO 5. Communication skills:** Communicate effectively various research themes of Animal Biology and Biotechnology and also complex zoological activities with the society through effective documentation and successful presentations,

**PO6. Analytical reasoning:** Understand the capacity to evaluate and synthesize the information from wide range of sources in order to analyze ideas and concepts and construct arguments in both non-scientific and scientific ways to draw valid conclusions and support them with evidences and examples.

**PO 7. Research related skills:** Use knowledge and skills required for identifying problems and issues by training in frontier areas of biotechnology and research mentoring with personal attention by the expertise faculty focused on a specific research question, working with a well-equipped research facilities, collection of relevant quantitative and/or qualitative data, analysis and evaluation using methodologies as appropriate to the subject(s) for formulating evidence-based solutions and arguments.

**PO 8. Collaboration/Cooperation/Team work:** Function effectively as a member in diverse teams by sharing their knowledge, in collaborative/ cooperative/team works.

**PO 9. Information/digital literacy:** Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for faunal identification and analysis of acquired data.

**PO 10. Leadership readiness:** Understand industrial training processes and gain expertise and suggest modifications when/where ever required. Formulate an inspiring vision, build a team to achieve the vision, motivate and inspire team members to engage with that vision, and use managerial skills to guide the team to the right destination.

**PO11. Moral and Ethical awareness:** Apply ethical principles and commit to professional ethics and responsibilities of various activities in the day to day life with a special focus on environment, animal biodiversity conservation and sustainable development of self and society.

**PO 12. Self - Learning and Life-long Learning:** Demonstrate a sense of inquiry and capability to develop their own interest, develop / select the specialization in various directions and methods of zoological research by the selection of elective subjects/ MOOCs as per choice/ interest. Recognize the need for, and have the preparation and ability to engage in independent (self) and life-long learning in the broadest context of technological change.

## **PROGRAM SPECIFIC OUTCOMES**

**The postgraduates of this program will be able to:**

- **PSO1:** Identify, classify and differentiate the functions and structures of various organisms based on key concepts, fundamental principles, and the scientific theories related to various scientific phenomena and their relevancies in the day-to-day life and the applications of Zoology in Aquaculture, Apiculture, Vermiculture, Sericulture, Poultry Science and fundamentals of Clinical Science and Immunology and to create new industry in their relevant area.
- **PSO2:** Use standard laboratory equipments, modern instrumentation and classical techniques to carry out experiments and develop skills to collect the data and interpret and explain the limits of accuracy of experimental data in terms of



significance and underlying theory by using technical skills gained through biotechnology, bioinformatics and biostatistics.

- **PSO3:**Combine theoretical and practical knowledge in handling the animals and using them as model organism with entrepreneurial skill to take up individual projects or work in teams in the field of Zoological sciences and also in multidisciplinary environments. Maintain high standards of learning in animal sciences leading towards self and life-long learning
- **PSO4.**Think creatively (divergently and convergent) to propose novel ideas in explaining facts and figures or providing new solution to the problems. Able to design research work in the relevant domain or appropriate domains for providing sustainable solutions to various societal and environmental problems with moral and ethical values for sustainable development of self and society.
- **PSO 5.**Gain an over view of the basic and advanced molecular techniques to apply them in different aspects related to environment and faunal biodiversity. Implement management strategies like bioremediation and biore Restoration to mitigate different societal and environmental problems.

## **SEMESTER –I**

### **COURSE - Zool 1.1: Biosystematics and functional anatomy of Invertebrates**

#### **Course Objectives**

Enable the students to

1. Understand the basic concepts of biosystematics, types of species concept, history, theories of biological classification, rules of Zoological Nomenclature and classification
2. Analyse the origin of metazoans and organization of different types of coeloms, flagella, ciliary movement in protozoa, hydrostatic movement in coelenterate, annelida and echinodermata
3. Analyse the different types of respiratory, circulatory organs, their mechanism and respiratory pigments in different animals
4. Differentiate excretory system, primitive advanced nervous system and trends in neural evolution
5. Describe the larval forms of free living invertebrates, their strategies, evolutionary significance and organization of minor phyla, general characteristics of nemertinea, rotifers, and chaetognatha

### Course Outcomes:

After the successful completion of the course the student will be able to

**CO1:** Explain (understand) the basic concepts of biosystematics, types of species concept, history, theories of biological classification, rules of Zoological classification and nomenclature to identify different types of animal species.

**CO2:** Analyse the origin of metazoans and organization of different types of locomotary organs and to compare different types of movements among lower invertebrates

**CO3:** Comprehend different types of respiratory, circulatory organs and respiratory pigments in different animals to describe the process of respiration and circulation process in animals of different phyla.

**CO4:** Compare different types of excretory organs, mechanism of excretion, primitive, advanced nervous system and trends in neural evolution

**CO5:** Illustrate the larval forms of free living invertebrates, their strategies, to interpret evolutionary significance, and organization of minor phyla.

**CO6:** Understand the importance of spotters based on their special identifying characters, different organ systems through virtual dissections and to prepare permanent microslides.

### Mapping Course Outcomes with Program Outcomes & Program-Specific Outcomes (CO-PO-PSO)

CLO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	H	M	L		M		M	H	H		H	H	H			

CO2	H	H	M						M				H				
CO3	H	H	H	L					M				H		M		
CO4	H	H	H	L					M				H		M		
CO5	H	H	H	L					M				H		M		
CO6	H	H							M		M	H		H	H		

## SYLLUBUS

### UNIT-1

#### Biosystematics

1. 1 Definition-Phylogenic tree-Components of Biosystematics(Taxonomy, nomenclature, classification) - Role of Biosystematics.
- 1.2 Species concept - Types of species concept-Taxonomic concept-Typological concept-Nominalist concept-Biological concept-Evolutionary concept.
- 1.3 History of Biological classification;Theories of biological classification-Scientific theory-non- scientific theory;Zoological classification-Hierarchy classification-Higher categories and higher taxa-Phylogeny-Differences between Classification and Systematics.
- 1.4 Rules of Zoological Nomenclature- Evolution of Nomenclature- International code- Interpretation and Applicability.

### UNIT-2

#### Basic concepts in animals

- 2.1 Origin of Metazoans- Haeckel theory-Hadzi theory.
- 2.1 Coelom-Definition-Organization of the Coelom-Acoelomates-Pseudocoelomates-Coelomates-Schizocoelomates and Enterocoelomates.Protostomia and duterostomia.
- 2.3 Flagella and ciliary movement in Protozoa.
- 2.4 Hydrostatic movement in Coelenterate- Annelida and Echinodermata.

### UNIT-3

#### Respiration & Circulation

- 3.1 Organs of respiration-Gills, Lungs and Trachea.
- 3.2 Structure of Respiratory organs- Structure of Gills- Lungs and Trachea and Mechanism of Respiration.
- 3.3 Respiratory pigments-Heamoglobin- Heamocyanin-Heamoerythrin-Chlorocruori-Pinnaglobin-Vannadiumchromogen-Echinochrome-Malpodin-Functions of respiratory pigments
- 3.4 Circulatory system in Annelids, Arthropods &Molluscs.

### UNIT-4

#### Excretion &Nervous System

- 4.1 Organs of excretion-coelome, coelomoducts, nephridia and malphigiantubules.Mechanism of excretion and osmoregulation.
- 4.2 Primitive nervous system-Coelenterata and Echinodermata.
- 4.3 Advanced nervous system-Annelida, Arthropoda (Crustacea and Insecta) and Mollusca (Cephalopoda)
- 4.4 Trends in neural evolution.

## UNIT-5

### Invertebrate larvae & Minor phyla

- 5.1 Larval forms of free living invertebrates -Amphiblastula larva-Planula larva-Trochophore larva-Nauplius larva-Glochidium larva; Larval forms of parasites-Sporocyst larva, Microfilaria larva
- 5.2 Strategies and evolutionary significance of larval forms
- 5.3 Concept - significance and organization of Minor Phyla
- 5.4 General character of Nemertinia, Rotifera and Chaetognatha

### PRACTICALS

- Virtual dissections:     Prawn external features  
                                      Prawn thoracic appendages  
                                      Prawn abdominal appendages  
                                      Prawn cephalic appendages  
                                      Nervous system of prawn.  
                                      Reproductive system of grass hopper  
                                      Cockroach reproductive  
                                      Cockroach nervous system
- Mounting:                   Mouth parts and sting apparatus of honey bees.  
                                      Nephridium and spermatheca of earth worm.  
                                      Trachea and book lungs of scorpion.  
                                      Sponge spicules.

Collect 10 invertebrates and prepare permanent slides and submit in the examinations (Parasites – 5 and Non-parasites – 5).

### Slides & Specimens:

- Protozoa:                    Gregarines, Monocystis, Ceratium, Opalina.
- Porifera:                    Section view of Sycon-L.S. & T.S. Grantia-T.S.
- Cnidaria:                   Tubiphora, Pennatula, Obelia colony
- Helminths:                   Ascaris, Taenia, Planaria
- Annelida:                   Neiries, Hirudinaria, Earthworm
- Arthropoda: Cyclops, Daphnia, Scolopendra, Peripatus,
- Lepas, Squilla, Eupagurus.
- Mollusca:                   Aplysia, Pila, Unio.
- Echinodermata:           Echinodiscus, Holothuria

## **TEXT BOOKS**

1. Kotpal, R.L. 1988 - 1992 Protozoa, Porifera, Coelenterata, Helminthes, Arthropoda, Mollusca, Echinodermata. Rastogi Publications, Meerut.
2. E.L. Jordan and P.S. Verma „Invertebrate Zoology’S. Chand and Company.
3. R.D. Barnes „Invertebrate Zoology’by: W.B. Saunders CO., 1986.
4. P.S. Dhami and J.K. Dhami. Invertebrate Zoology. S. Chand and Co. New Delhi.

## **REFERENCE BOOKS**

- 1.Simpson, G.G.Principles of animal taxonomy. Oxford IBH Publishing Company.
2. Mayr, E.Principles of taxonomy.
3. Jager G.et al. Evolution of metazoan life cycle .Academic Press, Newyork& London.
4. Barne, R.D.InvertebrateZoology.III<sup>rd</sup>edition.W.B.Saunders Co., Philadelphia.
5. Barrington, E.J.W.invertebrate structure and function. Thomas Nelion and Sons Ltd., London.
6. Hyman, L.H.THE INVERTEBRATES.Vol 1 to VIII. McGraw Hill Book Co., NY& London.
7. Parker, T.J.andHaswell, W.A.Text Book of Zoology, Macmillan & Co, London.

## **WEB REFERENCES**

- <https://en.wikipedia.org/wiki/Invertebrate>
- [https://www.diffen.com/difference/Invertebrate\\_vs\\_Vertebrate](https://www.diffen.com/difference/Invertebrate_vs_Vertebrate)

## **COURSE- Zool 1.2: Cell Biology**

### **Course Objectives**

Enable the students to

1. Understandthe structure, mechanism, structural organisation and functions of cell organelles

2. Analyse the importance of organization of genes, structure of chromosomes ,cell divisions, regulation and control of cell cycle
3. Differentiate cells and organs of immune system, types of antigenic determinants and barriers of innate immunity
4. Evaluate importance of cell signalling hormones and their receptors, transduction pathways, cellular communication and their principles in immune system
5. Distinguish genetic rearrangements in progenitor cells, oncogenesis, cancer cell cycle, virus induced cancer, interaction of cancer cells with normal cells, apoptosis and therapeutic interventions of uncontrolled cell growth.

### Course Outcomes:

After completion of the course the students will be able to

**CO1.**Identify the structure, mechanism, structural organisation and functions of cell organels

**CO2.**Analyse the importance of organization of genes, structure of chromosomes, cell divisions, regulation and control of cell cycle

**CO3.** Compare cells and organs of immune system, types of antigenic determinants and barriers of innate immunity

**CO4.**Evaluate the role of hormones in cell communication, cell signalling and regulation

**CO5.**Apply the knowledge of cancer biologyin preventing malignancy and its symptoms by taking precautionary measures to control the cancer.

**CO6.** Develop technical skills in utilizing laboratory equipment to get hands-on experience of different phases of cell cycle through experimentation.

### Mapping Course Outcomes with Program Outcomes & Program-Specific Outcomes (CO-PO-PSO)

CLO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	H							M				H	H	H	H		

CO2	H	H	H										H	H		H		M
CO3	H	H	H	M					M				H	H				M
CO4	H	H	H	M					M				H	H				M
CO5	H	H	H	M					M				H	H		H		M
CO6	H	H											H		H	M		

## Syllabus

### UNIT-1

#### Structure and function Cell organelles

- 1.1 Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps,
- 1.2 Mechanism of sorting and regulation of intracellular transport, electrical properties of membranes.
- 1.3 Structural organization and function of intracellular organelles: Nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes
- 1.4 Structure & function of cytoskeleton and its role in motility.

### UNIT-2

#### Organization of genes, Cell Division and Cell cycle

- 2.1 Organization of genes -Operon, unique and repetitive DNA, interrupted genes, gene families,
- 2.2 Structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons.
- 2.3 Cell division-Mitosis and meiosis, their regulation,
- 2.3 Cell cycle-regulation and control of cell cycle.

### UNIT-3

#### Cells and Organs of the immune system

- 3.1 Cells of the immune system: Lymphoid cells, Mononuclear cells, granulocytic cells, Mast Cells
- 3.2 Organs of the immune system: primary and secondary lymphoid organs, lymphatic system
- 3.3 Antigens: Antigenic determinants or Epitopes, Immunogenicity, Haptens, Adjuvants
- 3.4 Innate (Non-specific): Anatomical barriers, Phagocytosis, Physiological barriers, inflammatory barriers.

### UNIT-4

#### Cell communication and cell signaling and Regulation

- 4.1 Cell signaling Hormones and their receptors, cell surface receptor, signaling through G-

protein coupled receptors,

4.2 Signal transduction pathways, second messengers, regulation of signaling pathways

4.3 Cellular communication Regulation of hematopoiesis.

4.4 General principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation.

## **UNIT-5**

### **Cancer**

5.1 Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes,

5.2 Cancer and the cell cycle, virus-induced cancer, metastasis

5.3 Interaction of cancer cells with normal cells

5.2 Apoptosis, therapeutic interventions of uncontrolled cell growth.

### **PRACTICALS**

1. Preparation and Identification of slides of Mitotic divisions with onion root tips

2. Preparation and Identification of slides of Meiosis divisions with onion root bud

3. Preparation and Identification of different stages of Meiosis in Grasshopper Testes

4. Identification and study of the following slides

i). Different stages of Mitosis and Meiosis

ii) Lamp brush and Polytene chromosomes

5. Light microscope examination and preparation of a tissue section

6. Sub cellular fractionation: ribosomes, mitochondria and nucleus

### **TEXT BOOKS**

1. V.K.Agarwal,2016,S.Chand&CoLtd

2. P.S. Varma Cell Biology Genetics, Molecular Biology.Evolution and Ecology,2004,S.Chand Co ltd

3. N.Armugam,Cell Biology and Molecular Biology,Saras Publication

### **REFERENCE BOOKS**

1. Alberts, B. Bracy, P. Lewis , J. Raff, M. Roberts K and Watson, J. (eds) (2008). Molecular Biology of the Cell (5th Ed.), Garland Publishing , New York.

2. Cell Biology (Fundamentals and Applications) By Gupta/ Jangir, 2001; Agrobios, India.

3. Cell and Molecular Biology by EDR De Robertis and EMR De Robertis Jr, Indian Edition, B.I. Publicaitons, Pvt. Ltd.

4. Immunology introductory textbook by NandiniShetty, Wiley Eastern Ltd.

5. The Cell (A Molecular Approach) by Geoffrey M. Cooper, 2nd Edn.2000, ISBN.

6.Derobertis, E. D. P. and Derobertis, E.M.F. (2011). Essentials of Cell and Molecular Biology(8th Ed) Hold Saunders – Philadelphia



7. Cooper, G. M. (2015). The cell, A Molecular Approach (7th Ed)ASM press, Washington, D. C.

#### **WEB REFERENCES**

- [https://molbiomadeeasy.files.wordpress.com/2013/09/fundamental\\_molecular\\_biology](https://molbiomadeeasy.files.wordpress.com/2013/09/fundamental_molecular_biology)
- <https://www.studocu.com/en/document/murdoch-university/foundations-of-cell-andmolecular-biology/lecture-notes/lecture-notes-all-lectures-comprehensive-study-notesfor-final-exam/314293/view>.

### **Course: Zool 1.3: BIOCHEMISTRY**

#### **Course Educational Objectives**

Enable the students to

1. Understand the interactions of biomolecules, principles of biophysical chemistry and thermodynamics.
2. Describe the structure, classification, properties and metabolic path ways of carbohydrates
3. Define structure, classification, properties of proteins and aminoacids and able to describe metabolism of amino acids.
4. Explain the structure,classification, properties, and biological functions of fatty acids and biosynthesis of fatty acids.
5. Interpret thenomenclature, classification, and mechanism of enzyme action.
6. Gain practical knowledge to estimate biomolecules through different laboratory analytical techniques.

### **Course Outcomes**

After the successful completion of the course the student will be able to

**CO1** :Discuss the new developments in biochemistry and explain the biomolecules associated with animal life.

**CO2** :Develop an idea on structure, classification, properties,biosynthesis and functions of biomolecules.

**CO3**:Apply knowledge to illustratethe nomenclature, classification and mechanism of enzymes like enzyme kinetics andfactors affecting enzyme activity.

**CO4** :Analyze the pathway and chemicals which are responsible for the energy production in our body.

**CO 5**. Sharpen practical skills by performing lab experiments in different advanced areas of biochemistry byutilizing modern instruments.

### **Mapping Course Outcomes with Program Outcomes & Program-Specific Outcomes (CO-PO-PSO)**

CLO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	H	H										H		M		
CO2	H	H	H										H		M		
CO3	H	H	H										H		M	M	
CO4	H	H	H										H		M	M	
CO5	H	H	H									H	H	H	M	M	M

## **SYLLUBUS**

### **UNIT – 1**

#### **Introduction to Biochemistry**

- 1.1 Structure of atoms, molecules and chemical bonds.
- 1.2 Stabilizing interactions- Vander Waals, electrostatic, hydrogen bonding, hydrophobic interaction.
- 1.3 Principles of biophysical chemistry- pH, buffer, reaction kinetics, colligative properties.
- 1.4 Principles thermodynamics

### **UNIT –2:**

#### **Carbohydrates**

- 2.1 Structure of monosaccharides, disaccharides and polysaccharides.
- 2.2 Classification and Biological function of monosaccharides, disaccharides and polysaccharides.
- 2.3 Physical and chemical properties of Carbohydrates.
- 2.4 Metabolism of Carbohydrates- Glycogenesis- Glycogenolysis- Glycolysis-Citric acid cycle- Gluconeogenesis- HMP pathway-Uronic acid pathway

### **UNIT – 3**

#### **Proteins and Amino Acids**

- 3.1 Structure of proteins- Primary and secondary structure, domains, motif and folds.
- 3.2 Classification and Biological function of Proteins and Amino acid
- 3.3 Physical and chemical properties of Proteins and Amino acid
- 3.4 Metabolism of Amino acids-Transamination of amino acids, Deamination of amino acids: Oxidative and non-oxidative deamination, Urea cycle

### **UNIT – 4**

#### **Lipids**

- 4.1 Structure of Lipids and Biosynthesis of Fatty acids
- 4.2 Classification and Biological function of lipids, Physical and chemical properties of lipids,
- 4.3 Biosynthesis of Triacylglycerol, and degradation of Triacylglycerol
- 4.4 Biosynthesis of cholesterol and degradation of cholesterol

## **UNIT – 5**

### **Enzymes**

- 5.1 Nomenclature and Classification of Enzymes
- 5.2 Mechanism of enzyme action- Enzyme-Substrate complex formation - Lock and Key Hypothesis-induced fit theory, Substrate strain theory.
- 5.3 Enzyme Inhibition: Reversible and Irreversible Inhibition- Allosteric Inhibition
- 5.4 Factors affecting enzyme activity- concentration of enzymes - concentration of substrate temperature - PH- Effect of activators

### **PRACTICALS:**

- 1. Estimation of glucose
- 2. Estimation of Total, soluble and structural proteins
- 3. Estimation of carbohydrates
- 4. Estimation of amino acids
- 5. Estimation of glycogen
- 6. Estimation of Blood glucose
- 7. Estimation of Lipids
- 8. Estimation of Triglycerides

### **Text Books**

- 1. Lehninger AL. Nelson and Cox. *Principles of Biochemistry*. Lange Medical Publications, New Delhi.
- 2. U. Satyanarayana Biochemistry, 5<sup>th</sup> Edition, 2020.

### **REFERENCES BOOKS**

- 1. Biochemical calculations. I.H. Segel, 2nd Ed., John Wiley & Sons.
- 2. Biochemistry. D. Voet & J.G. Voet, J. Wiley & Sons.
- 3. Enzyme Kinetics. I.W. Segil.
- 4. Enzyme Kinetics. D.V. Roberties, Cambridge University Press.
- 5. Harper's Biochemistry. Robert K. Murray, Peter A. Mayer, D.K. Granner, V.W. Rodwell, Lange Medical

### **WEB REFERENCES**

- <http://www.agrimoon.com/wp-content/uploads/Fundamentals-of-Biochemistry.pdf>

## **Course: Zool 1.4: COMPARATIVE ANIMAL PHYSIOLOGY**

### **Course Objectives**

Enable the students to

1. Understand the comparative approach of physiology, concepts and mechanism of digestion, role of digestive enzymes and hormones in different animal species.
2. Describe the comparative physiology of respiration and excretion in different animal species.
3. Demonstrate the blood groups and circulation to interpret cardiac physiology. To discuss thermoregulation and osmoregulation in different animal groups.
4. Explain the neural anatomy and secretions and functions of endocrine glands.
5. Compare the physiology of reproduction and control of bioluminescence and functions of chromatophores in various chordates.

### **Course Outcomes**

After the successful completion of the course the student will be able to

**CO1:** Distinguish the basic concepts and processes of physiological regulation, from cellular to organ to organism and to explore the diversity of functional characteristics of various kinds of animal species which is closely related to evolutionary processes and environmental changes.

**CO2:** Compare the concepts of digestion, respiration, heart, excretion, nerve physiology etc to assess responses in different conditions in animal physiology.

**CO3:** Describe the endocrine glands and regulation of hormones to measure the impact of hormones on animal health.

**CO4:** Identify and understand the bioluminescence and functions of chromatophores to analyze the animal behaviour according to different situations.

**CO5:** Develop the practical knowledge about different organs and its nature and function to acquire technical skill in laboratory processes and to analyze various biological situations.

### **Mapping Course Outcomes with Program Outcomes & Program-Specific Outcomes (CO-PO-PSO)**

CLO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	H	H			M						H	H	H			
CO2	H	H	H			M						H	H	H			
CO3	H	H	H			M						H	H	H			
CO4	H	H	H			M						H	H	H			
CO5	H	H	H			M						H	H	H	H		

## **SYLLABUS**

### **UNIT-1**

#### **Introduction of Physiology and Digestion**

- 1.1 Aim and scope of physiology- General physiological functions and principles. Validity of Comparative approach of physiology.
- 1.2 Comparative physiology Digestive system in different species
- 1.3 Role of Digestive Enzymes and Hormones
- 1.4 Absorption, energy balance, BMR.

### **UNIT-2:**

#### **Excretory and Respiratory system**

- 2.1 Comparative physiology of excretion in different species
- 2.2 Physiology of urine formation-The significance of Henley's loop- Role of hormones in renal physiology
- 2.3 Comparison of respiration in different species- anatomical considerations, transport of gases, exchange of gases, waste elimination,
- 2.4 Chemical regulation of respiration.

### **UNIT-3**

#### **Circulation and Thermoregulation**

- 3.1 Blood and circulation-Blood corpuscles, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, immunity, haemostasis.
- 3.2 Cardiac physiology- physiology of heartbeat, Rhythmicity, and diseases associated with heart.
- 3.3 Thermoregulation-homeothermic and poikilothermic animals
- 3.4 Osmoregulation in different animal groups.

### **UNIT-4:**

#### **Nervous and Endocrinology**

- 4.1 Neurons, action potential, gross neuroanatomy of the brain and spinal cord
- 4.2 Central and peripheral nervous system, neural control of muscle tone and posture.
- 4.3 Anatomy, secretions and functions of pituitary, thyroid, adrenal and pancreas – Gonads and their hormones

4.4 Basic mechanism of hormone action (Peptide, corticosteroid), hormones and diseases processes, neuroendocrine regulation

#### **UNIT-5:**

#### **Reproductive system and Bioluminescence and Chromatophores**

5.1 Comparative physiology reproductive system in different species

5.2 Occurrence of bioluminescence among different animals, Mechanism of light production

5.3 Control of bioluminescence, Functions of luminescence.

5.4 Chromatophores- Regulations and their functions.

#### **PRACTICALS**

1. Estimation of salivary amylase activity.
2. Effect of pH and temperature on salivary amylase activity.
3. Qualitative tests for identification of ammonia, urea and uric acid
4. Demonstration of osmoregulation by using crab on exposure to different saline media.
5. Comparative study of lipase activity levels in Chick tissues.
6. Study of the rate of oxygen consumption by aquatic animals under various environmental stress conditions.

#### **TEXT BOOKS**

1. Goel KA and Satish KV. 1989. *A Text Book of Animal Physiology*, Rastogi Publications, Meerut, U.P.

2. Hoar, W.S., General and comparative physiology, Adaptation and Environment, 3rd ed., Cambridge University Press, 1983.

3. Schiemdt-Nielsen. *Animal Physiology, Adaptation and Environment*. Cambridge

#### **REFERENCES BOOKS**

1. Barrington, E.U.W. *Invertebrates Structure and Functions*. Boston: Houghton Mifflin Co., 1967.

2. Cooper, G.M. and Hausman, E. *The Cell: A Molecular Approach*. Sinauer Associates, 2013.

Hall, J.E. *Guyton and Hall Text Book of Medical Physiology*, XIII edition, Saunders Company, 2015.

3. Tortora, G.J. and Grabowski, S. *Principles of Anatomy & Physiology*. XI Edition John Wiley & sons, 2006.

4. Victor P. Eroschenko. *diFiore's Atlas of Histology with Functional correlations*. XII Edition. Lippincott W. & Wilkins, 2008.

5. R. Eckert. *Animal physiology, Mechanism and Adaptation*. W.H. Freeman & Company.

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- [http://www.dphu.org/uploads/attachements/books/books\\_1984\\_0.pdf](http://www.dphu.org/uploads/attachements/books/books_1984_0.pdf)
- <http://www.uvm.edu/~bio1and2/lab/Lab%20manuals%20Spring%202012/Animal%20Physiology.pdf>
- <https://www.pdfdrive.net/plant-and-animal-physiology-e1735854.html>

## **SEMESTER –II**

### **Course: 2.1: Functional anatomy of chordates**

#### **Course Objectives**

Enable the students to



1. Explain the basic concepts, origin and classification of Chordates
2. Describe the integument in different classes of Chordates, structure, functions, epidermal derivatives, glands, evolution of heart, aortic arches and portal system
3. Distinguish the types of respiration, respiratory organs, types of vertebrate skeletons and functions of endoskeletons
4. Describe the vertebrate kidney evolution, male, female reproductive organs and classification of sense organs.
5. Understand the comparative anatomy of nervous system in chordates in detail

### Course Outcomes

After completion of the course the students will be able to

CO1. Interpret the basic concepts, origin and classification of chordates

CO2. Illustrate structure and functions of integument and its glands, vertebrate circulatory system and evolution of heart.

CO3. Compare the respiratory systems and skeletal systems of vertebrates.

CO4. Differentiate the vertebrate kidneys, reproductive organs and sense organs

CO5. Compare the anatomy of nervous system in chordates

CO6. Identify the chordates based on special identifying external and anatomical features through demo or virtual dissections, thus developing empathy towards the fellow living beings and maintain a neat, labelled record of identified museum specimens.

### Mapping Course Outcomes with Program Outcomes & Program-Specific Outcomes (CO-PO-PSO)

CLO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	H			M							H	H		H		
CO2	H	H			M							H	H		H		
CO3	H	H			M							H	H		H		
CO4	H	H			M							H	H		H		
CO5	H	H			M							H	H		H		
CO6	H	H	H	H	M							H	H	H	H		

## SYLLUBUS

### UNIT-1

## **Basic concepts of Chordates**

- 1.1 The world of Chordates-Meaning-Phylum chordate-Diversity of Chordates.
- 1.2 Three fundamental Chordate Characters, Characters common to Chordates and Higher Non-Chordates, Advancements of Chordata over other phyla.
- 1.3 Comparison (Differences) of Chordates with Non-Chordates
- 1.4 Origin-classification and characters of Chordata.

## **UNIT-2**

### **Vertebrate Integument & Circulatory system**

- 2.1 Integument in different classes of Chordates.
- 2.2 General structure and functions of the skin.
- 2.3 Epidermal derivatives-Epidermal glands - Hard horny structures, dermal derivatives (Dermal scales, Plates, Fin-rays and Antlers).
- 2.4 Parts of circulatory system- evolution of heart-evolution of aortic arches and portal system.

## **UNIT-3**

### **Respiratory system and Skeletal system**

- 3.1 Characters of respiratory tissue-internal and external respiration
- 3.2 Comparative account of respiratory organs- Gills (True Gills, Larval Gills) - Lungs and ducts. Accessory Respiratory Organs
- 3.3 Types of Vertebrate Skeletons- Functions of Endoskeleton
- 3.4 Comparative account of jaw Suspensorium (Autodiastylic, Amphistylic, Hyostylic, Autostylic, Craniostylic) and vertebral column-limbs and girdles.

## **UNIT-4**

### **Urino-genital System & Sense organs in Vertebrate groups**

- 4.1. Vertebrate Kidneys and Ducts  
(Structure and Origin of Archinephros, Pronephros, Mesonephros, Metanephros)
- 4.2. Gonads and their Ducts-Testes and Male Genital ducts, Copulatory organs, Ovaries and Female genital ducts.
- 4.3. Common Senses, Classification of Sense organs
- 4.4. Olfactory, Gustatory, Photoreceptors, statocoustic organs in vertebrates

## **UNIT-5**

### **Nervous System**

- 5.1. Neural system and its functions, Division of neural system.
- 5.2. Comparative anatomy of the brain in relation to its functions.
- 5.3. Comparative anatomy of the spinal cord-Cranial nerves
- 5.4. Peripheral-Autonomous nervous system.

## **PRACTICALS**

Virtual dissections: Labeorohita-External features  
Labeorohita digestive system  
Labeorohita arterial system

Labeorohita venous system  
 Labeorohita cranial nerves  
 Labeorohita urinogenital system  
 Rattusrattus external features  
 Rattusrattus arterial system  
 Rattusrattus venous system  
 Rattusrattus male and female urinogenital system

Specimens: Protochordates: Salpa, Herdmania.  
 Fishes: Rhinobatus, Chimmera, Amia, Notopterus, Trachurus, Exocoetus and Echinus.  
 Amphibia: Ichthyophis, Rhacophorus, Amblystoma.  
 Reptiles: Python, Chelone, Naja henna, Russell's viper and Bungarus.  
 Aves: Indian quail, Indian tailor bird, kite and Jungle fowl  
 Mammals: Marmoset, Loris, Bat, and Pangolin.

### TEXT BOOKS

1. Arumugam, N. Chordate Zoology, Vol. 2. Saras Publication.
2. P.S. Dhami & J.K. Dhami, 1981. Chordate zoology. (R. Chand & Co.).
3. R.L. Kotpal, 2000. Modern textbook of zoology, Vertebrates. (Rastogi Publ., Meerut). 632 pages.
4. E.L. Jordan & P.S. Verma, 1998. Chordate zoology. (S. Chand & Co.). 1092 pages.
5. G.S. Sandhu, 2005. Objective Chordate Zoology. Campus Books, vii, 169 pp.

### REFERENCE BOOKS

1. Andrews, S.M. PROBLEMS IN VERTEBRATE EVOLUTION. Academic press, New York.
2. Colbert, E.H. EVOLUTION OF THE VERTEBRATES. John Wiley and Sons Inc., New York.
3. Kent, C.G. COMPARATIVE ANATOMY OF VERTEBRATES.
4. Kingsley, J.S. OUTLINES OF COMPARATIVE ANATOMY OF VERTEBRATES Central Book Dept., Allahabad.
5. Milton Hildebrand. ANALYSIS OF THE VERTEBRATE STRUCTURE. John Wiley and Sons, Inc., New York and London.
6. Montagna, W. COMPARATIVE ANATOMY. John Wiley and Sons Inc., NY.

### WEB REFERENCES

- <https://en.wikipedia.org/wiki/Vertebrate>
- [https://www.diffen.com/difference/Invertebrate\\_vs\\_Vertebrate](https://www.diffen.com/difference/Invertebrate_vs_Vertebrate)

## Course: Zool 2.2: GENETICS, BIOSTATISTICS AND BIOINFORMATICS

### Course Objectives

Enable the students to

1. Understand the concept of gene, mendelian principles and its extensions
2. Acquire knowledge on extra chromosomal inheritance, human genetics and diagnosis and treatment of different genetic disorders
3. Analyze different types of genetic mutations and genetic recombination
4. Elucidate the conceptual application of statistics in biology
5. Summarize the different protein databases by using bioinformatics tools

#### Course Outcomes:

After successful completion of the course the student will be able to

**CO1:** Explain the principles of genetics and different types of heritable traits and able to relate mechanism of extra chromosomal inheritance. Identify the genetic importance of pedigree analysis and karyotypes.

**CO2:** Able to apply the knowledge to understand various traits in individuals and populations of microbes and animals

**CO3:** Knowledge of modern methods for diagnosis and treatments of genetic disorders

**CO4:** Use the best data analysis methods in their research projects and to gain skill to solve problems using inferential statistical tools.

**CO5:** Apply the acquired knowledge in the emerging field of bioinformatics analyze different protein databases to excel in bioinformatics studies

#### Mapping Course Outcomes with Program Outcomes & Program-Specific Outcomes (CO-PO-PSO)

CLO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H		H				M					H	H		H		
CO2	H		H				M					H	H		H		
CO3	H		H				M					H	H		H		
CO4	H		H				M					H	H	H	H		H
CO5	H		H				M					H	H	H	H		

## SYLLABUS

### UNIT- 1

## **Concept of Gene and Mendelian principles**

- 1.1 Concept of gene - Allele, multiple alleles, pseudo allele, complementation tests.
- 1.2 Mendelian principles - Dominance, segregation, independent assortment
- 1.3 Extensions of Mendelian principles - Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity
- 1.4 Extensions of Mendelian principles - phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters.

## **UNIT- 2**

### **Extra chromosomal inheritance and Human genetics**

- 2.1 Extra chromosomal inheritance - Inheritance of Mitochondrial and maternal inheritance.
- 2.2 Human genetics - Pedigree analysis, lod score for linkage testing and karyotypes
- 2.3 Genetic disorders - Single gene-Autosomal dominant, Autosomal recessive, X-linked dominant, X-linked recessive, Y-linked, Mitochondrial and Multiple genes.
- 2.4 Diagnosis and Treatment of Genetic Disorder

## **UNIT- 3**

### **Mutation and Recombination**

- 3.1 Mutation - Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal versus somatic mutants, insertional mutagenesis.
- 3.2 Structural and numerical alterations of chromosomes - Deletion, duplication, inversion, translocation, ploidy and their genetic implications.
- 3.3 Recombination - Homologous recombination including transposition.
- 3.4 Recombination - Non-homologous recombination including transposition

## **UNIT-4**

### **B.BIOSTATISTICS**

- 4.1 Biostatistics -Definition-Diagrammatic and graphical representation of data.
- 4.2 Measures of central tendency (Mean mode and median), Measures of dispersion (Standard deviation- quartile deviation-coefficient of variation).
- 4.3 Correlation and Regression & Concept and uses of ANOVA
- 4.4 Analyses of data – tools of Statistics and Software applications

## **UNIT- 5:**

### **C. BIOINFORMATICS**

- 5.1 Primary databases - Nucleotide databases: NCBI, EMBL, DDBJ.  
Protein databases: SWISS PROT, PIR, MIPS, Tr-EMBL
- 5.2 Secondary databases - PROSITE, PRINTS, BLOCKS, PATTERNS
- 5.3 Protein structural Classification Databases: SCOP, CATH
- 5.4 Protein structure database: PDB

## **PRACTICALS**

1. Identification of Colour blindness
2. Identification of Sickle cell erythrocyte
3. Blood grouping and Rh Factor
4. Identification of taster and non-taster by using PTC
5. Calculation of mean, mode, median, standard deviation, standard error, coefficient of variance.

6. Correlation and regression.
7. Retrieval of sequences by using NCBI, EMBL, DDBJ
8. Submission of sequences by using Sequin, Bankit
9. Protein Sequences classification using SCOP and CATH
10. Secondary database information retrieving from PROSINTS and BLOCKS.
11. Local alignment of Sequence using BLAST
12. Global alignment of sequence using FASTA

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1. Genetics, B.D. Singh, 2019, Kalyani publication
2. A Text book of Genetics, H.S. Bhamrah and Chaturvedi, Anmol Publication
3. Genetics and Biostatistics, R.P. Meyyan, Saras Publication
4. Genetics-P.S. Verma and V.K. Agarwal-2009, S. Chand Publication.

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1. An introduction to Modern genetics by Ch. Waddington
2. Basic Human Genetics- E.J. Mange, Arthur P. Mange. Indian Print, 1997.
3. Genetic disorders of Man by M.R. Goodman.
4. Genetics - Monro W. Strickberger. 3rd Ed., May, 2000.
- Genetics-K.B. Alluwallia-1985.
5. Molecular Biology of genes- Watson, J.D., N.H. Hopkins, J.W. Roberts, J.A. Steitz & A.M. Weiner. The Benjamin Cummings publishing company. Inc. Tokyo.
6. Principles of Genetics - E.J. Gardner. M.J. Simmons & D.P. Snustad.
7. An introduction to genetic analysis. Griffiths, A.J. F., J.B. Miller, D.T. Suzuki, R.C. Lewontin & W.M. Gelbart, W.H. Freeman and Company, New York.
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11. Kroenke, D.M. (1990). DATABASE PROCESSING. Galgotia Publications Pvt. Ltd., New Delhi.
12. Lewis. A.E (1971). Biostatistics. Affiliated East-West Press Pvt. Ltd.
- Mather, K. (1972) Statistical analysis in biology. Chapman and
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- [http://www.bionet.nsc.ru/ICIG/CHM/books/Hartl\\_Jones\\_Genetics.pdf](http://www.bionet.nsc.ru/ICIG/CHM/books/Hartl_Jones_Genetics.pdf)
- [https://www.bio.bg.ac.rs/materijali\\_predmeta/med-eng-griffiths-an-introduction-to-genetic-analysis.pdf](https://www.bio.bg.ac.rs/materijali_predmeta/med-eng-griffiths-an-introduction-to-genetic-analysis.pdf)

## **Course: 2.3 Wildlife conservation and ecotourism**

### **Course Objectives**

Enable the students to

1. Identify the necessity for wildlife conservation, causes for wildlife depletion and to interpret establishment of clonal banks, sanctuaries and national parks.
2. Describe the wildlife protective acts, conservation organizations, red data books and role of NGO's organizations in wildlife conservation.
3. Predict the different values of wildlife, importance of Indian fauna and useful and harmful effects of wild life conflicts
4. Discover the threats of biodiversity and to list wildlife conservation projects, biosphere reserves in India, wildlife corridors of India and Andhra Pradesh
5. Analyse the importance of ecotourism, wildlife census methods and methods of capturing and marking of captured fauna.

### Course Outcomes

After the successful completion of the course the student will be able to

1. Assess the importance of wildlife conservation, establishment of sanctuaries and national parks.
2. Apply the knowledge of wildlife protective acts in conserving animal biodiversity and consider different conservation organizations, Red data books, role of NGO's organizations in wild life conservation.
3. Distinguish the values of wild life, importance of Indian fauna and causes of wild life conflicts
4. Assess the threats of biodiversity, choose wild life conservation projects, support biosphere reserves in India and wild life corridors of India and Andhra Pradesh
5. Analyse the importance of ecotourism and wild life census mathematically and statistically
6. Classify the different animal species with the help of acquired practical knowledge through field trips, visiting zoological parks and bird sanctuaries.

### Mapping Course Outcomes with Program Outcomes & Program-Specific Outcomes (CO-PO-PSO)

CLO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	H	H		M						H		H		H		H
CO2	H	H	H		M						H		H		H	M	H
CO3	H	H	H		M						H		H		H	M	H
CO4	H	H	H		M						H	H	H		H	M	H
CO5	H	H	H		M								H	H	H		M
CO6	H	H	H		M						H	H	L	M	H	M	

### SYLLUBUS

## **UNIT-1**

### **Wildlife conservation**

- 1.1 Definition and aims of Wildlife conservation
- 1.2 Necessity for conservation and causes for Wildlife depletion (Deforestation, Hunting, Poaching, Pollution, Natural calamities, Poor breeding)
- 1.3 Knowledge of Wildlife, Protective laws, wildlife protective acts, Restriction of Hunting, Habitat improvement, clonal banks, Census, Epidemic control
- 1.4 Establishment of Sanctuaries and National parks

## **UNIT – 2**

### **Organizations for wildlife conservationmanagement**

- 2.1 Indian Board for Wild Life conservation (IBWL), World Wildlife Fund – India (WWF-India)
- 2.2 Conceptual frame work management and Futuristic management of social responsibilities of Business and wildlife Acts in India
- 2.3 The wild birds and animals protection Act of 1887, Forest Act XVI1927, Indian boardfor wild life 1952, Wild life protection Act of 1972, The Madras Wild Elephant PreservationThe Madras Wild Elephant Preservation Act enacted in 1873.
- 2.4 Red Data Books and Role of NGO's in wildlife conservation (Wildlife preservation societyof India).

## **UNIT-3**

### **Importance of wildlife and Indian Fauna**

- 3.1 Ecological balance, economic values, genetic resources, biological diversity
- 3.2 Wildlife for aesthetic value, education and scientific values.
- 3.3 Importance of Indian Fauna - Indian lion, Indian Tiger, Indian Rhino, Indian Elephant, wild Buffalo and Indian Crocodiles.
- 3.4 Wildlife conflicts - Conflicts between elephant and man, wolf and man, tiger and man

## **UNIT-4**

### **Threats of Biodiversity and Biosphere reserves in India**

- 4.1 Human activity and loss of Habitat deforestation, desertification, Marine environment Increasing wildlife trade, climate change, poaching, Industrialization and Urbanization
- 4.2 Wildlife conservation projects – Tiger, Lion, Elephant, Musk deer, Thamin deer and crocodile.
- 4.3 Biosphere reserves in India-National parks, wildlife sanctuaries
- 4.4 Wildlife corridors of India with special reference to Andhra Pradesh.



## **UNIT-5**

### **Ecotourism and Wildlife census methods**

5.1 Concepts, definition, WTO's definition, Stake holders, Government, Tourists, Resort owner and local community.

5.2 Practice of tourism worldwide, Guidelines and Govt. policies to regulate ecotourism and sustainable development.

5.3 Wildlife census methods for mammals and birds- Capturing and marking techniques, Live trapping birds and mammals- chemical Immobilization

5.4 Methods of marking captured birds and mammals

### **PRACTICALS**

1. Documentation of Avifauna within the university campus and adjoining areas
2. Visit to S.V. Zoological park, Tirupati to study the management and behavior of animals
3. Recording the disease, health management practices of animals in S.V. Zoological park, Tirupati
4. Field visit to Bird sanctuary, Nelapattu, Nellore Dt. and presentation of report
5. Field visit to Pulicatlak for the observation of birds and preparation of field report.
6. Visit to eco- tourism centers

### **TEXT BOOKS**

1. Wildlife conservation and Management, Reena Mathur, 2018, Rastogi Publication

2. Fundamentals of Ecology, 3<sup>rd</sup> Edition, Madhab Chandra Dash, Satyaprakash Dash

### **REFERENCE BOOKS**

1. Ecology and Environmental Biology (HB) Hardcover – 2014 by Purohit SS and Agrawal AK (Author)

2. Essentials of ecology & environmental science, 5/E 5th Edition (English, Paperback, S. V. S. Rana)

3. Rural Tourism and Tribal Development December 2006- by S.B. Verma and S.K. Jiloka  
Fielder L.P. and Kareiva, M.P. 1997. Conservation biology.

4. Saharia, V.V. 1982. Wildlife in India. Natraco Pub. Dehradun.

### **WEB REFERENCES**

1. <https://en.wikipedia.org/wiki/Ecotourism>

2. [https://en.wikipedia.org/wiki/List\\_of\\_national\\_parks\\_of\\_India](https://en.wikipedia.org/wiki/List_of_national_parks_of_India)

## Course: Zool 2.4: Developmental Biology

### Course Objectives

Enable the students to

1. Learn the concepts of development and gametogenesis and describe the embryonic stem cells and their applications.
2. Explain the fertilization, gastrulation and environmental regulation of normal development
3. Illustrate the morphogenesis and organogenesis
4. Distinguish the pattern of sex determination, regeneration and concept of embryonic stem cells.
5. Recognize embryonic stem cells and their applications and to demonstrate the collection and cryopreservation of gametes and embryos

### Course Outcomes:

After the successful completion of the course the student will be able to

**CO1:** Discuss the gametogenesis and applications of embryonic stem cells in the repair/regeneration of tissue.

**CO2:** Differentiate the molecular events of fertilization, mechanism of germ layer formation and role of environment in growth regulation.

**CO3:** Acquire knowledge on regeneration mechanism and metamorphosis in insects and amphibians to interpret cells and tissues migration and interaction by distinct mechanisms to produce multiple organs.

**CO4:** Applies knowledge to work out on collection and preservation of embryos and gametes to illustrate the molecular basis of sex determination and differentiation

**CO5:** Create awareness on artificial embryology and its applications

**CO 6:** Hypothesize the experimental methods and designs that can be used for further study and research.

### Mapping Course Outcomes with Program Outcomes & Program-Specific Outcomes (CO-PO-PSO)

CLO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	H	H		H							H	H		H		
CO2	H	H	H		H							H	H		H	M	
CO3	H	H	H		H							H	H		H	M	
CO4	H	H	H		H						M	H	H		H	M	

CO5	H	H	H						M			H	H		H	M	
CO6	H	H	H		H							H	H	H	H	M	L

## **SYLLUBUS**

### **UNIT-1:**

#### **Concepts of development and Gametogenesis**

- 1.1 Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages
- 1.2 Stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development
- 1.3 Spermatogenesis, its cellular and hormonal regulation.
- 1.4 Oogenesis-Folliculogenesis and oocyte maturation and hormonal regulation.

### **UNIT-2:**

#### **Fertilization and Gastrulation**

- 2.1 Fertilization- Cell surface molecules in sperm egg recognition in animals
- 2.2 Molecular events of pre fertilization and Post fertilization.
- 2.2 Cleavage - Cleavage types, Blastula formation, Gastrulation Molecular mechanism in germ layers formation.
- 2.4 Environmental regulation of normal development.

### **UNIT-3:**

#### **Morphogenesis and Organogenesis**

- 3.1 Morphogenesis - Cell aggregation and differentiation in Dictyostelium
- 3.2 Axis and pattern formation in Drosophila, Amphibia and Chick.
- 3.3 Organogenesis - vulva formation in caenorhabditiselegans, eye lens induction.
- 3.4 Development in tetrapod Limb (Amphibians) and Neural fold formation.

### **UNIT-4:**

#### **Sex determination and Regeneration**

- 4.1 Sex determination in animals (mechanism of primary and secondary sex determination)
- 4.2 Hormonal regulation of sexual phenotypes.
- 4.3 Regeneration-types of Regeneration - Axial patterning during Regeneration.
- 4.4 Metamorphosis-hormonal regulation of metamorphosis in insects and amphibians.

### **UNIT-5:**

#### **Embryonic Stem cells**

- 5.1 Embryonic stem cells and their applications.
- 5.2 Collection and cryopreservation of gametes and embryos
- 5.3 Multiple ovulation and embryo transfer technology (MOETT)
- 5.4 *In vitro* oocyte maturation-super ovulation-in vitro fertilization.

## **PRACTICALS**

Slides: Frog-morula, cleavage stages-2, 4,8,16 cell stage-blastula and gastrula.  
Chick embryos-24, 48, 72 and 96hr.

Mounting: Window preparation of 72 hr chick embryo.  
Movement of rat sperm.

List of Experiments:

1. Observation of developmental stages in frog
2. Observation of developmental stages in chick
3. Observation of different cleavage stages in the eggs of Lymnea (fresh water snail)
4. Role of shell during development of chick
5. Protein turnover during development of chick
6. Phosphorous metabolism in developing chick embryo
7. Spermatozoa observation in different vertebrates

## **Text Books**

1. Rastogi VB and Jayaraj MS. 1989. *Developmental Biology*. KedaraNath Ram Nath Publishers, Meerut, Uttar Pradesh.
2. Austen, C.R. and Short, R.V. *Reproduction in Animals*

## **REFERENCES BOOKS**

1. Ethan Bier *The Coiled Spring* Harlsor Laboratory Press, NewYork
- F.T. Longo, *Fertilization*, Chapman & Hall
2. *Molecular Developmental Biology* – 2008, T. Subramonian, Narosa Publishing House
3. R.G. Edwards, *Human Reproduction*
4. S.F. Gillbert, *Developmental Biology*, Sinauer Associates Inc., Massachusetts
- Schatten and Schatten. *Molecular Biology of Fertilization*.

## **WEB REFERENCES**

- <https://study.com/academy/topic/basics-of-developmental-biology.html>
- [https://gurukpo.com/Content/Bsc-biotech/Development\\_Biology.pdf](https://gurukpo.com/Content/Bsc-biotech/Development_Biology.pdf)
- <https://www.khanacademy.org/science/biology/developmental-biology/developmentand-differentiation/a/introduction-to-development>
- <https://www2.bc.edu/christopher-kenaley/bio3030/Wolpert.Ch1.pdf>

## **SEMESTER-III**

### **Course: Zool 3.1 Internal Elective – (IE-I)**

#### **MOOCs (Courses available on Swayam platform)**

a)

b)

c)

#### **MOOCs COURSES**

##### **Course Objectives**

Enable the students to

1. Aim at large-scale interactive participation and open access via the web and to provide interactive user forums that help build a networking community.
2. Provide free and open registration, distance education learning and to access online resources.

##### **Course Outcomes**

**After successful completion of the course the student will be able to**

**CO1.**Acquire knowledge to access the free online courses and integrate social networking.

**CO2.**Choose to self-organize to participate according to learning goals, prior knowledge and skills and common interests.

**CO3.** Integrate the self-directed learning environments, to expand autonomy, computer and language skills.

##### **Mapping Course Outcomes with Program Outcomes & Program-Specific Outcomes (CO-PO-PSO)**

CLO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H		M			H			H					M	H		

CO2	H		M			H			H			H		M	H		
CO3	H		M			H			H					M	H		

## **Course: Zool 3.2: RESEARCH METHODOLOGY**

### **Course Objectives**

Enable the students to

- The students tounderstand the significance of research methodology, develop ability to use appropriate data gathering methods and enhance the ability to interpret and present data in research report.
- Gain the knowledge on the role of statistics in research, apply statistical techniques in interpreting data meaningfully, and to know the issues in research, intellectual property rights and patents.

### **Course Outcomes**

**After successful completion of the course the student will be able to**

**CO 1:** Acquire knowledge of literature collection, literature citation, components of research report and integrate Intellectual Property Rights – Biopiracy, copyrights, filing of patent on traditional knowledge and plagiarism check.

**CO2:** Develop skill to solve problems using inferential statistical tools

**CO3:** Apply knowledge to work on data collection, analysis & interpretation and presentation of the research data in scientific method.

**CO4:** Hypothesize the research and experimental sampling design

**CO5:** Prepare dissertations, project proposals, project reports and research papers.

### **Mapping Course Outcomes with Program Outcomes & Program-Specific Outcomes (CO-PO-PSO)**

CLO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1		H	M	H	H	H	H	M	H	M	H	M		H	H	M	
CO2			M	H		H			H	M		M		H	H	M	
CO3	H	M	M	H		H	H		H	H		M		H	H	M	
CO4				H		H	H		H	H		M		H	H	M	
CO5	H	M		H	H	H	H		H	H	M	H		H	H	M	

## **SYLLABUS**

## **UNIT-I**

**Research:** Meaning, Objectives, Motivation, Utility of Research, Research Significance – Types: Fundamental, Applied and methods, Qualities of researcher – Steps in Scientific research.

## **UNIT – II**

**Planning a Research:** Selection of a problem – Formulation of research problem – Need for literature review – Sources of literature – Hypothesis formation – Types of hypothesis.

## **UNIT – III**

**Research Design:** Basic principles – Features of a good design – Experimental designs.

**Sampling methods:** Characteristics of a good sample design – Probability and non-probability sampling methods.

## **UNIT – IV**

**Report Writing:** Components – Types of reports, Layout of research report, Principles of writing, References, Appendices – Format of publication in research Journals – Paper Presentations: Planning, Preparation, Visual aids –Preparation of research proposal.

## **UNIT –V**

**Application of research results and ethics:** Ethical issues –copy right, plagiarism, royalty-ethical committees, Intellectual property rights and Patents- Types of patents, Patent filling procedure.

### **Text Books**

1. Kumar, R. 2009. Research Methodology: A Step by Step Guide for Research. New Delhi: Pearson Education.
2. Leedy, P.D. and Ormrod, J.E. 2004 Practical Research: Planning and Design. New York: Prentice Hall.
3. William, C.G. 1981. Concepts of Statistical Influence 2<sup>nd</sup> Edition. New York: Mc. Graw Hill International.

### **REFERENCES BOOKS**

4. Anthony, M. Graziano, A.M. and Raulin, M.L. 2009. Research Methods: A Process of Inquiry. Allyn Bacon.
5. Burno, R.B.. 2000. Introduction to Research Methods. New Delhi: Sage Publications.
6. Coley, S.M. and Scheinberg, C.A. 1990. Proposal Writing. New Delhi: Sage Publications.
7. Aay, R.A. 1992. How to Write and Publish a Scientific Paper. Cambridge University Press.
8. Fink, A. 2009. Conducting Research Literature Reviews: From the Internet to Paper. New Delhi: Sage Publications.
9. Kothri. C.R. 2004. Research Methodology: Methods and Techniques. New Delhi: New age International Publishers.

#### **WEB REFERENCES**

- 1.<https://bujhansi.ac.in/econtent/pages/shortcodes/EDUCATION/Selecting%20a%20Research%20problem.pdf>
- 2.[http://www.aau.in/sites/default/files/Unit%203%20RESEARCH%20AND%20RESEARCH%20ETHICS%20\(Repaired\).pdf](http://www.aau.in/sites/default/files/Unit%203%20RESEARCH%20AND%20RESEARCH%20ETHICS%20(Repaired).pdf)



## Course: Zool: 3.3: Immunology

### Course Objectives

Enable the students to

1. Get the knowledge on cells and organs of immune system , types of immunity, structure, functions of antibodies,types of antigenic determinantsand theories of antibody formation.
2. Understand the primary, secondary antigen-antibody reactions,major histocompatibility complexes and its functions
3. Distinguish the knowledge of immune responses, transplantation and immunoregulation
4. Illustrate the knowledge of autoimmune diseases in identifying pathogenesis, diagnosis and treatment.
5. Predict the uses of immunoprophylaxis

### Course Outcomes

After the successful completion of the course the student will be able to

**CO1.** Identify types of immunity, organs, cells of the immune system, classes and sub classes of antibodies and antigenic determinants and to understand the importance of immunity and health.

**CO2.** Explain the primary, secondary antigen-antibody reactions, major histocompatibility complexes and its functions to identify curative methodologies.

**CO3.** Analyse the immune responses, transplantation and immunoregulation

**CO4.** Apply the knowledge of autoimmune diseases in identifying pathogenesis, diagnosis and treatment.

**CO5.** Evaluate the role of immunoprophylaxis in prevention of diseases.

**CO6.** Acquainting the immunological techniques interconnect the theoretical and practical knowledge of immunity with the outer world for the development of a healthier life.

### Mapping Course Outcomes with Program Outcomes & Program-Specific Outcomes (CO-PO-PSO)

CLO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
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CO1	H	H	H												H	M	M	H	H
CO2	H	H	H												H	M	M	H	H
CO3	H	H	H												M		H		
CO4	H	H	H			H								M	M				
CO5	H	H	H			H								M	M				
CO6	H	H	H	M										M	M	H	H	H	

## Syllabus:

### UNIT-1

#### Introduction to Immunology

- 1.1History of Immunology –Types of Immunity-Innate Immunity-Adaptive Immunity.
- 1.2Organs of the Immune System-Primary Lymphoid Organs - Secondary Lymphoid Organs; Cells of the Immune System- Lymphocytes- B lymphocytes and T lymphocytes-Mast cells- Lymphocyte traffic.
- 1.3Structure and functions of antibodies; Classes and Subclasses of Immunoglobulins.
- 1.4 Types of Antigenic Determinants- Idiotypes- Isotypes-Allotypid determinants. Theories of antibody formation - generation of antibody diversity-antibody mediated effector functions.

### UNIT-2

#### Antigen – Antibody Interactions

- 2.1Primary and SecondaryAntigen – Antibody reactions.
- 2.2 Detection of Antigen-antibody Reaction -Antibody affinity-Cross reactivity-Precipitation reactions-Agglutination reactions-Haemagglutination-Bacterial agglutination –Passive agglutination-Agglutination inhibition-immunoprecipitation.
- 2.3 Major Histocompatibility Complex (MHC)-Defintion-Histocompatibility Molecules-H-2 Complex of mouse-Human leucocyte antigen(HLA)
- 2.4Functions of MHC -Production of HLA,Production of Immune associated antigens, Control of the levels of complement components, Graftrejection,Non-Immunological functions of MHC,HLA Complex help in T-Cell recognition.

### UNIT-3

#### Immune Responses

- 3.1 Humoral immunity-B-cell receptors-plasma cells-B-cell activation and proliferation, B-cell maturation-activation and differentiation.
- 3.2Cell mediated immunity- T- cell receptors T-cell maturation-T-cell differentiation-cell deathand T-cell populations.

- 3.3 Cells involved in the Cell mediated immunity Cytokines, Lymphokines and Interleukins and their immune response
- 3.4 Transplantation-Immuno regulation.

#### **UNIT-4**

##### **Autoimmune diseases**

- 4.1 Definition-characteristics of autoimmune diseases-causes of autoimmune diseases
- 4.2 Pathogenesis of autoimmune diseases-classification of autoimmune diseases.
- 4.3 Common Autoimmune diseases Hemolytic anemia-Thrombocytopenia-Thyrototoxicosis-Addison's diseases-Myasthenia gravis-Lupus erythematosus-Rheumatoid arthritis-Hashimoto
- 4.4 Diagnosis of Autoimmune diseases-Treatment of Autoimmune diseases.

#### **UNIT-5**

##### **Immunoprophylaxis**

- 5.1 Definition-Immunization-Active Immunization-Passive Immunization
- 5.2 Common Vaccines used in Immunoprophylaxis.
- 5.3 Immunizing agents-Immunoglobulins-Vaccines
- 5.4 Time of Immunization-Hazards of Immunization.

#### **PRACTICALS**

1. Histology of lymphoid organs in fish
2. Histology of lymphoid organs in chick
3. Immunological diagnosis of pregnancy.
4. Differential leucocyte count
5. Wild test
6. Total count of RBC
7. Total count of WBC
8. Separation of plasma and serum
9. Estimation of Hemoglobin
10. Some protozoan parasites: Entamoeba, Plasmodium, Giardia and Babesia.
11. Some helminth parasites: Taenia, Echinococcus, Wuchereria, Triturus, Ascaris-helminth larval forms.

#### **TEXT BOOKS**

1. A text book of Immunology, Dr. P.V. Madavi Latha, S. Chand
2. Essentials of Immunology, Second edition Dr. S.K. Gupta, 2017, Arya Publications

#### **REFERENCE BOOKS**

1. Goldsby, R.A., Kindt, T.J., Osburne, A. KUBY IMMUNOLOGY. W.H. Freeman Pub., USA.
2. Paul, W. FUNDAMENTALS OF IMMUNOLOGY
3. Roitt, I.M. ESSENTIAL IMMUNOLOGY. ELBS Edition.
4. Wier, E.M. IMMUNOLOGY: AN OUTLINE FOR MEDICINE AND BIOLOGY. Mansour. TROPICAL DISEASES.
5. Cheng, T.C. SYMBIOSIS.
6. Snay, J.D. INTRODUCTION TO PARASITOLOGY.

- 7.Cheng, T.C.GENERAL PARASITOLOGY.
- 8.Pleczer.GENERAL MICROBIOLOGY.
- 9.Power, C.B.MICROBIOLOGY.
- 10Atlas.MICROBIOLOGY.
- 11.Black. MICROBIOLOGY
- 12.Krushank.MICROBIOLOGY.
- 13.Joklik&Walet.ZINSHERS MICROBIOLOGY

## WEB REFERENCES

- <https://en.wikipedia.org/wiki/Immunology>
- [http://www.dphu.org/uploads/attachements/books/books\\_5451\\_0.pdf](http://www.dphu.org/uploads/attachements/books/books_5451_0.pdf)
- [http://missinglink.ucsf.edu/lm/immunology\\_module/prologue/prologue\\_syllabus\\_2008PDF](http://missinglink.ucsf.edu/lm/immunology_module/prologue/prologue_syllabus_2008PDF)

## **Couse: Zool 3.4: MOLECULAR BIOLOGY**

### **Couse Objectives:**

Enable the students to

- Understand the structure of DNA, mitochondrial genome and maternal inheritance.
- Explain the DNA replication, extra chromosomal replication mechanisms of DNA damage and repair and homologous and site-specific recombination.
- learn the process of transcription, structure and functions of different types of RNA, processing, editing, splicing, and polyadenylation of RNA
- Define the protein synthesis and to examine role of ribosome, initiation factors and their regulation, elongation factors, termination and genetic code
- Distinguish the control of gene expression at transcription and translation level regulating the expression of phages and viruses, prokaryote and eukaryotic genes.

### **Couse Outcomes**

After the successful completion of the course the student will be able to

**CO1.** Discuss the structure of chromosomal DNA and mitochondrial genome to predict maternal inheritance.

**CO2.** Distinguish the recombinant DNA technology, to analyze their applications at industrial level.

**CO3.** Illustrate the Different types and processes of RNA to analyze the process of transcription.

**CO4.** Distinguish the link between protein synthesis, metabolic pathways and gene regulation to demonstrate the applications of molecular biology in different fields.

**CO5.** Apply the knowledge of gene expression to control the gene expression at transcription and translation level.

**CO6.** Develop the practical skills in molecular biology techniques and to enhance the entrepreneurial activities among rDNA technology.

## **Mapping Course Outcomes with Program Outcomes & Program-Specific Outcomes (CO-PO-PSO)**

CLO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	M		M	M		M						M	M	M	H		H
CO2	M		M	M		M						M	M	M	H		H
CO3	M		M	M		M						M	M	M	H		H
CO4	M		M	M		H						M	M	M	H		M
CO5	M		M	M		M						M		M	H		H
CO6		H					M	M			M			H	M		

## Syllabus

### UNIT- 1

#### Structure of DNA and mitochondrial genome

- 1.1 Watson and Crick Model of DNA, Types of DNA
- 1.2 Properties of DNA(C-value paradox, Cot value)
- 1.3 Structure of gene (Cistron, Muton, Recon, Cis-trans test)
- 1.4 Nuclear and mitochondrial genome, mitochondrial and maternal Inheritance

### UNIT- 2

#### DNA recombination

- 2.1DNA replication- Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication
- 2.2 Extrachromosomal replicons
- 2.3Mechanisms of DNA damage and repair
- 2.4 Homologous and site-specific recombination.

### UNIT- 3

#### RNA synthesis and processing

- 3.1 Transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping, elongation, and termination
- 3.2RNA processing, RNA editing, splicing, and polyadenylation
- 3.2 Structure and function of different types of RNA
- 3.4Transport of RNA.

### UNIT - 4

## **Protein synthesis and processing**

- 4.1 Protein synthesis- Role of Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code
- 4.2 Aminoacylation of tRNA, tRNA-identity and aminoacyl-tRNA synthetase
- 4.3 Translational proof-reading, translational inhibitors
- 4.4 Post- translational modification of proteins.

## **UNIT- 5**

### **Gene expression**

- 5.1 Control of gene expression at transcription and translation level
- 5.2 Regulating the expression of phages and viruses,
- 5.3 Regulating the expression of prokaryotic and eukaryotic genes.
- 5.4 Role of chromatin in gene expression and gene silencing.

## **PRACTICALS**

- 1. Isolation of DNA in given sample.
- 2. Estimation of DNA by Diphenylamine method.
- 3. Isolation and estimation of plasmid DNA
- 4. Extraction of RNA from Dry yeast
- 5. Estimation of RNA by Orcinol method
- 6. Determination of melting point/ thermal denaturation of DNA.
- 7. Southern blotting

## **TEXT BOOKS**

- 1. Gupta, P.K. (2007) Cell and Molecular Biology, Rastogi Publications, Meerut.
- 2. Watson, J.D, Basker, T.A., Bell, S.P., Gann, A., Levine, M and Losick, R (2004) "Molecular biology of the gene", Pearson Education Pvt. Ltd., Singapore.
- 3. Bruce, A, Alexander, J, Julian, L, Martin, R, Keith R, and Peter, W, (2002) Molecular Biology of the Cell, Garland Science, Taylor Francis Group, New York

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- 1. Cooper, G. M. (2015). The cell, A Molecular Approach (7th Ed) ASM press, Washington, D.C.
- 2. Darnell, J. Lodish, H. and Baltimore, D. (2007). Molecular Cell Biology, 6th edition, Freeman, New York.
- 3. Derobertis, E. D. P. and Derobertis, E.M.F. (2011). Essentials of Cell and Molecular Biology (8th Ed) Hold Saunders – Philadelphia.
- 4. Karp G. (2013). Cell and Molecular Biology. Concepts and Experiments, 7th Edition John Wiley and Sons, Inc. New York, Brisbane, Toronto.

5. Loewy, A. G., Siekevitz, P., Menningee, J. R., and Allant, J. A. N. (1999). Cell structure and Functions. An integrated Approach 3rd edition. Saunders College Publishing, Philadelphia, London.

## **WEB REFERENCES**

➤ [https://molbiomadeeasy.files.wordpress.com/2013/09/fundamental\\_molecular\\_biology](https://molbiomadeeasy.files.wordpress.com/2013/09/fundamental_molecular_biology)

## **EXTERNAL ELECTIVE (EE)**

### **Couse: Zool EE: WILDLIFE CONSERVAION & ECOTOURISM**

#### **Course Objectives**

Enable the students to

1. Identify the necessity for wildlife conservation, causes for wildlife depletion and to interpret establishment of clonal banks, sanctuaries and national parks.
2. Describe the wildlife protective acts, conservation organizations, red data books and role of NGO's organizations in wild life conservation.
3. Predict the different values of wildlife, importance of Indian fauna and useful and harmful effects of wildlife conflicts
4. Discover the threats of biodiversity and to list the wildlife conservation projects, biosphere reserves in India, wildlife corridors of India and Andhra Pradesh
5. Analyse the importance of ecotourism, wildlife censuses methods and the methods of capturing and marking of captured fauna.

#### **Course Outcomes**

After the successful completion of the course the student will be able to

CO1. Asses the importance of wildlife conservation, establishment of sanctuaries and national parks.

CO2. Apply the knowledge of wildlife protective acts in conserving animal biodiversity and consider different conservation organizations, red data books, role of NGO's organizations in wildlife conservation.

CO3. Distinguish the values of wild life, importance of Indian fauna and causes of wild life conflicts

CO4. Asses the threats of biodiversity, choose wildlife conservation projects, support biosphere reserves in India and wildlife corridors of India and Andhra Pradesh

CO5. Analyse the importance of ecotourism and wild life census mathematically and statistically

CO6. Classify the different animal species with the help of acquired practical knowledge through field trips, visiting zoological parks and bird sanctuaries.

### Mapping Course Outcomes with Program Outcomes & Program-Specific Outcomes (CO-PO-PSO)

CLO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	H	H		M						H		H		H		H
CO2	H	H	H		M						H		H		H	M	H
CO3	H	H	H		M						H		H		H	M	H
CO4	H	H	H		M						H	H	H		H	M	H
CO5	H	H	H		M								H	H	H		M
CO6	H	H	H		M						H	H	L	M	H	M	

## SYLLABUS

### UNIT-1

#### Wildlife conservation

##### 1.1 Definition and aims of Wildlife conservation



- 1.2 Necessity for conservation and causes for Wildlife depletion (Deforestation, Hunting, Poaching, Pollution, Natural calamities, Poor breeding)
- 1.3 Knowledge of wildlife, Protective laws, wildlife protective acts, Restriction of Hunting, Habitat improvement, clonal banks, Census, Epidemic control
- 1.4 Establishment of Sanctuaries and National parks

## **UNIT – 2**

### **Organizations for wildlife conservation**

- 2.1 Indian Board for Wild Life conservation (IBWL), World Wildlife Fund – India (WWF-India)
- 2.2 Conceptual framework management and Futuristic management of social responsibilities of Business and wildlife Acts in India
- 2.3 The wild birds and animals protection Act of 1887, Forest Act 1927, Indian board for wild life 1952, Wild life protection Act of 1972, The Madras Wild Elephant Preservation Act enacted in 1873.
- 2.4 Red Data Books and Role of NGO's in wildlife conservation (Wildlife preservation society of India).

## **UNIT-3**

### **Importance of wildlife and Indian fauna**

- 3.1 Ecological balance, economic Values, genetic resources, biological diversity
- 3.2 Wildlife for aesthetic value, education and scientific values.
- 3.3 Importance of Indian Fauna - Indian lion, Indian Tiger, Indian Rhino, Indian Elephant, wild Buffalo and Indian Crocodiles.
- 3.4 Wildlife conflicts - Conflicts between elephant and man, wolf and man, tiger and man

## **UNIT-4**

### **Threats of Biodiversity and Biosphere reserves in India**

- 4.1 Human activity and loss of Habitat deforestation, desertification, Marine environment Increasing wildlife trade, climate change, poaching, Industrialization and Urbanization
- 4.2 Wildlife conservation projects – Tiger, Lion, Elephant, Musk deer, Thamin deer and crocodile.
- 4.3 Biosphere reserves in India-National parks, wildlife sanctuaries
- 4.4 Wildlife corridors of India with special reference to Andhra Pradesh.

## **UNIT-5**

### **Ecotourism and wildlife census methods**

- 5.1 Concepts, definition, WTO's definition, Stake holders, Government, Tourists, Resort owner and local community.

5.2 Practice of tourism worldwide, Guidelines and Govt. policies to regulate ecotourism and sustainable development.

5.3 Wildlife census methods for mammals and birds- Capturing and marking techniques, Live trapping birds and mammals- chemical Immobilization

5.4 Methods of marking captured birds and mammals

### **TEXT BOOKS**

1. Rural Tourism and Tribal Development December 2006- by S.B. Varma and S.K. Jiloka

2. L.P. and Kareiva, M.P. 1997. CONSERVATION BIOLOGY

### **REFERENCE BOOKS**

**1. Ecology and Environmental Biology (HB) Hardcover – 2014 by Purohit SS and Agrawal AK (Author)**

2. ESSENTIALS OF ECOLOGY & ENVIRONMENTAL SCIENCE, 5/E 5th Edition (English, Paperback, S. V. S. Rana)

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3. Saharia, V.V. 1982. WILDLIFE IN INDIA. Natraco Pub. Dehradun.

### **WEB REFERENCES**

1. <https://en.wikipedia.org/wiki/Ecotourism>

2. [https://en.wikipedia.org/wiki/List\\_of\\_national\\_parks\\_of\\_India](https://en.wikipedia.org/wiki/List_of_national_parks_of_India)

## **SEMESTER –IV**

### **Couse: Zool4.1(a): Animal Biotechnology**

#### **Course Objectives**

Enable the students to

1. Get the knowledge of different methods of culture media preparations, cell culture techniques and applications of animal cell culture
2. Analyse the tools of genetic engineering, molecular vectors, restriction enzymes, DNA-RNA markers and their applications in daily life
3. Evaluate the role of molecular cloning strategies in the field of Biotechnology and research labs
4. Evaluate the importance of PCR types their applications, DNA finger printing hybridization and gene mapping
5. Apply the transgenic technology in production of transgenic mice, fish, birds and cattle

#### **Course Outcomes**

After the successful completion of the course the student will be able to

CO1: Analyse the different methods of culture media preparations, cell culture techniques to experiment in applications of animal cell culture and cell culture based vaccines.

CO2 Analyse the tools of genetic engineering, molecular vectors, restriction enzymes, DNA-RNA markers and their applications in daily life

CO3 Evaluate the role of molecular cloning strategies in the field of Biotechnology and in research labs

CO4 Assess the importance of PCR types, their applications, DNA finger printing hybridization to evaluate gene mapping.

CO5. Apply the transgenic technology in production of transgenic mice, fish, birds and cattle

CO6. Demonstrate the basic laboratory skills necessary for Biotechnology research, Promoting application of the lab techniques for taking up research in higher studies

### Mapping Course Outcomes with Program Outcomes & Program-Specific Outcomes (CO-PO-PSO)

CLO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	M	H	M					H	M		H	H	H	H	H	H
CO2	H	M	H	M					H	M	H	H	H	H	H	H	H
CO3	H	M	H	M					H	M	H	H		H	H	H	H
CO4	H	M	H	M					H	M		H		H	H	H	H
CO5	H	M	H	M					H	M		H		H	H	H	H
CO6	H	M	H	M					H	M		H		H	H	H	H

## SYLLABUS

### UNIT-1

#### Cell culture

1.1 Equipment and material for animal cell culture technology. Primary and established cell line cultures.

1.2 Culture media preparation-chemical, physical and metabolic function of different constituents of culture medium.

1.3 Cell culture techniques –Raft method, agar gel, plasma cod method and Crud method.

Cell separation-cell synchronization.

1.4 Applications of animal cell culture-cell culture based vaccines-somatic cell genetics-organ

Andhistotypic cultures-tissues engineering.

### UNIT-2

#### Recombinant DNA Technology

2.1 Scope of genetic engineering-tools of genetic Engineering.

- 2.2 Molecular vectors: Cloning-shuttle and binary vectors-plasmids-viruses-PBR322- PBS-T-SV40-bacteriophages-phasmids-cosmids.
- 2.3 Restriction enzymes-modified enzymes.
- 2.4 DNA and RNA markers-their applications

### **UNIT-3**

#### **Molecular Cloning Strategies**

- 3.1 Generation of DNA fragments: RE digestion-mechanical shearing-duplex cDNA synthesis-chemical synthesis.
- 3.2 Joining of DNA fragments to vectors-Homopolymertailing,cohesive and blunt ligation-Linkers
- 3.3Transformation- Biological and non-biological means
- 3.4 Separation and sequencing: Agarose and PAGE- High voltage PAGE for sequencing gel-Maxam and Gilbert DNA sequencing- Dideoxy sequencing of Sanger.

### **UNIT-4**

#### **Nucleic acid Amplification**

- 4.1PCR- types and their applications, site directed mutagenesis and its methods
- 4.2 Restriction enzyme analysis, RFLP, DNA finger printing
- 4.3Southern, Northern and Hybridization
- 4.4Gene mapping, Microarrays

### **UNIT-5**

#### **Transgenic Technology**

- 5.1Trans genesis and transgenic methods
- 5.2 production of transgenic mice and fish
- 5.3 production of transgenic birds and cattle.
- 5.4 Manipulation of reproduction in animals - Artificial insemination, multiple ovulations, in vitro fertilization, Embryo transfer technology

### **PRACTICALS**

- 1. Instrumentation in animal biotechnology laboratory
- 2. Preparation of different types of culture media
- 3. Screening of transgenics
- 4. Animal cell culture and characteristics
- 5. Bacterial transformation.
- 6. Southern blotting
- 7. PCR
- 8. Real time PCR
- 9. SDS Page

### **TEXT BOOKS**

- 1.Animal Biotechnology-M.M. Ranga, Agrobios (India)-2000
- 2.Biotechnology-Fundamentals & Applications-S.S.Purohit& S.K. Mathur, Agro Botonics-1999
- 3.A text book on Biotechnology-(II Ed.) H.D. Kumar. EWP-Private Ltd., New Delhi-1998

4. A text book of Biotechnology-R.C. Dubey.S.Chand& Company Ltd., New Delhi-1996

## **REFERENCE BOOKS**

- 1.Biotechnology-V.Kumaresan.Saras Publication-1994
- 2.Animal Biotechnology – Recent concepts and developments. P. Ramadass, MJP Publications, Chennai, 2009
- 3.Venkitaraman: Economic Zoology (Sudarsana Publishers, 1983)
- 4.Srivastava: A text book of Applied Entomology, Vol. II and III (Kalyani Publishers, 1988, 1991)
- 5.Shukla&Upadhyaya: Economic Zoology (Rastogi Publishers, 1999-2000)

## **WEB REFERENCES**

- 1.<https://www.vanderbilt.edu/viibre/CellCultureBasicsEU.pdf>
- 2.[https://en.wikipedia.org/wiki/Molecular\\_cloning](https://en.wikipedia.org/wiki/Molecular_cloning)

## **Couse: Zool 4.1IE-II (b) NEUROBIOLOGY AND ENDOCRINOLOGY**

### **CourseObjectives**

Enable the students to

- Make the students to learn the basics of neurophysiology and mechanism of neurotransmitters.
- Understand the history of endocrine glands and the mechanism of hormones

### **Course Outcomes:**

After the successful completion of the course the student will be able to

**CO1:**Describe the basics of neurophysiology like anatomy, types of neuron and mechanism of nervous system in different animals.

**CO2:** Illustrate the concept of synthesis, storage and activation mechanism of neurotransmitters and to predict different functions of neurotransmitters

**CO3:** Describe the characteristics, classification and mechanism of hormones, and pheromones to review their mechanisms

**CO 4:** Differentiate the location, structure and functions of endocrine glands and their hormones to evaluate cause and effects of endocrine glands on animal physiology.

**CO 5:** Develop the practical skills in neurotransmitters and the techniques to carryout the experiments.

**Mapping Course Outcomes with Program Outcomes & Program-Specific Outcomes (CO-PO-PSO)**

CLO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	H	M						M			M	H			H	
CO2	H	H	M						M			M	H			H	
CO3	H	H	M	M					M			M	H			H	
CO4	H	H	M	M		M			M			M	H			H	
CO5	H	H	H	H			M		M			M	H	H	H	H	

## Syllabus

### UNIT-I

#### Basics of Neurophysiology

- 1.1 Micro anatomy of neurons and types of nerve cells.
- 1.2 Autonomic nervous system – Sympathetic division and parasympathetic division.
- 1.3 Bioelectrical properties of neurons - Resting membrane potential- Sodium and potassium pump- Propagation of nerve impulse.
- 1.4 Synapses- Structure and Integration - Types of synapses- Ultra structure of synapse - Chemical transmission and Electrical transmission

### UNIT-II

#### Synthesis and mechanism of Neurotransmitters

- 2.1 Chemical composition of the nervous system-Cerebrospinal fluid-CNS barriers
- 2.2 Synthesis – Storage-release and inactivation mechanisms - functions of the Neurotransmitters- Acetylcholine & Catecholamines - Norepinephrine, Epinephrine, Dopamine
- 2.3. Amino acid Neurotransmitters-Glutamate and GABA
- 2.4 Neuropeptides - Oxytocin and Vasopressin

## Endocrinology

### UNIT-III

#### Characteristics, classification and mechanism of hormones

- 3.1 Introduction to Endocrinology- Historical back ground, characteristic features of hormones

- 3.2 Classification and chemical nature of hormones
- 3.3 Mechanism of hormone action -Peptide and Steroid hormones
- 3.4 General account of Pheromones

#### **UNIT-IV**

##### **Endocrine glands**

- 4.1 Structure and functions of glands- Pineal, Pituitary, thyroid and Parathyroid
- 4.2 Structure and functions of glands – Adrenal and Pancreas
- 4.3 Structure and functions of Ovaries - Female sexual cycle, Pregnancy and lactation
- 4.4 Structure and functions of Testis- Hormones of Testis and regulation of spermatogenesis

#### **UNIT-V**

##### **Hormone receptors**

- 5.1 Biosynthesis and secretion of hormones Corticosteroid hormones-Peptide hormones-Catecholamines
- 5.2 Hormone receptors- Receptor structure and signal transduction mechanism-G-protein family
- 5.3 Growth hormones and growth factors
- 5.4 Hormones and homeostasis - Calcium, glucose, Phosphate, water

#### **PRACTICALS**

1. Dissection of Rat/Chick/Fish Brain and separation brain regions
2. Acetyl Choline Esterase activity in different regions of rat/chick brain
3. Acetyl choline activity in different regions of rat/chick brain
4. Glutamine activity in different regions of rat/chick brain
5. Dissection of Rat/Chick/Fish of pituitary, adrenals, pancreas and gonads
6. Isolation and extraction of pituitary gland from fish
7. Estimation of glucose levels in the blood of frog/rat exposed to adrenaline and insulin

#### **TEXT BOOKS**

1. Williams, R.H. Textbook of endocrinology. W.B. Saunders Co., Philadelphia.
2. Martin, C.R. Endocrine physiology. Oxford Univ. Press, Oxford.

#### **REFERENCE BOOKS**

1. T.H. Bullock, R. Cork, A. Granner, Introduction to nervous system, W.H. Freeman & Co.
2. Shepherd, G.M. Neurobiology, Oxford University Press, London.
3. G.J. Seigal, R.W. Albers, B.W. Agranoff, R. Katzman (1981). Basic neurochemistry, Little, Brown and Company, Boston.
4. Cooper, T.G. Tools of Biochemistry.
5. Barrington, E.J.W. General and comparative endocrinology.

Cambridge Press, Oxford.

6. Bentley, P.J. Comparative vertebrate endocrinology. Cambridge Press, Oxford.

7. Darnell, J., Lodish, H. and Baltimore, Molecular cell biology. Scientific American Books Inc., USA.

8. Alberts, b., Bray, D., Lewis, J., Rall, M., Roberts, K. and Watson, J.D. Molecular biology of the cell. Garland Pub. Inc., NY.

9. Benjamin Lewin. GENE VI. Oxford Univ. Press, UK.

10. Ethan Bier. The Coiled Spring, Cold Spring Harbor Press.

Freedman, L.P. Molecular biology of steroid and nuclear hormone receptors.

11. Litwack, G. Biochemical actions of hormones. Academic Press.

## **WEB REFERENCES**

1. <https://en.wikipedia.org/wiki/Neurotransmitter>

2. [https://en.wikipedia.org/wiki/Endocrine\\_gland](https://en.wikipedia.org/wiki/Endocrine_gland)

## **Couse: Zool 4.1 IE-II (c) SILKWORM BIOLOGY AND PHYSIOLOGY**

### **Couse Objectives:**

#### **Enable the student to**

- Study the external morphology of silkworm, stages of embryology and secretions of silk gland
- Learn about the various systems such as digestive, excretory, circulation, nervous, endocrine and reproductive systems and their physiology.

### **Course Outcomes:**

After the successful completion of the course the student will be able to

**CO1:** Identify the taxonomic position of silkworm and morphology of silkworms to identify different silkworm species.

**CO2:** Distinguish the internal morphology of silkworm with respect to digestive, secretory and respiratory systems.

**CO3:** Explain the physiology of digestion, excretion, circulatory and nervous systems of silkworm

**CO4:** Analyze the biological rhythms of insect behavior

**CO5:** Investigate silk worm glandular systems and their functions with special reference to endocrine system and hormonal mechanism.



## Mapping Course Outcomes with Program Outcomes & Program-Specific Outcomes (CO-PO-PSO)

CLO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	H	M									H	H	H	H		
CO2	H	H	M										H	H	H		
CO3	H	H	M									H	H	H	H		
CO4	H	H	M	M									H	H	H		
CO5	H	H	M									H	H	H	H		

### Syllabus

#### UNIT-1:

#### Morphology and Life cycle of Silkworm

- 1.1 Systematic position of mulberry silkworm-Life cycle of silkworm, *Bombyxmori* L.
- 1.2 External morphology of silkworm-Egg, Larva, Pupa and Adult
- 1.3 Embryology-Structure of Egg-Fertilization-Cleavage-Blastoderm-Germ band formation-Blastokinesis-Involution of the embryo
- 1.4 Silk gland-Structure and functions

#### UNIT -2:

#### Systems of Silkworm Biology

- 2.1 Silkworm digestive system-Nutritional requirements of silkworm
- 2.2 Excretory system-Morphology and ultrastructure of Malpighian tubules
- 2.3 Respiratory system-Spiracles-Trachea-Types of respiration-Respiratory pigments
- 2.4 Circulatory system-Types of circulatory system-Dorsal blood vessel-Aorta-Heart-Heart beat-Alary muscles-Haemolymph
- 2.5 Reproductive system- Male and female silkworm

#### UNIT -3:

#### Silkworm Physiology

- 3.1 Physiology of digestion in silkworm
- 3.2 Physiology of circulation in silkworm
- 3.3 Physiology of excretion in silkworm
- 3.4 Physiology of nervous system in silkworm during metamorphosis

## **UNIT -4:**

### **Insect behaviour**

- 4.1 Insect behaviour: Insect clocks
- 4.2 Types of biological rhythms
- 4.3 Photoperiodism-Dormancy
- 4.4 Quiescence and Diapause-Types of diapauses

## **UNIT -5:**

### **Glandular system**

- 5.1 Glandular system: Exuvial gland, salivary gland, tracheal gland, prothoracic gland
- 5.2 Suboesophageal gland, peritracheal gland, oenocytes and pericardial cells
- 5.3 Structure and function of silk gland.
- 5.4 Insect endocrinology-Endocrine glands and their secretions-Mode of action of insect hormones-functions of endocrine organs

## **PRACTICALS**

1. Study of larval morphology and Dissection and display of *Bombyxmori*
  - i. Mouth parts
  - ii. Silk glands
  - iii. Digestive system
  - iv. Nervous system
  - v. Reproductive system
2. Activity levels of amylase in mid gut and haemolymph silkworm, *Bombyxmori*.
3. Estimation of trehalose in haemolymph of silkworm larvae.
4. Estimation of glycogen in different tissues of silkworm larvae.
5. Estimation of glucose in different tissues of silkworm larvae.
6. Calculation of consumption index, digestability, conversion of ingested food in two races and sexes of *Bombyxmori*.

## **TEXT BOOKS**

1. **Insect Biochemistry**, Text Book, Widsom Press, New Delhi, ChinmoyGoswami and Abha Bhardwaj

## **REFERENCES**

1. Introduction to Sericulture. Text book, Oxford and IBH Pub. Co. Pvt. Ltd., New Delhi, p Ganga, G. and SulochanaChetty, J. (2010)
2. Development Physiology of Silkworms,(translation of second Japanese edition), Text Book, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi

### **WEB REFERENCES**

- 1.[https://ncte.gov.in/oer/Forms/OERDocs/OERDoc/OERDoc\\_13\\_35696\\_03\\_08\\_2021.pdf](https://ncte.gov.in/oer/Forms/OERDocs/OERDoc/OERDoc_13_35696_03_08_2021.pdf)
- 2.<https://www.healthline.com/health/biological-rhythms#types>

## **Couse: Zool 4.2: Ecology and Environmental Biology**

### **Course Objectives**

Enable the students to

- Understand the basic concepts of ecology
- Compare the population growth curves, regulation, life history strategies, age structured populations and the types of interactions
- Understand the nature, structure of community ,levels of species diversity and its measurements, ecotones, ecological succession types, mechanisms and the changes involved in succession
- Evaluate the problems evolved from different types of pollution, causes for greenhouse effect, global warming and give new ideas to control different types of pollution and to give suggestions to control greenhouse effect and global warming.

- Choose the appropriate methods in controlling significance, values and threats, conservation methods of biodiversity and to use standard gene bank to preserve the genitic material

### Course Outcomes

After the successful completion of the course the student will be able to

CO1.Explain the basic concepts of ecology.

CO2. Compare the population growth curves, regulation, life history strategies, age structured populations and the types of interactions

CO3. Describe the nature, structure of community,levels of species diversity and its measurements, ecotones, ecological succession types, mechanisms and the changes involved insuccession

CO4. Evaluate the problems caused by different types of pollution, causes for greenhouse effect, global warming and give new ideas to control different types of pollution and to give suggestions to control greenhouse effect and global warming

CO5. Choose the appropriate methods in controlling significance, values and threats, conservation methods of biodiversity and to use standard gene bank to preserve the genitic material

CO6. Gain the practical knowledge through demonstrating different types of experiments related to ecology and environmental biology

### Mapping Course Outcomes with Program Outcomes & Program-Specific Outcomes (CO-PO-PSO)

CLO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	H	H	M	M			M			H		H	H	H	M	H
CO2	H	H	H	H	H	M	L	M	L		H	M	H	H	H	M	H
CO3	H	H	H	H	H	M					H	M	H	H	H	M	
CO4	H	H	H	H	H	H	M	M	L		H	M	H	H	H	M	H
CO5	H	H	H	H	H	H	M	M			H	M	H	H	H	M	M
CO6	H	H	H	H	H		H	M			H	H	H	H	H	M	

## **Syllabus**

### **UNIT-1**

#### **Basic Concepts of Ecology**

- 1.1 Environment-Physical environment; biotic environment; biotic and abiotic interactions
- 1.2 Ecosystem structure; ecosystem function; energy flow and mineral cycling (C,N,P)
- 1.3 Primary production and decomposition; structure and function of some Indian ecosystems:  
terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine).
- 1.4 Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.

### **UNIT –2**

#### **Population Ecology and Species Interactions**

- 2.1 Characteristics of a population- Population growth curves and population regulation;
- 2.2 Life history strategies ( $r$  and  $K$  selection);
- 2.3 Concept of metapopulation – Demes and dispersal, interdemic extinctions, age structured populations.
- 2.4 Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis.

### **UNIT-3**

#### **Community Ecology**

- 3.1 Nature of communities-community structure and attributes
- 3.2 Levels of species diversity and its measurement- Edges and ecotones
- 3.3 Ecological Succession-Types- mechanisms
- 3.4 Changes involved in succession- concept of climax.

### **UNIT-4**

#### **Environmental Biology**

- 4.1 Environmental pollution-Types of pollution-Air, water and sound pollutions
- 4.2 Eutrophication, biological indicator and water quality
- 4.3 Greenhouse effect and global environmental change
- 4.4 Major terrestrial biomes; theory of island biogeography; biogeographical zones of India.

### **UNIT-5**

#### **Biodiversity**

- 5.1 Definition- Levels of biodiversity and Concepts of biodiversity- Significance of biodiversity & values of biodiversity.
- 5.2 Types of Biodiversity- Species- genetic and ecosystem diversity- Indian and global Biodiversity- Hotspots- Endemic and biogeographical areas of India.
- 5.3 Biodiversity conservation- threats and conservation methods – insitu and exsitu conservation plan.
- 5.4 Gene Bank- Theory of gene banking – Gene bank at global level.

## **PRACTICALS**

1. Estimation of dissolved oxygen content in different water samples
2. Effect of Photoperiodism on CO<sub>2</sub> levels in different water samples
3. Estimation of Organic matter in water and soil samples
4. Estimation of BOD in different water samples
5. Calculation of energy budget of an ecosystem
6. Analysis of OP compounds in water samples through TLC
7. Estimation of inorganic phosphate levels and biomass in surface and sediment waters
8. Determination of Calcium in a sedimentary bed and surface waters of freshwater pond
9. Recording the biodiversity of any visited area
10. Preparation of video clipping / photo feature based on field study.

## **TEXT BOOKS**

1. Fundamentals of environmental Biology, Meeru Gupta, 2020, Dreamtech Press
2. Environmental Biology (Principles of ecology), Dr. P.S. Verma, Dr. V.K. Agarwal 2020, S Chand, Publication

## **REFERENCES BOOKS**

1. Ecology & Environment – P.D. Sharma, 1991.
2. Environmental Biology and Toxicology-P.D. Sharma, Rastogi Publications, Meerut (India), 1998.
3. Biodegradation & Bioremediation – 2nd edition, Martein Alexander – Academic Press, 1999 USA.
4. Water Treatment and purification technology – W.J. Ryan, Agrobios (India), Jodhpur, 2002.
5. Methods in Environmental Analysis – Water soil and air by P.K. Gupta – Agrobios (India), Jodhpur, 2001.
6. Industrial Pollution - VP. Kudesia, 1990

## **WEB REFERENCES**

1. <https://en.wikipedia.org/wiki/Ecology>
2. <https://en.wikipedia.org/wiki/Pollution>

## **Zool 4.3 RP: RESEARCH PROJECT AND SUBMISSION OF DISSERTATION, PROJECT PRESENTATION AND VIVA- VOCE**

### **Course Objectives**

Enable the students to

- Enable the students to develop scientific research skills to design and carry out scientific investigations.
- Learn the data collection and analysis of data.

### **Course Outcomes**

After the successful completion of the course the student will be able to

- Define the problem or research question to be tested by a scientific investigation. Formulate a hypothesis and to explain it using logical scientific reasoning.
- Distinguish to design the scientific investigations that include variables and controls, material/equipment needed, a method to be followed, data to be collected and the suggestions for its analysis..
- Demonstrate an awareness and application of the appropriate personal, societal, and professional ethical standards.
- Apply the fundamental, disciplinary concepts and methods andways of principal areas of the study.
- Demonstrate the skill and knowledge of current information and technological tools and techniques specific to the professional field of study.

**Mapping Course Outcomes with Program Outcomes & Program-Specific Outcomes (CO-PO-PSO)**

CLO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1		H	M	H	H		H	H	H	H				H	H	M	
CO2			M	H	H		H	H	H	H				H	H	M	
CO3											H					H	
CO4	H		M										M				
CO5	H																

**Zool 4.4 IT: INDUSTRIAL TRAINING AND SUBMISSION OF REPORT, PRESENTATION AND VIVA- VOCE**

**CourseObjectives**

Enable the students to

- Train the students to be independent in finding the Industrial training placement and to prepare them to join the workforce in the future.
- Expose the students to the actual working environment including rules, regulations and safety practices.
- Enhance and supplement the knowledge, skills, competence and interpersonal relationship of the students.

### Course Outcomes

After the successful completion of the course the student will be able to

- Students will generate a report based on the experiences and the project will be carried out with the ability to apply knowledge of Zoology.
- Demonstrate the competency in research through problem identification, formulation and solution.
- Effectively implement the skills in communication, writing and using multimedia tools.
- Develop the ability to work as an individual and in group with the capacity to be an effective team member, leader or manager.
- Capability and enthusiasm for the self-improvement through continuous professional development and life-long learning.

### Mapping Course Outcomes with Program Outcomes & Program-Specific Outcomes (CO-PO-PSO)

CLO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1		L					M								H		
CO2				M			M									M	
CO3					H		M										
CO4								H		H					L		
CO5												H			H		