ST. JOSEPH'S COLLEGE (AUTONOMOUS)
JAKHAMA-NAGALAND

SYLLABUS
(Outcome Based Education)

CURRICULUM AND CREDIT FRAMEWORK
FOR
UNDERGRADUATE PROGRAMMES (NEP-2020)

DEPARTMENT OF ZOOLOGY

With effect from the Academic Year 2023-2024
(1st to 4thFYUGP)

INTRODUCTION

The framework of curriculum for the Bachelor's program in Zoology aims to transform the course content and pedagogy to provide a multidisciplinary, student-centric, and outcome-based, holistic education to the next generation of students.

Aside from structuring the curriculum to be more in-depth, focused, and comprehensive with significant skill-set for all exit levels; keeping in mind the job prospects; the emphasis has been to maintain academic coherence and continuum throughout the program of study and help build a strong footing in the subject, thereby ensuring a seamless transition into their careers. Special attention is given to eliminate redundancy, discourage rote learning, and espouse a problem-solving, critical thinking, and inquisitive mindset among learners.

The curriculum embraces the philosophy that science is best learned through experiential learning, not limited to the confines of a classroom but rather through hands-on training, projects and field studies.

This updated syllabus, with modern technology, helps students stay informed on the leading-edge developments in animal sciences and promotes curiosity, innovation, and a passion for research that will serve them well in their journey into scientific adventure and discovery beyond graduation.

The goal is to equip students with holistic knowledge, competencies, professional skills, and a strong positive mindset that they can leverage while navigating the current stiff challenges of the job market.

PROGRAM SPECIFIC OUTCOMES

B.Sc. Zoology

PSO 1: To produce graduates who can demonstrate comprehensive knowledge of the discipline. Execute strong theoretical and practical understanding generated from the specific graduate programme in the area of work so as to enable the learners to pursue academic or professional careers.

PSO 2: To create empathetical social concern and equity centered national development, and ability to act with an informed awareness of moral and ethical issues and commit to professional ethics and responsibility.

PSO 3: To understand the impact of the scientific solutions in societal and environmental contexts and demonstrate the knowledge and need for sustainable development.

PSO 4: To develop the working knowledge and applications of modern technology in education and scientific research.

PSO 5: To gain knowledge about research methodologies, effective communication, skills of problem-solving methods and ability to work in teams.

PSO 6: To create scientific temperament among the students.

Programme Structure

Semester	Major or Core Paper (4 credits each)	Inter-disciplinary Minor Paper (4 credits each)	Multidisciplinary course (4 credits each)	Skill Enhancement courses (SEC) OR Internship/ Apprenticeship/Project/Community Outreach (2 credits each)	Ability enhancement courses (AEC) (2 credits each)	Value addition course (VAC) (2 credits each)	Total Credits
I	ZOC 1.1: Techniques in Biology (3) ZOC 1.1(P): Techniques in Biology (1) ZOC 1.2: Non- Chordates I: Protista to pseudocoelomates (3) ZOC 1.2(P): Non- Chordates I: Protista to pseudocoelomates (1)	ZOM 1: Biology of Non-Chordates I (3) ZOM 1(P): Biology of Non-Chordates I (1)	MDC-1: Environmental Studies	ZOS 1: Bee Keeping and its Management (2)	AEC 1: English Communication	VAC-1 (2) Constitutional Values	22
II	ZOC 2.1: Non-Chordates II: Coelomates (3) ZOC 2.1(P): Non-Chordates II: Coelomates (1) ZOC 2.2: Cell Biology (3) ZOC 2.2(P): Cell Biology (1)	ZOM 2: Biology of Non-Chordates II (3) ZOM 2(P): Biology of Non-Chordates II (1)	MDC-2: Programming using python	ZOS 2: Introduction to Vermiculture (2)	AEC 2: Basic Functional English	VAC-2(2) Consumer Rights	22
Exit option with Undergraduate Certificate (44 Credits)							**44**
III	ZOC 3.1: Diversity of Chordates (3) ZOC 3.1(P): Diversity of Chordates (1) ZOC 3.2: Principles of Ecology (3) ZOC 3.2(P): Principles of Ecology (1) ZOC 3.3: Fundamentals of biochemistry (3) ZOC 3.3(P): Fundamentals of biochemistry (1)	ZOM 3: Life of Chordates (3) ZOM 3(P): Life of Chordates (1)	MDC-3(Intellectual Property Rights)	ZOS 3: Sericulture (2)			22
IV	ZOC 4.1: Comparative anatomy of vertebrates (3) ZOC 4.1(P): Comparative anatomy of vertebrates (1) ZOC 4.2: Animal physiology: controlling and coordinating systems (3) ZOC 4.2(P): Animal physiology: controlling and coordinating systems (1) ZOC 4.3: Biochemistry of metabolic processes (3) ZOC 4.3(P): Biochemistry of metabolic processes (1)	ZOM 4: Animal Physiology-I (3) ZOM 4(P): Animal Physiology-I (1)		ZOS 4: Pisciculture (2)	AEC 3: Poetry, Prose and Short stories	VAC-3 (2) Work Ethics	22
Exit option with Undergraduate Diploma (88 Credits)							**88**
V	ZOC 5.1: Molecular Biology (3) ZOC 5.1(P): Molecular Biology (1) ZOC 5.2: Biostatistics (3) ZOC 5.2(P): Biostatistics (1) ZOC 5.3: Animal physiology: life sustaining systems (3) ZOC 5.3(P): Animal physiology: life sustaining systems (1)	ZOM 5: Animal physiology II (3) ZOM 5(P): Animal physiology II (1)		ZOS 5: Food, Nutrition and Health (2)	AEC 4: Novel and Drama	VAC (2) India through the ages	22
VI	ZOC 6.1: Developmental Biology (3) ZOC 6.1(P): Developmental Biology (1) ZOC 6.2: Evolutionary Biology (3) ZOC 6.2(P): Evolutionary Biology (1) ZOC 6.3: Immunology (3) ZOC 6.3(P): Immunology (1) ZOC 6.4: Principles of Genetics (3) ZOC 6.4 (P): Principles of Genetics (1)	ZOM 6: Reproductive biology of animals (3) ZOM 6(P): Reproductive biology of animals (1)		ZOS 6: Medical Diagnostics (2)			22
Exit option with Bachelor of Science, B.Sc. Zoology (132 Credits)-UG Degree							**132**

Semester	Major or Core Paper (4 credits each)	Interdisciplinary Minor Paper (4 credits each)	Multidisciplinary course (4 credits each)	Skill Enhancement courses (SEC) OR Internship/ Apprenticeship/Project/Community Outreach (2 credits each)	Research Project/ Dissertation (12 Credits) OR 3 Theory Papers (12 Credits)	Total Credits
VII	ZOC 7.1: Reproductive biology (3) ZOC 7.1(P): Reproductive biology (1) ZOC 7.2: Endocrinology (3) ZOC 7.2(P): Endocrinology (1) RM 7: Research Methodology (3) RM 7(P): Research Methodology (1)	ZOM 7: Introductory endocrinology (3) ZOM 7(P): Introductory endocrinology (1) ZOM 8: Basics of Immunology (3) ZOM 8(P): Basics of Immunology (1)			Research Project/ Dissertation will start	20
VIII	ZOC 8.1: Biology of Insecta (3) ZOC 8.1(P): Biology of Insecta (1)	ZOM 9: Insect vectors and diseases (3) ZOM 9 (P): Insect vectors and diseases (1)			Research Project/Dissertation in major (12) **OR** ZOM 10: Animal Diversity (3) ZOM 10(P): Animal Diversity (1) ZOC 8.2: Parasitology (3) ZOC 8.2 (P): Parasitology (1) ZOC 8.3: Fish and Fisheries (3) ZCC 8.3 (P): Fish and Fisheries (1)	20
Bachelor of Science, B.Sc. Zoology (Honours) with Research (172 Credits)						**172**

TITLES FOR THEORY AND PRACTICAL PAPERS WITH CREDIT POINTS SEMESTER WISE

SEMESTER	COURSES OPTED	PAPER CODE	COURSE NAME	CREDIT(S)	TOTAL CREDITS
I	DSC-1	ZOC-1.1	Techniques in Biology	3	22
	DSC-1 Practical	ZOC-1.1(P)		1	
	DSC-2	ZOC-1.2	Non-chordates 1: Protista to Pseudocoelomates	3	
	DSC-2 Practical	ZOC-1.2(P)		1	
	IDM 1	ZOM 1	Biology of non-chordates I	3	
	IDM 1 Practical	ZOM 1(P)		1	
	MDC 1	MDC 1	Environmental Studies	4	
	AEC-1	AEC 1	English Communication	2	
	SEC-1	ZOS 1	Bee Keeping and its Management	2	
	VAC-1	VAC 1	Constitutional Values	2	
II	DSC-3	ZOC-2.1	Non-Chordates II: Coelomates	3	22
	DSC-3 Practical	ZOC-2.1(P)		1	
	DSC-4	ZOC-2.2	Cell Biology	3	
	DSC-4 Practical	ZOC-2.2(P)		1	
	IDM-2	ZOM 2	Biology of non-chordates II	3	
	IDM-2 Practical	ZOM 2 (P)		1	
	MDC 2	MDC 2	Programming using python	4	
	AEC-2	AEC 2	Basic Functional English	2	
	SEC-2	ZOS 2	Introduction to Vermiculture	2	
	VAC-2	VAC 2	Consumer Rights	2	
Undergraduate Certificate in Zoology				44	
III	DSC-5	ZOC-3.1	Diversity of Chordates	3	22
	DSC-5 Practical	ZOC-3.1(P)		1	
	DSC-6	ZOC-3.2	Principles of Ecology	3	
	DSC-6 Practical	ZOC-3.2(P)		1	
	DSC-7	ZOC-3.3	Fundamentals of Biochemistry	3	
	DSC-7 Practical	ZOC-3.3(P)		1	
	IDM-3	ZOM 3	Life of Chordates	3	
	IDM-3 Practical	ZOM 3 (P)		1	
	MDC-3	MDC 3	Intellectual Property Rights	4	
	SEC-3	ZOS 3	Sericulture	2	
IV	DSC-8	ZOC-4.1	Comparative Anatomy of Vertebrates	3	22
	DSC-8 Practical	ZOC-4.1(P)		1	
	DSC-9	ZOC-4.2	Animal Physiology: Controlling and coordinating systems	3	
	DSC-9 Practical	ZOC-4.2(P)		1	
	DSC-10	ZOC-4.3	Biochemistry of Metabolic Processes	3	
	DSC-10 Practical	ZOC-4.3(P)		1	
	IDM 4	ZOM 4	Animal physiology-I	3	
	IDM 4 Practical	ZOM 4 (P)		1	
	AEC-3	AEC 3	Poetry, Prose and Short stories	2	

	SEC-4	ZOS 4	Pisciculture	2	
	VAC-3	VAC 3	Work Ethics	2	
Undergraduate Diploma in Zoology				88	
V	DSC-11	ZOC-5.1	Molecular Biology	3	22
	DSC-11 Practical	ZOC-5.1(P)		1	
	DSC-12	ZOC-5.2	Biostatistics	3	
	DSC-12 Practical	ZOC-5.2(P)		1	
	DSC-13	ZOC-5.3	Animal physiology: Life sustaining systems	3	
	DSC-13 Practical	ZOC-5.3(P)		1	
	IDM 5	ZOM 5	Animal Physiology-II	3	
	IDM 5 Practical	ZOM 5 (P)		1	
	AEC 4	AEC 4	Novel and Drama	2	
	SEC 5	ZOS 5	Food, Nutrition and Health	2	
	VAC 4	VAC 4	India through the ages	2	
VI	DSC-14	ZOC 6.1	Developmental Biology	3	22
	DSC-14 Practical	ZOC-6.1(P)		1	
	DSC-15	ZOC-6.2	Evolutionary Biology	3	
	DSC-15 Practical	ZOC-6.2(P)		1	
	DSC-16	ZOC-6.3	Immunology	3	
	DSC-16 Practical	ZOC-6.3(P)		1	
	DSC-17	ZOC-6.4	Principles of Genetics	3	
	DSC-17 Practical	ZOC-6.4(P)		1	
	IDM 6	ZOM 6	Reproductive biology of animals	3	
	IDM 6 Practical	ZOM 6 (P)		1	
	SEC 6	ZOS 6	Medical Diagnostics	2	
Bachelor of Science (Zoology)				132	
VII	DSC-18	ZOC-7.1	Reproductive biology	3	20
	DSC-18 Practical	ZOC-7.1(P)		1	
	DSC-19	ZOC-7.2	Endocrinology	3	
	DSC-19 Practical	ZOC-7.2(P)		1	
		RM-7	Research Methodology	3	
		RM-7(P)		1	
	IDM 7	ZOM 7	Introductory Endocrinology	3	
	IDM 7 Practical	ZOM 7(P)		1	
	IDM 8	ZOM 8	Basics of Immunology	3	
	IDM 8 Practical	ZOM 8(P)		1	
			Start of Research dissertation		
VIII	DSC-20	ZOC-8.1	Biology of Insecta	3	20
	DSC-20 Practical	ZOC-8.1(P)		1	
	DSC-21 (Optional)	ZOC-8.2	Parasitology	3	
	DSC-21 Practical	ZOC-8.2(P)		1	
	DSC-22 (Optional)	ZOC-8.3	Fish and Fisheries	3	
	DSC-22Practical	ZOC-8.3(P)		1	
	IDM 9	ZOM 9	Insect vectors and diseases	3	
	IDM 9 Practical	ZOM 9 (P)		1	
	IDM 10 (Optional)	ZOM 10	Animal Diversity	3	
	IDM 10	ZOM 10(P)		1	

			Dissertation on Major	12	
Bachelor of Science (Zoology with Research)				172	

DISCIPLINE SPECIFIC COURSES (DSC)

DSC 1	ZOC 1.1	Techniques In Biology
DSC 2	ZOC 1.2	Non-Chordates I: Protista to Pseudocoelomates
DSC 3	ZOC 2.1	Non-Chordates II: Coelomates
DSC 4	ZOC 2.2	Cell Biology
DSC 5	ZOC 3.1	Diversity Of Chordates
DSC 6	ZOC 3.2	Principles Of Ecology
DSC 7	ZOC 3.3	Fundamentals of Biochemistry
DSC 8	ZOC 4.1	Comparative Anatomy of Vertebrates
DSC 9	ZOC 4.2	Animal Physiology: Controlling and Coordinating Systems
DSC 10	ZOC 4.3	Biochemistry Of Metabolic Processes
DSC 11	ZOC 5.1	Molecular Biology
DSC 12	ZOC 5.2	Biostatistics
DSC 13	ZOC 5.3	Animal Physiology: Life Sustaining Systems
DSC 14	ZOC 6.1	Developmental Biology
DSC 15	ZOC 6.2	Evolutionary Biology Parasitology
DSC 16	ZOC 6.3	Immunology
DSC 17	ZOC 6.4	Principles Of Genetics
DSC 18	ZOC 7.1	Reproductive Biology
DSC 19	ZOC 7.2	Endocrinology
DSC 20	ZOC 8.1	Biology of Insecta
DSC 21	ZOC 8.2 (Optional)	Parasitology
DSC 22	ZOC 8.3 (Optional)	Fish and Fisheries
	RM 7	Research Methodology

INTER DISCIPLINARY MINOR PAPERS (IDM)

IDM 1	ZOM 1	Biology of non-chordates I
IDM 2	ZOM 2	Biology of non-chordates II
IDM 3	ZOM 3	Life of Chordates
IDM 4	ZOM 4	Animal Physiology-I
IDM 5	ZOM 5	Animal Physiology-II
IDM 6	ZOM 6	Reproductive biology of animals
IDM 7	ZOM 7	Introductory Endocrinology
IDM 8	ZOM 8	Basics of Immunology
IDM 9	ZOM 9	Insect vectors and diseases
IDM 10	ZOM 10 (Optional)	Animal diversity

SKILL ENHANCEMENT COURSES

SEC-1	ZOS 1	Bee-Keeping and Its Management
SEC-2	ZOS 2	Introduction to Vermiculture
SEC-3	ZOS 3	Sericulture
SEC-4	ZOS 4	Pisciculture
SEC-5	ZOS 5	Food, nutrition and health
SEC-6	ZOS 6	Medical diagnostics

MULTIDISCIPLINARY/INTRODUCTORY COURSES

SEMESTER	PAPER CODE	TITLE OF THE PAPER	CREDITS
I	MDC-1	Environmental Studies	4
II	MDC-2	Programming using python	4
III	MDC-3	Intellectual Property Rights (IPR)	4

VALUE ADDED COURSES (VAC)

SEMESTER	PAPER CODE	TITLE OF THE PAPER	CREDITS
I	VAC 1	Constitutional Values	2
II	VAC 2	Consumer Rights	2
IV	VAC 3	Work Ethics	2
V	VAC 4	India through the ages	2

Discipline Specific Core Courses

NAME OF THE PAPER (CODE) **: Techniques in Biology (ZOC 1.1)**
Number of Credit **: 03**
Number of Hours of Lecture **: 45**

COURSE OBJECTIVES (COs):

The following are the Course Objectives (COs) for the paper **Techniques in Biology**:

CO1:	To create awareness among students the working of various tools & techniques used in biological systems and gives them insight about their use in research.
CO2:	To be well versed with histological methods.
CO3:	To learn about different separation techniques for various biomolecules.
CO4:	To study and understand the techniques used to collect sequence and expression of data.
CO5:	To gain knowledge about bioinformatics and its applications.

COURSE SPECIFIC OBJECTIVES (CSOs)

Unit & Title	Unit Contents	Course specific outcome (CSOs)	Lecture Hours	Marks	LOs
UNIT 1 Instrumentation	Microscopy: Light, phase-contrast, fluorescent and electron microscopy. Spectrophotometry: Spectroflourometry, spectroscopy.	**CSO 1.1:** To learn about different parts of microscope. (U) **CSO 1.2:** To learn and understand the working of light microscope. (K+U) **CSO 1.3:** To learn and understand the working of phase-contrast microscope. (K+U) **CSO 1.4:** To learn and understand the working of flourescent microscope. (K+ U) **CSO 1.5:** To learn and understand the working of electron microscope. (K+U) **CSO 1.6:** To understand and demonstrate the principle and basics of spectrophotometry. (U+ A) **CSO 1.7:** To understand the working and applications of spectroflourometry. (U+A) **CSO 1.8:** To understand the working and applications of spectroscopy. (U+A)	**8**	**18**	

Unit 2 Histological methods	Methods in Cell Biology: Cell and tissue culture. Principle and application of tracer techniques: Autoradiography, radioimmunoassay. Immunological techniques: Immunodiffusion, immunoelectrophoresis.	**CSO 2.1:** To define and understand tissue culture. **CSO 2.2:** To learn about plant tissue culture, its different types, the steps involved and its uses. (K+U) **CSO 2.3:** To learn about animal tissue culture, its different types, the steps involved and its applications. (K+U+A) **CSO 2.4:** To gain knowledge on autoradiography, principle, its procedure and applications. (K+U+A) **CSO 2.5:** To gain knowledge on radioimmunoassay, principle, its procedure, result interpretation and applications. (K+U+A) **CSO 2.6:** To gain knowledge on immunological techniques, its types, its procedure, result interpretation and applications. (K+U+A) **CSO 2.7:** To gain knowledge on immunodiffusion test, its types, advantages and applications. (K+U+A) **CSO 2.8:** To gain knowledge on immune-electrophoresis, its principle, procedure, advantages and applications. (K+U+A)	**8**	**18**	
Unit 3 Separation techniques	Chromatography: Adsorption, ion-exchange, gel filtration, affinity and high-performance liquid chromatography (HPLC). Electrophoresis: Isoelectrophoresis and pulse field electrophoresis.	**CSO 3.1:** To understand different types of chromatography. (K+U) **CSO 3.2:** To gain knowledge on the working principle of different types of chromatography. (K+U) **CSO 3.3:** To learn about the application of different types of chromatography. (A) **CSO 3.4:** To understand the	**10**	**22**	

	Tissue processing and separation of various sub-cellular organelles by centrifugation.	principle and demonstrate the mechanism of electrophoresis. (U+A) **CSO 3.5:** To learn, understand and the use of different types of media used in electrophoresis. (K+U) **CSO 3.6:** To gain knowledge on the clinical applications of electrophoresis. (A) **CSO 3.7:** To gain knowledge on principle and objectives of centrifugation. (K+U) **CS0 3.8:** To understand the different parts and the process of centrifuge. (K+U) **CSO 3.9:** To understand the principle and demonstrate the mechanism of tissue processing. (U) **CSO 3.10:** To gain knowledge on the working and applications of Centrifugation. (U+A)			
Unit 4 Molecular biology techniques	Blotting Technique: Southern, Northern and Western blotting. Sequencing of nucleic acids. Polymerase chain reaction (PCR).	**CSO 4.1:** To gain knowledge on different blotting techniques used in biotechnology. (K+U) **CSO 4.2:** To learn the about southern blotting, its principle, procedure, applications and advantages. (K+U+A) **CSO 4.3:** To learn the about northern blotting, its principle, procedure, applications and advantages. (K+U+A) **CSO 4.4:** To learn the about western blotting, its principle, procedure, applications and advantages. (K+U+A) **CSO 4.5:** To be able to differentiate which techniques to be used for	**10**	**22**	

		different biomolecules. (A) **CSO 4.6:** To learn about DNA sequencing and its applications. (K+A) **CSO 4.7:** To gain knowledge and learn on different types of DNA sequencing methods. (K+U) **CSO 4.8:** To learn about the different applications of different DNA sequencing methods. (A) **CSO 4.9:** To define, explain and learn the objectives of Polymerase chain reaction (PCR) (K+U) **CSO 4.10:** To learn about the principle, components and types of PCR. (K) **CSO 4.11:** To learn about the process, advantages and applications of PCR. (U+A)			
Unit 5 Bioinformatis	Introduction to bioinformatics: Database concepts and biological databases (NCB, EBI and DDBJ). Information retrieval and sequence alignment (BLAST and FASTA). Database submission.	**CSO 5.1:** To discuss and learn the concept of bioinformatics. (K+U) **CSO 5.2:** To discuss and learn and gain information on aims, goals and applications of bioinformatics. (U+A) **CSO 5.3:** To learn the concepts of database, GenBank, EMBL, DDBJ. (K) **CSO 5.4**: To discuss the applications of primary databases, (A) **CSO 5.5:** To learn about the concept of FASTA programs, (K+U) **CSO 5.6:** To gain knowledge on the working of FATS and the statistical significance and applications. (K+U+A) **CSO 5.7:** To learn the concept of BLAST, its working and types. (K+U) **CSO 5.8:** To gain	**9**	**20**	

		information on the characteristic features and applications of BLAST. (U+A) **CSO 5.9:** To learn the concept of Database submission. (K) **CSO 5.10:** To learn about the goals and roles of NCBI. (K) **CSO 5.11:** To gain information on sequence submission tools. (K+U)			

NAME OF THE PAPER, CODE : Techniques in Biology, ZOC 1.1 (P)
Number of Credit : 01
Number of Hours of Lecture : 30

PRACTICAL **50 Marks**

1. Use of different types of microscopes: Simple, Compound and light microscope.
2. Demonstration of Agarose gel electrophoresis.
3. Estimation of certain biomolecules using spectrophotometry.
4. Identification or separation of amino acids using paper chromatography.
5. Retrieval of DNA sequences.

SUGGESTED READINGS:

1. Wilson K and Walker J (2010) Principles and Techniques of Practical Biochemistry, Cambridge University Press.
2. Nelson and Cox (2013) Lehninger, Principles of Biochemistry, 6th Edn.
3. Plummer D.T. (2008) Introduction to Practical Biochemistry, 3rd Edn., Tata McGraw Hill.
4. Hayat M.A (2000) Principle and Techniques of Electron Microscopy: Biological Application, 4th Edn. Maniatis T et al. (1982) Molecular Cloning. A Laboratory Manual. Cold Spring.

NAME OF THE PAPER (CODE) : **NON-CHORDATES I: PROTIST TO PSEUDOCOELOMATES (ZOC 1.2)**

Number of Credit : **03**

Number of Hours of Lecture : **45**

COURSE OBJECTIVES (COs)

The following are the Course Objectives (COs) for the paper **Non-chordates I: protist to pseudocoelomates**:

CO 1	Learn about various aspects of Protista and Parazoa
CO 2	Understand about Porifera world
CO 3	To classify and understand Cnidaria
CO 4	To inculcate among the students about classification, characters and pathogenicity of Platyhelminthes.
CO 5	To inculcate among the students about classification, characters and parasitic adaptation of Nemathelminths.

COURSE SPECIFIC OBJECTIVES (CSOs)

Unit & Title	Unit Contents	Course Specific Objective (CSOs)	Lecture Hours	Marks	LOs
Unit 1: Protista and Parazoa	General characteristics and classification up to classes; Study of Euglena, Amoeba and Paramecium. Life-cycle and pathogenicity of Plasmodium vivax. Nutrition, Locomotion and Reproduction in Protista.	**CSO 1.1**: To explain the general characteristics of Protista and Parazoa. (U) **CSO 1.2:** To classify Protista and Parazoa up to classes. (U) **CSO 1.3:** To explain about Euglena. (U) **CSO 1.4:** To explain about Amoeba. (U) **CSO 1.5:** To explain about Paramecium. (U) **CSO 1.6:** To explain about the Life-cycle and pathogenicity of *Plasmodium vivax*. (U) **CSO 1.7**: To understand about Nutrition in Protista. (U) **CSO 1.8:** To explain Locomotion in Protista. (U) **CSO 1.9:** To describe about Reproduction in Protista. (K)	**14**	**30**	
Unit 2: Porifera	General characteristics and classification up to classes; Canal system and spicules in sponges (Sycon)	**CSO 2.1:** To explain about the general characteristics and classification of Porifera up to classes;(U) **CSO 2.2:** To explain about the different types Canal system (U) **CSO 2.3**: To define Spicules and	**7**	**16**	

		explain the different types of spicules in sponges (K+U) **CSO 2.4:** To illustrate the economic importance of sponges. (A)			
Unit 3: Cnidaria	General characteristics and classification up to classes; Polymorphism in Cnidaria Corals and Coral reefs	**CSO 3.1:** To explain about the general characteristics and classification of Cnidaria up to classes (U) **CSO 3.2:** To explain abou Polymorphism in Cnidaria. (U) **CSO 3.3:** To define Corals and Coral reefs. (K) **CSO 3.4:** To explain the different types of coral reefs (U) **CSO 3.5:** To illustrate the economic importance of Coral reefs in everyday life. (A)	**9**	**20**	
UNIT-4: Platyhelminthes	General characteristics and classification up to orders; Life-cycle and pathogenicity of Fasciola hepatica	**CSO 4.1**: To explain about general characteristics and classification of Platyhelminthes up to orders(U) **CSO 4.2:** To explain about the Life-cycle of *Fasciola hepatica.* (U) **CSO 4.3**: To explain about pathogenicity of *Fasciola hepatica*. (U)	**6**	**14**	
Unit 5: Nemathelminthes	General characteristics and classification up to classes; Life-cycle and pathogenicity of Ascaris lumbricoides Parasitic adaptation in helminthes.	**CSO 5.1:** To explain about the general characteristics and classification of Nemathelminthes up to classes (U) **CSO 5.2:** To explain about the Life-cycle of *Ascaris lumbricoides (U)* **CSO 5.3:** To explain about th Parasitic-adaptation in helminthes (U) **CSO 5.4:** To explain about th pathogenicity of *Ascari lumbricoides (U)*	**9**	**20**	

NAME OF THE PAPER, CODE : NON-CHORDATES I: PROTIST TO PSEUDOCOELOMATES, ZOC 1.2 (P)
Number of Credit : 01
Number of Hours of Lecture : 30

PRACTICALS **50 Marks**

1. Study of whole mount of Euglena, Amoeba and Paramecium, Binary fission and conjugation in Paramecium
2. Study of Sycon (T.S and L.S), Hyalonema, spongilla
3. Study of *Physalia, Millepora, Aurelia, Tubipora, Corallium, Alcyonium, Gorgonia, Metridium, Pennatula, Meandrina, Madrepora*
4. Study of adult *Fasciola hepatica* and their life-cycle (Slides/micro-photographs)
5. Study of *Ascaris lumbricoides* and its life stages (Slides/ micro-photographs)

SUGGESTED READINGS

1. Ruppert and Branes, R.D (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition.
2. Barnes, R.S.K., Calow, P., Olive, P. J. W., Golding, D.W. and Spicer, J.I. (2002)
3. E.L. JORDAN and P.S. VERMA Invertebrate Zoology.

NAME OF THE PAPER (CODE) : NON-CHORDATES II: COELOMATES (ZOC 2.1)
Number of Credit : 03
Number of Hours of Lecture : 45

COURSE OBJECTIVES (COs)

The following are the Course Objectives (COs) for the paper **Non-chordates II: coelomates:**

CO 1	To help students understand the meaning of Coelomates and its Evolution
CO 2	To make students understand the differences between Excretion and Locomotion in Annelida.
CO 3	To learn about the social life of different insects
CO 4	To make students aware about the characteristics and morphological features of diverse animals.
CO 5	To make students understand the different types of water-vascular systems in Echinodermata.

COURSE SPECIFIC OBJECTIVES (CSOs)

Unit & Title	Unit Contents	Course Specific Objective (CSOs)	Lecture Hours	Marks	LOs
Unit 1: Introduction to Coelomates	Evolution of Coelom and Metamerism.	**CSO 1.1:** To explain about Evolution of Coelom(U) **CSO 1.2:** To explain about Metamerism (U)	4	10	
Unit 2: Annelida	General Characteristics and classification up to classes; Excretion and locomotion in Annelida.	**CSO 2.1:** To explain about the general Characteristics and classification of Annelida up to classes. (U) **CSO 2.2:** To explain about Excretion in Annelida (U) **CSO 2.3:** To explain about locomotion in Annelida (U)	6	14	
Unit 3: Arthropoda	General characteristics and classification up to classes; Respiration in Arthropoda Metamorphosis in Insects; Social life in Bees and Termites.	**CSO 3.1:** To explain about the general characteristics and classification of Arthropoda up to classes. (U) **CSO 3.2:** To explain about respiration in Arthropoda (U) **CSO 3.3:** To explain about metamorphosis in Insects (U) **CSO 3.4:** To explain about social life in Bees(U) **CSO 3.5:** To study about social life of Termites. (U)	12	26	
Unit 4: Mollusca	General characteristics and classification up to classes;	**CSO 4.1:** To explain about general characteristics and classification up to classes(U) **CSO 4.2:** To explain about respiration in Mollusca (U)	14	30	

	Respiration in Mollusca Torsion and Detorsion in Gastropods Pearl formation in Bivalves	**CSO 4.3:** To explain about Torsion and Detorsion in Gastropods (U) **CSO 4.4:** To explain about Pearl formation in Bivalves (U)			
Unit 5: Echinodermata	General characteristics and classification up to classes; Water- vascular system in Asteroidea Larval forms in Echinodermata.	**CSO 5.1:** To explain about the general characteristics and classification of Echinodermata up to classes. (U) **CSO 5.2:** To define Water-vascular system in Asteroidea and its functions. (K) **CSO 5.3:** To study the different types of water-vascular system in Asteroidea. (U) **CSO 5.4:** To explain about Larval forms in Echinodermata. (U)	9	20	

NAME OF THE PAPER, CODE : NON-CHORDATES II: COELOMATES, ZOC 2.1 (P)
Number of Credit : 01
Number of Hours of Lecture : 30

PRACTICAL **50 Marks**

1. Study of following specimens:
   Annelids- *Aphrodite, Nereis, Heteronereis, Sabella, Serpula, Chaetopterus, Pheritima, Hirudinaria*
   Arthropoda- *Limulus, Palamnaeus, Palaemon, Balanus, Sacculina, Scolopendra, Julus, Peripatus.*
   Mollusca- *Chiton, Dentalium, Pila, Doris, Helix, Unio, Pinctada, Sepia, Nautilus*
   Echinodermates- *Pentaceros/Asterias, Clypeaster, Echinus, Cucumaria and Antedon*
2. Study of digestive system, Septal nephridia and pharyngeal nephridia of earthworm
3. T.S. through pharynx, gizzard, and typhlosolar intestine of earthworm

SUGGESTED READINGS

1. Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition
2. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates; A New Synthesis, III Edition, Blackwell Science
3. Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson

NAME OF THE PAPER : Cell Biology (ZOC 2.2)
Number of Credit : 03
Number of Hours of Lecture : 45

COURSE OBJECTIVES (COs):

The following are the Course Objectives (COs) for the paper **Cell Biology**:

CO1:	To gain an overview of cells and their origin and evolution.
CO2:	To learn and understand the structure and functions of important cell organelles.
CO3:	To help understand the structure and function and molecular organization of nucleic acids.
CO4:	To learn about the structural organisation of mitochondria and its importance in cellular respiration.
CO5:	Students will understand the cellular components underlying mitotic cell division. · It will also help the students to understand the functions of cellular organelles, the cellular basis of differentiation and signalling between and within the cells.

COURSE SPECIFIC OBJECTIVES (CSOs)

Unit & Title	Unit Contents	Course specific outcome (CSOs)	Lecture Hours	Marks	LOs
Unit 1: Overview of Cells and Plasma Membrane	Prokaryotic and Eukaryotic cells, Virus and PPLOs; Various models of plasma membrane structure; Transport across membranes: Active, Passive and Facilitated Transport; Cell junctions: Tight junctions, Desmosomes, Gap junctions	**CSO 1.1:** To define and learn about cell. (K) **CSO 1.2:** To differentiate between Prokaryotic and Eukaryotic cells. (K+U) **CSO 1.3:** To study the different components of prokaryotic cells. (K) **CSO 1.4:** To learn about the different components of eukaryotic cells. (K) **CSO 1.5:** To understand the structure and function of PPLOs. (K+U) **CSO 1.6:** To learn and understand about the structure and functions of viroids and viruses. (K+U) **CSO 1.7:** To learn about plasma membrane and its different models. (K+U) **CSO 1.8:** To learn the concept of how molecules are transported across membranes. (K+U) **CSO 1.9:** To gain knowledge on active and passive transport and their types. (K+U) **CSO 1.10:** To learn about different types of junctions in	9	20	

		cells, structure and how they function. (K+U)			
Unit 2: Endomembrane	Structure and Functions: Endoplasmic Reticulum, Golgi Apparatus and Lysosomes	**CSO 2.1:** To gain information about endoplasmic reticulum. (K) **CSO 2.2:** To understand the structure of endoplasmic reticulum. (U) **CSO 2.3:** To learn about the different types of ER. (K+U) **CSO 2.4:** To understand the different functions of ER. (K+U) **CSO 2.5:** To gain information about golgi apparatus. (K) **CSO 2.6:** To understand the structure of Golgi apparartus. (K+U) **CSO 2.7:** To learn about the different forms of golgi appararus. (K+U) **CSO 2.8:** To understand the different functions of golgi apparatus. (K+U). **CSO 2.9:** To define and learn about lysosomes. (K) **CSO 2.10:** To understand the structure of lysosomes and how they are synthesised. (U) **CSO 2.11:** To learn about the different functions of lysosomes. (K+U)	9	20	
Unit 3: Mitochondria, Peroxisomes and Cytoskeleton	Mitochondria: Structure, Semi-autonomous nature; Mitochondrial Respiratory Chain, Chemiosmotic hypothesis; Peroxisome Structure and Functions: Microtubules, Microfilaments and Intermediate filaments	**CSO 3.1:** To learn about the structural organisation of mitochondria. (K) **CSO 3.2:** To understand the different functions of mitochondria. (U) **CSO 3.3**: To learn the concept of semi-autonomous nature of mitochondria. (U) **CSO 3.4:** To learn about endosymbiotic theory and the different evidences supporting it. (K+U) **CSO 3.5:** To learn the concept of mitochondrial respiratory chain. (U)	9	20	

		CSO 3.6: To understand the different enzyme complexes involved in electron transport. (U) **CSO 3.7:** To learn the concept of chemisosmosis. (K+U) **CSO 3.8:** To learn about the structure and function of peroxisomes. (K+U) **CSO 3.9:** To gain knowledge on the different components of cytoskeleton. (K) **CSO 3.10:** To learn about the structure and functions of microfilament, IF and microtubules. (K+U)			
Unit 4: Nucleus	Structure of Nucleus: Nuclear envelope, Nuclear Pore Complex, Nucleolus Chromatin: Euchromatin and Heterochromatin and packaging (nucleosome)	**CSO 4.1:** To learn about the concept of nucleus and its composition. (K+U) **CSO 4.2:** To learn and understand the structure of nuclear envelope. (U) **CSO 4.3:** To learn about the structure of nuclear lamina and its functions. (K+U) **CSO 4.4:** To gain knowledge on the structure. (K) **CSO 4.5:** To understand about the different functions of nuclear pores. (K+U) **CSO 4.6:** To learn about nucleoplasm and its components. (K+U) **CSO 4.7:** To learn and understand the concept of packaging of genetic material inside the nucleus. (K+U) **CSO 4.8:** To differentiate between hetrochromatin and euchromatin. (U)	9	20	
Unit 5: Cell Division and Cell Signalling	Mitosis, Meiosis, Cell cycle and its regulation; GPCR and Role of second messenger (cAMP)	**CSO 5.1:** To learn the concept of mitosis, meiosis and cell cycle. (K) **CSO 5.2:** To gain information on mitosis and its functions. (K+U) **CSO 5.3:** To learn about interkinesis and the various stages involved and its	9	20	

		significance. (K+U+A) **CSO 5.4:** To learn about the various stages of mitosis. (K+U) **CSO 5.5:** To gain information on the cytokinesis and how they occur in plants and animal cells. (K+U) **CSO 5.6:** To learn the process of meiosis, the different stages involved. (K+U) **CSO 5.7:** To gain knowledge on the significance of meiosis. (K+U) **CSO 5.8:** To understand cell cycle and the stages involved. (K+U) **CSO 5.9:** To learn the concept of regulation of cell cycle and its importance. (U+A) **CSO 5.10:** To learn about cell signalling and the different receptors associated with it. (U+A) **CSO 5.11:** To the learn the concept of cAMP as a second messenger. (U+A)			

NAME OF THE PAPER, CODE : Cell Biology, ZOC 2.2 (P)
Number of Credit : 01
Number of Hours of Lecture : 30

PRACTICAL **50 Marks**

1. Preparation of temporary stained squash of onion root tip to study various stages of mitosis.
2. Study of bacterial cell structure, shape and arrangement using micrographs.
3. Study of permanent slides of various stages of meiosis.
4. Study of eukaryotic and prokaryotic cells using micrographs or models.
5. Preparation of permanent slide to show the presence of Barr body in human female blood cells/cheek cells.
6. Study of the different cell organelles using micrographs.

SUGGESTED READINGS

1. Karp, G. (2010). *Cell and Molecular Biology: Concepts and Experiments*. VI Edition. John Wiley and Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). *Cell and Molecular Biology*. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. (2009). *The Cell: A Molecular Approach*. V Edition. ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA.

NAME OF THE PAPER (CODE) : DIVERSITY OF CHORDATES (ZOC 3.1)
Number of Credit : 03
Number of Hours of Lecture : 45

COURSE OBJECTIVES (COs)

The following are the Course Objectives (COs) for the paper **Diversity of chordates**:

CO 1	To provide scope and historical background of chordates.
CO 2	To impart knowledge regarding basic concepts of origin of chordates and to make the students understand the characteristics and classification of animals with notochord.
CO 3	To help the students differentiate between Pisces and Amphibian.
CO 4	To help the students differentiate between Reptiles and Aves
CO 5	To create interest among students by understanding various mechanisms involved in thriving survival of the animals within their geographical realms.

COURSE SPECIFIC OBJECTIVES (CSOs)

Unit & Title	Unit Contents	Course Specific Objective (CSOs)	Lecture Hours	Marks	LOs
Unit 1: Introduction to chordates and Protochordata	General characteristics and outline classification of Chordates General characteristics of Hemichordata, Urochordata and Cephalochordata Study of larval forms in Protochordates	**CSO 1.1:** To explain about the general characteristics and outline classification of Chordates (U) **CSO 1.2:** To explain about the general characteristics of Hemichordata, **CSO 1.3:** To enumerate the general characteristics of Urochordata. (U) **CSO 1.4:** To enumerate the general characteristics of Cephalochordata. (U) **CSO 1.5:** To define Protochordates and explain about the larval forms in Protochordates. (K+U)	**9**	**20**	
Unit 2: Origin of Chordata and Agnatha	Echinoderm theory of origin of chordates; Advanced features of vertebrates over Protochordata; General characteristics and classification of Cyclostomes up to class.	**CSO 2.1:** To explain about Echinoderm theory of origin of chordates (U) **CSO 2.2:** To explain about advanced features of vertebrates over Protochordata (U) **CSO 2.3:** To explain about general characteristics and classification of Cyclostomes up to class (U)	**9**	**20**	
Unit 3: Pisces and Amphibia	General characteristics of Chondrichthyes and Osteichthyes, Classification up	**CSO 3.1:** To explain about general characteristics of Chondrichthyes and Osteichthyes and Classification up to orders. (U) **CSO 3.2:** To explain about	**9**	**20**	

	to orders; Migration, Osmoregulation and Parental care in Fishes. General characteristics and classification up to orders; Parental care in Amphibians.	Migration and its types in fishes. (U) **CSO 3.3:** To explain Osmoregulation in fishes. (u) **CSO 3.4:** To explain Parental care in Fishes. (U) **CSO 3.5:** To explain about general characteristics and classification of amphibia up to orders (U) **CSO 3.6:** To explain about Parental care in Amphibians (U)			
Unit 4: Reptilia and Aves	General characteristics and classification up to order; Poison apparatus and Biting mechanism in snakes. General characteristics and classification up to order; Flight adaptation and Migration in birds.	**CSO 4.1:** To explain about General characteristics and classification of Reptilia up to order. (U) **CSO 4.2:** To explain about Poison apparatus and Biting mechanism in snakes. (U) **CSO 4.3:** To explain about general characteristics and classification of Aves up to order (U) **CSO 4.4:** To explain about Flight adaptation in birds. (U) **CSO 4.5**: To explain about Migration in birds. (U)	**9**	**20**	
Unit 5: Mammals and Zoogeography	General characteristics and classification up to order; Affinities of Prototheria; Zoographical realms, Theories pertaining to distribution of animals, Continental drift theory, Distribution of vertebrates in different realms.	**CSO 5.1:** To explain about general characteristics and classification of Mammals. (U) **CSO 5.2:** To explain the Affinities with Prototheria. (U) **CSO 5.3:** To explain about Zoographical realms. (U) **CSO 5.4:** To explain the Theories pertaining to distribution of animals. (U) **CSO 5.5:** To explain Continental drift theory. (U) **CSO 5.6:** To explain the Distribution of vertebrates in different realms. (U)	**9**	**20**	

NAME OF THE PAPER, CODE : DIVERSITY OF CHORDATES, ZOC 3.1 (P)
Number of Credit : 01
Number of Hours of Lecture : 30

PRACTICALS **50 Marks**

1. **Protochordata:** *Balanoglossus, Herdmania,* Permanent slides of *Herdmania spicules*
2. **Agnatha:** Petromyzon, Myxine
3. **Fishes:** Scoliodon, Sphyrna, Pristis, Torpedo, Chimaera, Heteropneustes, Labeo, Hippocampus, Tetradon, Anabas
4. **Amphibia:** Ichthyophis, Necturus, Bufo, Hyla, Alytes, Salamandra
5. **Reptilia:** Chelone, Hemidactylus, Varanus, Bungarus, Vipera, Naja, Identification of poisonous and non-poisonous snakes
6. **Aves:** Study of six common birds from different orders. Types of beaks and claws
7. **Mammalia:** Sorex, Funambulus, Loris, Herpestes, Erinaceous.

SUGGESTED READINGS:

1. Young, J.Z. (2004). The life of Vertebrates III Edition. Oxford university press.
2. Pough H. Vertebrate life, VIII Edition, Pearson International.
3. Diversity of Chordata First Edition by Manideep Raj

NAME OF THE PAPER (CODE) : PRINCIPLES OF ECOLOGY (ZOC-3.2)
Number of Credit : 03
Number of Hours of Lecture : 45

COURSE OBJECTIVES (COs)

The following are the Course Objectives (COs) for the paper **Principles of ecology**:

CO 1:	To make the students aware of ecological history and various physical factors of ecology
CO 2:	To aid the students in the understanding of the population attributes and help them to analyze population dynamics.
CO 3:	To create an understanding among the students, the characteristics of community and how the climax community are formed.
CO 4:	To inculcate and create interest among students in the understanding of ecosystem and its importance.
CO 5:	To create an understanding among students, the applied zoology and make them aware about the management and conservation of biodiversity

COURSE SPECIFIC OBJECTIVES (CSOs)

Unit & Title	Unit Contents	Course Specific Objective (CSOs)	Lecture Hours	Marks	LOs
UNIT 1 Introduction to ecology (CO 1)	History of ecology, autecology and synecology, levels of organization, laws of limiting factors, study of physical factors.	**CSO 1.1:** to define the term Ecology (K) **CSO 1.2:** to understand the history of ecology. (U) **CSO 1.3:** to define autecology and synecology. (K) **CSO 1.4:** to explain autecology and synecology. (U) **CSO 1.5: t**o demonstrate the ecological levels of organization. (A) **CSO 1.6:** to define limiting factors. (K) **CSO 1.7:** to understand the laws of limiting factors. (U) **CSO 1.8:** to define physical factors. (K) **CSO 1.9:** to illustrate how various physical factors influence and effect ecosystem. (A)	9	20	
UNIT 2 Population (CO 2)	Unitary and modular populations; Unique and	**CSO 2.1:** to define Unitary and modular populations. (K) **CSO 2.2:** to elaborate Unitary and modular populations. (U)	10	22	

	group attributes of population: density, natality, mortality, life tables, survivorship curves, age ratio, sex ratio, dispersion. Exponential and logistic growth, r and K strategies; Population regulation- density- dependent and independent factors; Population interactions	**CSO 2.3:** to explain Unique and group attributes of population. (U) **CSO 2.4:** to examine natality and understand how it effects population. (A) **CSO 2.5:** to explain Mortality. (U) **CSO 2.6:** to define life tables (K) **CSO 2.7:** to compare life tables of various organisms. (A) **CSO 2.8:** to discuss survivorship curves. (U) **CSO 2.9:** to understand dispersion. (U) **CSO 2.10:** to analyse the exponential and logistic growth. (A) **CSO 2.11:** to analyse the r and K strategies. (A) **CSO 2.12:** to discuss population regulation- density- dependent and independent factors. (U) **CSO 2.13:** to analyse population interactions.			
UNIT 3 Community	Community characteristics: species richness, dominance, diversity, abundance, vertical stratification, ecotone and edge effect. Ecological succession with one example; theories pertaining to climax community	**CSO 3.1:** to define community. (K) **CSO 3.2:** to explain Community characteristics. (U) **CSO 3.3:** to illustrate species richness. (A) **CSO 3.4:** to explain species dominance. (U) **CSO 3.5:** to compare species diversity. (A) **CSO 3.6:** to explain species abundance. (U) **CSO 3.7:** to interpret vertical stratification. (A) **CSO 3.8:** to explain ecotone and edge effect. (U) **CSO 3.9:** to relate ecological succession with one example. (A) **CSO 3.10:** to understand	8	18	

		theories pertaining to climax community. (U)			
UNIT 4 **Ecosystem**	Types of ecosystems with one example in detail. Food chain: Detritus and grazing food chains, linear and Y- shaped food chains. Food web; Energy flow through the ecosystem; Ecological pyramids. Nutrient and biogeochemical cycle with one example of nitrogen cycle	**CSO 4.1:** to define Ecosystem. (K) **CSO 4.2:** to explain types of ecosystems with one example in detail. (U) **CSO 4.3:** to illustrate Food chain: Detritus and grazing food chains. (A) **CSO 4.4:** to differentiate linear and Y- shaped food chains. (A) **CSO 4.5:** to understand Food web. (U) **CSO 4.6:** to demonstrate energy flow through the ecosystem. (A) **CSO 4.7:** to define ecological pyramid. (K) **CSO 4.8:** to explain the types of ecological pyramids. **CSO 4.9:** to interpret ecological pyramids. (A) **CSO 4.10:** to explain nutrient and biogeochemical cycle. (U) **CSO 4.11:** to illustrate nitrogen cycle. (A)	9	20	
UNIT 5 Applied Ecology	Ecology in wildlife conservation and management: types of wildlife management, elements of wildlife management, forms of wildlife management, bioethics, causes of extinction, IUCN Red Data Books, conservation and preservation, wildlife conservation projects, biodiversity	**CSO 5.1:** to define wildlife. (K) **CSO 5.2:** to discuss the importance of wildlife conservation and management. (U) **CSO 5.3:** to elaborate on types of wildlife management. (U) **CSO 5.4:** to explain the elements of wildlife management. (U) **CSO 5.5:** to determine the forms of wildlife management. (A) **CSO 5.6:** to discuss bioethics. (U) **CSO 5.7:** to enumerate the causes of extinction. (K) **CSO 5.8:** to explain IUCN Red Data Books. (U)	9	20	

	conservation in forest ecosystems.	**CSO 5.9:** to discuss about conservation and preservation of wildlife. (U) **CSO 5.10:** to illustrate wildlife conservation projects. (A) **CSO 5.11:** to generalise biodiversity conservation in forest ecosystems. (A)			

NAME OF THE PAPER, CODE : PRINCIPLES OF ECOLOGY, ZOC-3.2 (P)
Number of Credit : 01
Number of Hours of Lecture : 30

PRACTICAL 50 Marks

1. Determination of population density in a natural community by quadrate method and calculation of Shannon-Weiner diversity index for the same community.
2. Estimation of population size of unknown samples of *Tribolium* by mark-recapture method.
3. Study of life tables and plotting of survivorship curves of different types from the hypothetical data provided.
4. Study of an aquatic ecosystem: Phytoplankton and zooplankton, Measurement of area, temperature, penetration of light, determination of pH, Dissolved Oxygen content (Winkler's method) and free CO_2.
5. Report on a visit to National Park/Biodiversity Park/Wildlife sanctuary.

SUGGESTED READINGS:

1. Colin vaux, P.A. (1993). Ecology. II Edition. Wiley, John and Sons, Inc.
2. Krebs, C.J. (2001). Ecology.VI Edition. Benjamin Cummings.
3. Odum, E.P., (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole
4. Ricklefs, R.E., (2000). Ecology. V Edition. Chiron Pres

NAME OF THE PAPER (CODE) : FUNDAMENTALS OF BIOCHEMISTRY (ZOC-3.3)
Number of Credit : 03
Number of Hours of Lecture : 45

COURSE OBJECTIVES (COs)

The following are the Course Objectives (COs) for the paper **Fundamentals of Biochemistry**:

CO 1:	To inculcate in students about the structure and biological importance of carbohydrates.
CO 2:	To make the students aware of structure and significance of lipids.
CO 3:	To create an understanding among students, the structure, properties and function of amino acid and proteins.
CO 4:	To inculcate and create interest among students in the understanding of nucleic acids.
CO 5:	To create an understanding among students, the nomenclature and classification of enzymes and how to solve enzyme kinetics.

COURSE SPECIFIC OBJECTIVES (CSOs)

Unit & Title	Unit Contents	Course Specific Objective (CSOs)	Lecture Hours	Marks	LOs
UNIT 1 Carbohydrates (CO 1)	Structure and Biological importance: Monosaccharides, Disaccharides, Polysaccharides and Glycoconjugates	**CSO 1.1:** to define the term Carbohydrates (K) **CSO 1.2:** to understand the Structure of carbohydrates. (U) **CSO 1.3:** to discuss the biological importance of carbohydrates. (U) **CSO 1.4:** to illustrate the structure and function of Monosaccharides. (A) **CSO 1.5: t**o demonstrate the structure and function of disaccharides. (A) **CSO 1.6:** to demonstrate the structure and function of polysaccharides. (A) **CSO 1.7:** to define glycoconjugates. (K) **CSO 1.8:** to understand the structure of glycoconjugates. (U) **CSO 1.9:** to discuss the structure of glycoconjugates. (U)	**7**	16	
UNIT 2 Lipids (CO 2)	Structure and Significance: Physiologically important	**CSO 2.1:** to define the term Lipids. (K) **CSO 2.2:** to elaborate the structure of lipids. (U)	8	18	

	saturated and unsaturated fatty acids, Tri-acylglycerols, Phospholipids, Glycolipids, Steroids.	**CSO 2.3:** to explain the significance of lipids. (U) **CSO 2.4:** to generalise the physiological importance of saturated fatty acids. (A) **CSO 2.5:** to define unsaturated fatty acid. (K) **CSO 2.6:** to elaborate the physiological importance of saturated fatty acids. (U) **CSO 2.7:** to define Tri-acylglycerols. (K) **CSO 2.8:** to discuss the structure of Tri-acylglycerols. (U) **CSO 2.9:** to explain the function of Tri-acylglycerols. (U) **CSO 2.10:** to illustrate the structure and function of Phospholipids. (A) **CSO 2.11:** to illustrate the structure and function of Glycolipids. (A) **CSO 2.12:** to define steroids. (K) **CSO 2.13:** to elaborate the structure and function of steroids. (U)			
UNIT 3 Proteins (CO 3)	**Amino acids:** Structure, Classification and General properties of α-amino acids; Physiological importance of essential and non-essential α-amino acids. **Proteins:** Bonds stabilizing protein structure; Levels of organization in proteins; Introduction to simple and conjugate proteins.	**CSO 3.1:** to define protein. (K) **CSO 3.2:** to explain structure of amino acids. (U) **CSO 3.3:** to classify amino acids. (U) **CSO 3.4:** to explain the general properties of of α-amino acids. (U) **CSO 3.5:** to illustrate the Physiological importance of essential α-amino acids. (A) **CSO 3.6:** to illustrate the Physiological importance of non-essential α-amino acids. (A) **CSO 3.7:** to define bond stabilization. (K) **CSO 3.8:** to explain Bonds stabilizing protein structure.	10	22	

		(U) **CSO 3.9:** to demonstrate Levels of organization in proteins. (A) **CSO 3.10:** to discuss simple proteins. (U) **CSO 3.11:** to explain conjugate proteins. (U)			
UNIT 4 **Nucleic Acids (CO 4)**	Structure: Purines and pyrimidines, Nucleosides, Nucleotides, Nucleic acids Cot Curves: Base pairing, Denaturation and Renaturation of DNA Types of DNA and RNA, Complementarity of DNA. .	**CSO 4.1:** to define nucleic acids. (K) **CSO 4.2:** to explain the sstructures of purines and pyrimidines. (U) **CSO 4.3:** to illustrate the structure and importance of Nucleosides. (A) **CSO 4.4:** to illustrate the structure and importance of Nucleotides. (A) **CSO 4.5:** to illustrate the structure and importance of Nucleic acids. (A) **CSO 4.6:** to explain Cot Curves. (U) **CSO 4.7:** to discuss base pairing. (U) **CSO 4.8:** to define Denaturation and Renaturation of DNA. (K) **CSO 4.9:** to interpret Denaturation and Renaturation of DNA in its stability. (A) **CSO 4.10:** to explain the types of DNA and RNA. (U) **CSO 4.11:** to illustrate the complementarity of DNA. (A)	10	22	
UNIT 5 **Enzymes (CO 5)**	Nomenclature and classification; Cofactors; Specificity of enzyme action; Isozymes; Mechanism of enzyme action; Factors affecting rate of enzyme-catalysed reactions;	**CSO 5.1:** to define enzymes. (K) **CSO 5.2:** to elaborate on nomenclature of enzymes. (U) **CSO 5.3:** to explain the classification of enzymes. (U) **CSO 5.4:** to explain Cofactors. (U) **CSO 5.5:** to determine the Specificity of enzyme action. (A) **CSO 5.6:** to discuss	10	22	

	Derivation of Michaelis-Menten equation, Concept of Km and Vmax, Lineweaver-Burk plot; Enzyme inhibition; Allosteric enzymes and their kinetics; Regulation of enzyme action.	Isozymes. (U) **CSO 5.7:** to examine Mechanism of enzyme action. (A) **CSO 5.8:** to explain the Factors affecting rate of enzyme-catalysed reactions. (U) **CSO 5.9:** to derive of Michaelis-Menten equation. (A) **CSO 5.10:** to explain the Concept of Km and Vmax. (U) **CSO 5.11:** to construct Lineweaver-Burk plot to find out the type of enzyme inhibition. (A). **CSO 5.12:** to discuss Enzyme inhibition. (U) **CSO 5.13:** to demonstrate Allosteric enzymes and their kinetics. (A) **CSO 5.14:** to analyse the Regulation of enzyme action. (A)			

NAME OF THE PAPER, CODE : FUNDAMENTALS OF BIOCHEMISTRY, ZOC-3.3 (P)
Number of Credit : 01
Number of Hours of Lecture : 30

PRACTICAL **50 Marks**

1. Qualitative tests of functional groups in carbohydrates, proteins and lipids.
2. Paper chromatography of amino acids.
3. Action of salivary amylase under optimum conditions.
4. Effect of pH, temperature and inhibitors on the action of salivary amylase.

SUGGESTEDREADING

1. Cox, M.M and Nelson, D.L. (2008). *Lehninger's Principles of Biochemistry*, V Edition, W.H. Freeman and Co., New York.
2. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2007). *Biochemistry*, VI Edition, W.H. Freeman and Co., New York.
3. Murray, R.K., Bender, D.A., Botham, K.M., Kennelly, P.J., Rodwell, V.W. and Well P.A. (2009). *Harper's Illustrated Biochemistry*, XXVIII Edition, International Edition, The McGraw-Hill Companies Inc.

NAME OF THE PAPER (CODE) : **COMPARATIVE ANATOMY OF VERTEBRATES (ZOC 4.1)**

Number of Credit : **03**

Number of Hours of Lecture : **45**

COURSE OBJECTIVES (COs)

The following are the Course Objectives (COs) for the paper **Comparative anatomy of vertebrates:**

CO 1:	The objective of this course is to develop a proper understanding of evolution and structure of the vertebrates
CO 2:	It will help to understand vertebrate anatomical levels of organisation and related functions.
CO 3:	To allow students to make a comparative study of the anatomy of an organ in different groups of vertebrates.
CO 4:	To learn about the basic morphological features of representative chordate systems.
CO 5:	To assist the students in the understanding of human sense organ

COURSE SPECIFIC OBJECTIVES (CSOs)

Unit & Title	Unit Contents	Course Specific Objective (CSOs)	Lecture Hours	Marks	LOs
UNIT 1 Integumentary System and Skeletal System	Structure, functions and derivatives of integument; Visceral Arches. Overview of axial and appendicular skeleton	**CSO 1.1:** To define integument (K) **CSO 1.2:** To describe Structure of integument (U) **CSO 1.3:** To elaborate derivatives of integument (U) **CSO 1.4:** To discuss visceral arches of vertebrates. (U). **CSO 1.5:** To define Visceral Arches (K) **CSO 1.6:** To outline axial and appendicular skeleton (K)	**9**	**20**	
UNIT 2 Digestive System and Respiratory System	Alimentary canal and associated glands, dentition, Skin, gills, lungs and air sacs; Accessory respiratory organs	**CSO 2.1:** To explain Alimentary canal and associated glands (U) **CSO 2.2:** To compare Alimentary canal and associated glands of vertebrates(U) **CSO 2.3:** To define dentition (K) **CSO 2.4:** To discuss types of dentition (U) **CSO 2.5:** to explain Respiratory system (U) **CSO 2.6:** to elaborate Accessory respiratory organs (U)	**9**	**20**	

		CSO 2.7: to explain Accessory respiratory organs of all the vertebrates (U)			
UNIT 3 Circulatory System and Urinogenital System	General plan of circulation, evolution of heart and aortic arches. Succession of kidney, Evolution of urinogenital ducts	**CSO 3.1:** to outline General plan of circulation (K). **CSO 3.2:** to discuss parts of circulatory system. (U) **CSO 3.3:** to explain evolution of heart (U) **CSO 3.4:** to discuss types of hearts (U). **CSO 3.5:** to illustrate aortic arches (A). **CSO 3.6:** to explain evolution of aortic arches in vertebrates (U). **CSO 3.7:** to describe basic structure of kidney (K) **CSO 3.8:** to discuss types of kidneys in vertebrates (U). **CSO 3.9:** to outline Evolution of urinogenital ducts (K) **CSO 3.10:** to explain urinogenital ducts of vertebrates. (U)	**9**	**20**	
UNIT 4 Nervous System	Comparative account of brain of vertebrates; Autonomic nervous system, Spinal cord, Cranial nerves in mammals	**CSO 4.1:** to explain types of brain (U) **CSO 4.2:** to discuss comparative anatomy of brain in vertebrates. (U) **CSO 4.3:** to define nervous system (K) **CSO 4.4:** to outline types of nervous system (K) **CSO 4.5:** to define Autonomic nervous system (K). **CSO 4.6:** to explain anatomy of Autonomic nervous system (U) **CSO 4.7:** to discuss comparative anatomy of Autonomic nervous system in vertebrates (U) **CSO 4.8:** to explain parts of spinal cord in mammals (U) **CSO 4.9:** to define cranial nerves and its function (K)	**9**	**20**	

UNIT 5 **Sense Organs**	Classification of receptors Brief account of visual and auditory receptors in man	**CSO 5.1:** to define receptors (K) **CSO 5.2:** to elaborate types of receptors (U) **CSO 5.3:** to explain visual receptors in man (U) **CSO 5.4:** to outline auditory receptor in man (U).	**9**	**20**	

NAME OF THE PAPER, CODE : COMPARATIVE ANATOMY OF VERTEBRATES, ZOC 4.1 (P)
Number of Credit : 01
Number of Hours of Lecture : 30

PRACTICAL **50 Marks**

1. Study of placoid, cycloid and ctenoid scales through permanent slides/photographs
2. Disarticulated skeleton of Frog, *Varanus,* Fowl, Rabbit
3. Mammalian skulls: One herbivorous and one carnivorous animal
4. Study of structure of any two organs (heart, lung, kidney, eye and ear)
5. Project on skeletal modifications in vertebrates.

SUGGESTED READINGS

1. Kardong, K.V. (2005) *Vertebrates' Comparative Anatomy, Function and Evolution*. IV Edition. McGraw-Hill Higher Education
2. Kent, G.C. and Carr R.K. (2000). *Comparative Anatomy of the Vertebrates*. IX Edition. The McGraw-Hill Companies
3. Hilderbrand, M and Gaslow G.E. *Analysis of Vertebrate Structure*, John Wiley and Sons
4. Walter, H.E. and Sayles, L.P; *Biology of Vertebrates*, Khosla Publishing

NAME OF THE PAPER (CODE) **: ANIMAL PHYSIOLOGY: CONTROLLING AND CONTROLLING SYSTEM (ZOC 4.2)**

Number of Credit **: 03**

Number of Hours of Lecture **: 45**

COURSE OBJECTIVES (COs):

The following are the Course Objectives (COs) for the paper Animal Physiology: Controlling and coordinating system:

CO1:	To provide a course of study in mammalian, principally human and its physiology, building on knowledge of basic physiological principles.
CO2:	To provide a course of study on the endocrine system and the interactions between physiological systems.
CO3:	To study the fundamental processes and mechanisms that serve and control the various functions of the body such as neurons.
CO4:	To explore the basic physiological principles common to animals, relating to structure and functions of muscular system.
CO5:	To integrate an understanding on the reproductive system and their hormonal control.

COURSE SPECIFIC OBJECTIVES (CSOs)

Unit & Title	Unit Contents	Course specific outcome (CSOs)	Lecture Hours	Marks	LOs
Unit 1: Tissues, Bone and Cartilage	Structure, classification and functions of epithelial tissue, connective tissue, muscular tissue and nervous tissue; Structure and types of bones and cartilages, Ossification and resorption.	**CSO 1.1:** To learn about the different types of tissues in animals. (K) **CSO 1.2:** To learn about the structure of epithelial tissue. (K) **CSO 1.3:** To differentiate the different types of epithelial tissues and their functions. (U) **CSO 1.4:** To learn about the structure of connective tissue. (K) **CSO 1.5:** To differentiate the different types of connective tissues and their functions. (U) **CSO 1.6:** To gain knowledge on the structure of muscular tissue. (K) **CSO 1.7:** To learn and understand the different type of muscular tissues and their functions. (U) **CSO 1.8:** To study about the structure, types and functions of nervous tissue. (K+U) **CSO 1.9:** To study about the structure and types of cartilage. (K) **CSO 1.10:** To learn about bones	**9**	**20**	

		and its types. (K) **CSO 1.11:** To gain information on the concept of ossification. (U) **CSO 1.12:** To understand the process of bone resorption. (U)			
Unit 2: Nervous System	Structure of neuron, resting membrane potential, Origin of action potential and its propagation across nerve fibers; Types of synapses; Synaptic transmission and, Neuromuscular junction; Reflex action and its types - reflex arc.	**CSO 2.1:** To define neuron and understand its structure. (K+U) **CSO 2.2:** To differentiate the different types of neurons and their functions. (U) **CSO 2.3:** To understand the resting membrane potential of neurons. (U) **CSO 2.4:** To learn the concept of action potential of neuron. (U) **CSO 2.5:** To understand the concept of synapses in neurons. (U) **CSO 2.6:** To learn about the concept of reflex action, reflex arc. (K) **CSO 2.7:** To learn about the mechanism of reflex action and its significance. (U+A) **CSO 2.8:** To gain information on the structure of mammalian ear and its functions and working. (K+U) **CSO 2.9:** To learn about the structure and working of mammalian eye. (K+U)	**9**	**20**	
Unit 3: Muscle	Histology of different types of muscle; Ultra structure of skeletal muscle; Molecular and chemical basis of muscle contraction; Characteristics of muscle twitch; Motor unit, summation and tetanus; Physiology of hearing and vision.	**CSO 3.1:** To learn the basics of muscle tissue and its types. (K) **CSO 3.2:** To learn about the structure and function of skeletal muscle. (K+U) **CSO 3.3:** To learn the structure and function of smooth muscle. (K+U) **CSO 3.4:** To understand the structure and function of cardiac muscle. (K+U) **CSO 3.5:** To learn about the ultrastructure of skeletal muscle. (U) **CSO 3.6:** To understand the mechanism of muscle contraction. (U) **CSO 3.7:** To learn the concept of	**9**	**20**	

		muscle twitch and the stages involved. (K+U) **CSO 3.8:** To gain information on motor unit, wave summation. (K+U) **CSO 3.9:** To understand the phenomenon of tetanus and its types. (K+U)			
Unit 4: Reproductive System	Histology of testis and ovary; Physiology of male and female reproduction; Methods of contraception in male and female.	**CSO 4.1:** To learn the basic concepts of reproductive system and its importance. (K) **CSO 4.2:** To learn the basics of the male reproductive system. (K) **CSO 4.3:** To learn about the structure and histology of testes. (K+U) **CSO 4.4:** To gain information and learn on the hormonal control of testicular function. (U) **CSO 4.5:** To learn the basics of the female reproductive system. (K) **CSO 4.6:** To learn about the structure and histology of ovary. (K+U) **CSO 4.7:** To learn about gametogenesis- spermatogenesis and oogenesis. (U) **CSO 4.8:** To understand the structure of sperm and ovum. (U) **CSO 4.9:** To learn and understand the menstrual cycle. (U) **CSO 4.10:** To gain information and learn on the endocrine control of menstrual cycle. (U) **CSO 4.11:** To learn about different contraceptives methods used. (U+A) **CSO 4.12:** To learn about the concept of medical termination of pregnancy. (U+A)	**9**	**20**	
Unit 5: Endocrine System	Histology of endocrine glands - pineal, pituitary, thyroid, parathyroid, pancreas, adrenal; Hypothalamus	**CSO 5.1:** To gain information on endocrine glands. (K) **CSO 5.2:** To study and understand the structure of hypothalamus and pituitary gland. (K+U) **CSO 5.3:** To learn about the different hormones secreted by pituitary gland. (K+U)	**9**	**20**	

	(neuroendocrine gland) - control of endocrine system.	**CSO 5.4:** To study about the structure, hormones secreted and functions of pineal gland. (K+U) **CSO 5.5:** To learn about the structure, hormones and functions of thyroid gland. (K+U) **CSO 5.6:** To study about the structure, hormones and functions of parathyroid gland. (K+U) **CSO 5.7:** To learn about the structure, hormones and regulation of blood sugar by pancreas. (K+U) **CSO 5.8:** To learn about the structure, hormones and functions of adrenal gland. (K+U) **CSO 5.9:** To understand the hypothalamic control of pituitary gland. (U)			

NAME OF THE PAPER, CODE : ANIMAL PHYSIOLOGY: CONTROLLING AND CONTROLLING SYSTEM, ZOC 4.2 (P)
Number of Credit : 01
Number of Hours of Lecture : 30

PRACTICALS **50 Marks**

1. Recording of simple muscle twitch with electrical stimulation (or Virtual)
2. Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee jerk reflex)
3. Preparation of temporary mounts: Squamous epithelium, Striated muscle fibres and nerve cells
4. Study of permanent slides of Mammalian skin, Cartilage, Bone, Spinal cord, Nerve cell, Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid
5. Microtomy: Preparation of permanent slide of any five mammalian (Goat/white rat) tissues

SUGGESTED BOOKS

1. · Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company.
2. · Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons
3. · Victor P. Eroschenko. (2008). DiFiore's Atlas of Histology with Functional co-relations. XII Edition. Lippincott W. & Wilkins.

NAME OF THE PAPER (CODE) : **BIOCHEMISTRY OF METABOLIC PROCESSES (ZOC 4.2)**

Number of Credit : **03**

Number of Hours of Lecture : **45**

COURSE OBJECTIVES (COs)

The following are the Course Objectives (COs) for the paper **Biochemistry of Metabolic Processes**:

CO 1:	To create awareness and interest in students about the metabolic activities in organisms.
CO 2:	To help the students understand carbohydrate metabolism.
CO 3:	To create an understanding among students, lipid metabolism.
CO 4:	To inculcate and create interest among students in the understanding protein metabolism
CO 5:	To create an understanding among students, the oxidative phosphorylation.

COURSE SPECIFIC OBJECTIVES (CSOs)

Unit & Title	Unit Contents	Course Specific Objective (CSOs)	Lecture Hours	Marks	LOs
UNIT 1 Overview of Metabolism	Catabolism *vs* Anabolism, Stages of catabolism, Shuttle systems and membrane transporters; ATP as "Energy Currency of cell"; coupled reactions; Intermediary metabolism and regulatory mechanisms	**CSO 1.1:** to define the term Metabolism. (K) **CSO 1.2:** to define the term Catabolism. (K) **CSO 1.3:** to define the term Anabolism. (K) **CSO 1.4:** to contrast Catabolism and Anabolism. (A) **CSO 1.5: t**o demonstrate the stages of catabolism. (A) **CSO 1.6:** to explain the Shuttle systems. (U) **CSO 1.7:** to discuss membrane transporters. (U) **CSO 1.8:** to analyse ATP as "Energy Currency of cell". (A) **CSO 1.9:** to enumerate coupled reactions. (U) **CSO 1.10:** to define Intermediary metabolism. (K) **CSO 1.11:** to explain Intermediary metabolism. (U) **CSO 1.12:** to analyse the regulatory mechanisms of Intermediary metabolism. (A)	9	20	

UNIT 2 Carbohydrate Metabolism	Sequence of reactions of glycolysis, Citric acid cycle, Phosphate-pentose pathway, Gluconeogenesis, Glycogenolysis and Glycogenesis	**CSO 2.1:** to define what is Carbohydrate Metabolism. (K) **CSO 2.2:** to illustrate the Sequence of reactions of glycolysis. (A) **CSO 2.3:** to explain the Sequence of reactions in Citric acid cycle. (U) **CSO 2.4:** to generalise the Sequence of reactions in Phosphate-pentose pathway. (A) **CSO 2.5:** to define Gluconeogenesis. (K) **CSO 2.6:** to to generalise the Sequence of reactions in Gluconeogenesis. (A) **CSO 2.7:** to define Glycogenolysis. (K) **CSO 2.8:** to discuss the Sequence of reactions in Glycogenolysis. (U) **CSO 2.9:** to define Glycogenesis. (K) **CSO 2.10:** to illustrate the Sequence of reactions in Glycogenesis. (A)	9	20	
UNIT 3 Lipid Metabolism	β-oxidation and omega-oxidation of saturated fatty acids with even number of carbon atoms; Biosynthesis of palmitic acid; Ketogenesis	**CSO 3.1:** to define lipid metabolism. (K) **CSO 3.2:** to define β-oxidation. (K) **CSO 3.3:** to define omega-oxidation. (K) **CSO 3.4:** to explain β-oxidation of saturated fatty acids with even number of carbon atoms. (U) **CSO 3.5:** to illustrate the omega-oxidation of saturated fatty acids with even number of carbon atoms. (A) **CSO 3.6:** to define biosynthesis. (K) **CSO 3.7:** to define palmitic acid. (K) **CSO 3.8:** to explain Biosynthesis of palmitic acid. (U)	9	20	

		CSO 3.9: to define ketogenesis (K) **CSO 3.10:** to interpret ketogenesis. (A)			
UNIT 4 **Protein Metabolism**	Catabolism of amino acids: Transamination, Deamination, Urea cycle; Fate of C-skeleton of Glucogenic and Ketogenic amino acids	**CSO 4.1:** to define protein metabolism. (K) **CSO 4.2:** to explain Catabolism of amino acids. (U) **CSO 4.3:** to define Transamination. (K) **CSO 4.4:** to illustrate the process of Transamination. (A) **CSO 4.5:** to define deamination. (K) **CSO 4.6:** to explain the process of Deamination. (U) **CSO 4.7:** to define Urea cycle. (K) **CSO 4.8:** to illustrate the cycle of Urea. (A) **CSO 4.9:** to interpret the fate of C-skeleton of Glucogenic amino acids. (A) **CSO 4.10:** to demonstrate the fate of C-skeleton of Ketogenic amino acids. (A)	9	20	
UNIT 5 **Oxidative Phosphorylation**	Redox systems; Review of mitochondrial respiratory chain, Inhibitors and un-couplers of	**CSO 5.1:** to define Oxidative Phosphorylation. (K) **CSO 5.2:** to define redox system. (K) **CSO 5.3:** to explain the structure of mitochondrial respiratory chain. (U) **CSO 5.4:** to illustrate the working mechanism of mitochondrial respiratory chain. (A) **CSO 5.5:** to define Electron Transport System. (K) **CSO 5.6:** to discuss the process of Electron Transport System. (U) **CSO 5.7:** to define Electron Transport System. (K) **CSO 5.8:** to discuss the process of Electron Transport System. (U)	9	20	

		CSO 5.9: to define Inhibitor. (K) **CSO 5.10:** to interpret the effect of inhibitors on Electron Transport System. (A) **CSO 5.11:** to define un-couplers. (K) **CSO 5.12:** to interpret the effect of un-couplers on Electron Transport System. (U).			

NAME OF THE PAPER, CODE : BIOCHEMISTRY OF METABOLIC PROCESSES, ZOC 4.2 (P)
Number of Credit : 01
Number of Hours of Lecture : 30

PRACTICAL **50 Marks**

1. Estimation of total protein in given solutions by Lowry's method.
2. Detection of SGOT and SGPT or GST and GSH in serum/tissue.
3. To study the enzymatic activity of Urease.
4. Study of biological oxidation (SDH) [goat liver]
5. To perform the Acid and Alkaline phosphatase assay from serum/tissue.

SUGGESTED READINGS

1. Cox, M.M and Nelson, D.L. (2008). *Lehninger Principles of Biochemistry*, V Edition, W.H. Freeman and Co., New York.
2. Berg, J.M, and Stryer, L. (2007). *Biochemistry*, VI Edition, W.H. Freeman and Co., New York.
3. Murray, R.K., Bender, *D.A.*, Botham, K.M., Kennelly, P.J., Rodwell, V.W. and Well, P.A. (2009). *Harper Illustrate Biochemistry*, XXVIII Edition, International Edition, The Mc Graw-Hill Companies Inc.
4. Hames, B.D. and Hooper, N.M. (2000) *Instant Notes in Biochemistry*, II Edition, BIOS Scientific Publishers Ltd U.K.

NAME OF THE PAPER (CODE) : **MOLECULAR BIOLOGY (ZOC 5.1)**
Number of Credit : **03**
Number of Hours of Lecture : **45**

COURSE OBJECTIVES (COs)

The following are the Course Objectives (COs) for the paper **MOLECULAR BIOLOGY:**

CO 1:	To study how DNA, RNA and proteins are synthesized.
CO 2:	To acquire knowledge on transcription and mechanism of transcription in prokaryotes and eukaryotes.
CO 3:	To learn about translation and their processes
CO 4:	To learn the Post Transcriptional Modifications and Processing of Eukaryotic RNA and DNA Repair Mechanisms.
CO 5:	To learn about gene regulations and their processes

COURSE SPECIFIC OBJECTIVES (CSOs)

Unit & Title	Unit Contents	Course Specific Objective (CSOs)	Lecture Hours	Marks	LOs
UNIT 1 Nucleic Acids and DNA Replication	Salient features of DNA and RNA. Watson and Crick model of DNA. DNA Replication in prokaryotes and eukaryotes, Semi-conservative, bidirectional and semi-discontinuous replication.	**CSO 1.1:** To explain about Salient features of DNA and RNA. (U). **CSO 1.2:** To classify types of DNA (U). **CSO 1.3:** To classify types of RNA (U). **CSO 1.4:** To outline history of Watson and Crick model of DNA (U). **CSO 1.5:** to describe structure of Watson and Crick model of DNA (K) **CSO 1.6:** to explain features of Watson and Crick structure of DNA (U). **CSO 1.7:** to define Replication in prokaryotes (K) **CSO 1.8:** to define Replication in eukaryotes (K) **CSO 1.9:** to compare Prokaryotic and eukaryotic replication (U) **CSO 1.10:** to explain Semi-conservative (U) **CSO 1.11:** to explain bidirectional and semi-discontinuous replication (U) **CSO 1.12:** to define RNA priming (K) **CSO 1.13:** to list function of RNA primer (K)	**9**	**20**	

UNIT 2 Transcription	RNA polymerase and transcription Unit, mechanism of transcription in prokaryotes and eukaryotes, synthesis of rRNA and mRNA, transcription Factors.	**CSO 2.1:** To define RNA polymerase (K) **CSO 2.2:** To explain types of RNA polymerase (U) **CSO 2.3:** To define transcription Unit (K) **CSO 2.4:** To discuss stages of transcription (U) **CSO 2.5:** to define transcription in prokaryot es and eukaryotes (K) **CSO 2.6:** to explain transcription in prokaryotes (U) **CSO 2.7:** to elaborate transcription in eukaryotes (U). **CSO 2.8:** to define rRNA (K) **CSO 2.9:** to explain synthesis of rRNA (U) **CSO 2.10:** to define mRNA (K) **CSO 2.11:** to explain synthesis of mRNA (U). **CSO 2.12:** to define transcription Factors (K) **CSO 2.13:** to elaborate mechanism of transcript ion Factors (U) **CSO 2.14:** to list function of transcript ion Factors (K)	**9**	**20**	
UNIT 3 Translation	Genetic code, Degeneracy of the genetic code and Wobble Hypothesis; Process of protein synthesis in prokaryotes: Ribosome structure and assembly in prokaryotes, fidelity of protein synthesis, aminoacyl tRNA synthetases and charging of tRNA; Proteins involved in initiation, elongation and termination of polypeptide chain	**CSO 3.1:** to define genetic code (K). **CSO 3.2:** to discuss Degeneracy of the genetic code (U) **CSO 3.3:** to explain Degeneracy of the Wobble Hypothesis (U) **CSO 3.4:** to discuss Process of protein synthesis in prokaryotes. (U) **CSO 3.5:** to illustrate Ribosome structure. (A) **CSO 3.6:** to explain assembly in prokaryotes (U). **CSO 3.7:** to describe fidelity of protein synthesis (K) **CSO 3.8:** to define aminoacyl tRNA synthetases (K). **CSO 3.9:** to outline mechanism of aminoacyl tRNA synthetases (K) **CSO 3.10:** to explain class of aminoacyl tRNA synthetases (U).	**10**	**22**	

		CSO 3.11: to describe structure of aminoacyl tRNA synthetases (K). **CSO 3.12:** to define charging of tRNA (K) **CSO 3.13:** to illustrate mechanism charging of tRNA (A) **CSO 3.14:** to outline Proteins involved in initiation, elongation and termination of polypeptide chain (K)			
UNIT 4 **Post Transcriptional Modifications and Processing of Eukaryotic RNA and DNA Repair Mechanisms**	Structure of globin mRNA; Split genes: concept of introns and exons, splicing mechanism, alternative splicing, exon shuffling, and RNA editing, Processing of tRNA. Pyrimidine dimerization and mismatch repair	**CSO 4.1:** to explain Structure of globin mRNA (U). **CSO 4.2:** to describe split genes(K) **CSO 4.3:** to define introns (K) **CSO 4.4:** to explain exons (U) **CSO 4.5:** to define splicing (K). **CSO 4.6:** to explain mechanism of splicing (U) **CSO 4.7:** to discuss alternative splicing (U) **CSO 4.8:** to define exon shuffling (K) **CSO 4.9:** to explain mechanism of exon shuffling (U) **CSO 4.10:** to define RNA editing (K) **CSO 4.11:** to explain Processing of tRNA (U) **CSO 4.12:** to define Pyrimidine (K) **CSO 4.13:** to explain dimerization (U). **CSO 4.14:** to describe mismatch repair (K)	**8**	**18**	
UNIT 5 **Gene Regulation**	Transcription regulation in prokaryotes: Principles of transcriptional regulation with examples from *lac* operon and *trp* operon; Transcription regulation in eukaryotes: Activators, repressors,	**CSO 5.1:** to discuss Principles of transcriptio nal regulation in prokaryotes (U). **CSO 5.2:** to elaborate *lac* operon concept (U). **CSO 5.3:** to explain *trp* operon (U). **CSO 5.4:** to outline Transcription regulation in eukaryotes (U). **CSO 5.5:** to explain Activators (U). **CSO 5.6:** to discuss repressors (U). **CSO 5.7:** to explain enhancers (U)	**9**	**20**	

	enhancers, silencer elements; Gene silencing, Genetic imprinting	**CSO 5.8:** to outline silencer elements (K) **CSO 5.9:** to explain Gene silencing (U) **CSO 5.10:** to elaborate Genetic imprinting (U)			

NAME OF THE PAPER, CODE : MOLECULAR BIOLOGY, ZOC 5.1(P)
Number of Credit : 01
Number of Hours of Lecture : 30

PRACTICAL **50 Marks**

1. Study of Polytene chromosomes from *Chironomous* / Drosophila larvae
2. Preparation of liquid culture medium (LB) and raise culture of *E. coli*
3. Preparation of solid culture medium (LB) and growth of *E. coli* by spreading and streaking
4. Demonstration of antibiotic sensitivity/resistance of *E. coli* to antibiotic pressure and interpretation of results
5. Quantitative estimation of RNA using Orcinol reaction
6. Study and interpretation of electron micrographs/ photograph showing
    a) DNA replication
    b) Transcription
    c) Split genes

SUGGESTED READINGS

1. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). *The World of the Cell.* VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
2. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter: *Molecular Biology of the Cell*, IV Edition.
3. Cooper G. M. and Robert E. Hausman R. E. *The Cell: A Molecular Approach***,** V Edition, ASM Press and Sinauer Associates.
4. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). *Cell and Molecular Biology*. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
5. Karp, G. (2010) *Cell and Molecular Biology: Concepts and Experiments*. VI Edition. John Wiley and Sons. Inc.

NAME OF THE PAPER (CODE) : BIOSTATISTICS (ZOC-5.2)
Number of Credit : 03
Number of Hours of Lecture : 45

COURSE OBJECTIVES (COs)

The following are the Course Objectives (COs) for the paper **Biostatistics**:

CO 1:	To make the students aware of statistical methods and basic principles of biostatistics.
CO 2:	To help the students learn about the collection of primary and secondary data.
CO 3:	To create an understanding among students, the measures of central tendency.
CO 4:	To inculcate and create interest among students in the understanding of types and methods of correlation.
CO 5:	To make the students learn how to draw conclusion from statistical data.

COURSE SPECIFIC OBJECTIVES (CSOs)

Unit & Title	Unit Contents	Course Specific Objective (CSOs)	Lecture Hours	Marks	Los
UNIT 1 Introduction to Biostatistics	Definition - statistical methods - basic principles. Variables - measurements, functions, limitations and uses of statistics	**CSO 1.1:** to define the term Biostatistics. (K) **CSO 1.2:** to understand various methods of statistics used in biology. (U) **CSO 1.3:** to discuss the basic principles of biostatistics. (U) **CSO 1.4:** to define Variables. (K) **CSO 1.5: t**o discuss about measurements of variables. (U) **CSO 1.6:** to apply measurements of variables in solving biological data. (A) **CSO 1.7:** to explain the functions of variables. (U) **CSO 1.8:** to elaborate the limitations of variables. (U) **CSO 1.9:** to discuss the uses of variables in statistics. (U)	6	14	
UNIT 2 Collection of data primary and secondary	Types and methods of data collection procedures - merits and demerits. Classification - tabulation and presentation of data - sampling methods	**CSO 2.1:** to define the term primary data. (K) **CSO 2.2:** to define the term secondary data. (K) **CSO 2.3:** to discuss how to collect data. (U) **CSO 2.4:** to analyse raw data. (A) **CSO 2.5:** to understand Types of data collection procedures. (U)	9	20	

		CSO 2.6: to elaborate the methods of data collection procedures. (U) **CSO 2.7:** to explain merits of data collection. (U) **CSO 2.8:** to discuss the demerits of data collection. (U) **CSO 2.9:** to analyse merits and demerits of data collection (A) **CSO 2.10:** to classify data. (U) **CSO 2.11:** to construct table using collected data. (A) **CSO 2.12:** to organise and present the data. (A) **CSO 2.13:** to elaborate sampling methods. (U)			
UNIT 3 Measures of central tendency	Mean, median, mode - merits & demerits. Measures of dispersion - range, standard deviation, mean deviation, quartile deviation - merits and demerits; Co-efficient of variations	**CSO 3.1:** to define central tendency. (K) **CSO 3.2:** to explain different measures of central tendency. (U) **CSO 3.3:** to define and apply mean to get the overall idea about the data. (K+A) **CSO 3.4:** to explain the median and its usage. (U+ A) **CSO 3.5:** to explain the mode and its usage. (U+ A) **CSO 3.6:** to enumerate merits & demerits of Mean, median and mode. (A) **CSO 3.7:** to define the Measures of dispersion. (K) **CSO 3.8:** to explain and apply range in solving biological data. (U+A) **CSO 3.9:** to explain and apply standard deviation in solving biological data. (U+A) **CSO 3.10:** to explain and apply mean deviation in solving biological data. (U+A) **CSO 3.11:** to explain and apply quartile deviation in	14	30	

		solving biological data. (U+A) **CSO 3.12:** to compare range, standard deviation, mean deviation, quartile deviation - merits and demerits. (A) **CSO 3.13:** to explain and apply Co- efficient of variations in solving biological data. (U+A)			
UNIT 4 Correlation	Types and methods of correlation, regression, simple regression equation, fitting prediction, similarities and dissimilarities of correlation and regression	**CSO 4.1:** to define correlation. (K) **CSO 4.2:** to explain the types of correlation. (U) **CSO 4.3:** to elaborate the methods of correlation (U) **CSO 4.4:** to apply correlation in solving problems in biology. (A) **CSO 4.5:** to define regression. (K) **CSO 4.6:** to apply regression in solving problems in biology. (A) **CSO 4.7:** to derive simple regression equation. (A) **CSO 4.8:** to determine fitting prediction. (A) **CSO 4.9:** to contrast similarities between correlation and regression. (A) **CSO 4.10:** to contrast dissimilarities between correlation and regression. (A)	8	18	
UNIT 5 Statistical inference	Hypothesis - simple hypothesis - student 't' test - chi square test.	**CSO 5.1:** to define statistical inference. (K) **CSO 5.2:** to elaborate on statistical hypothesis. (U) **CSO 5.3:** to explain the simple hypothesis. (U) **CSO 5.4:** to explain student 't' test. (U) **CSO 5.5:** to apply student 't' test in solving biological data. (A) **CSO 5.6:** to define chi square	8	18	

		test. (K) **CSO 5.7:** to understand the use of chi square test. **CSO 5.8:** to apply chi square test to compare observed and expected results. (A)			

NAME OF THE PAPER, CODE : BIOSTATISTICS, ZOC-5.2 (P)
Number of Credit : 01
Number of Hours of Lecture : 30

PRACTICAL **50 Marks**

1) Calculation of mean, standard deviation and standard error
2) Calculation of correlation coefficient values and finding out the probability
3) Calculation of 'F' value and finding out the probability value for the F value.

SUGGESTED READINGS

1. Biostatistic, Danniel, W.W., 1987.New York, John Wiley Sons.
2. An introduction to Biostatistics, 3rd edition, Sundarrao, P.S.S and Richards, J. Christian Medical College, Vellore
3. Statistics for Biology, Boston, Bishop, O.N. Houghton, Mifflin.
4. The principles of scientific research, Freedman, P. New York, Pergamon Press.
5. Statistics for Biologists, Campbell, R.C., 1998.Cambridge University Press.

NAME OF THE PAPER (CODE) **: ANIMAL PHYSIOLOGY: LIFE SUSTAINING SYSTEM (ZOC 5.3)**

Number of Credit **: 03**

Number of Hours of Lecture **: 45**

COURSE OBJECTIVES (COs):

The following are the Course Objectives (COs) for the paper Animal Physiology: Life sustaining system:

CO1:	To study about the structural organization and functions of gastrointestinal tract and the process of digestion and absorption.
CO2:	To give knowledge on the physiology of respiration.
CO3:	To give information on the physiology of excretory system and its mechanism.
CO4:	To study about the structural organization of heart and its components.
CO5:	To give knowledge on the mechanism of circulatory system and its importance.

COURSE SPECIFIC OBJECTIVES (CSOs)

Unit & Title	Unit Contents	Course specific outcome (CSOs)	Lecture Hours	Marks	LOs
Unit 1: Physiology of Digestion	Structural organization and functions of gastrointestinal tract; Digestion and absorption of nutrients; Hormonal control of secretion of enzymes in Gastrointestinal tract.	**CSO 1.1:** To learn about the concept of digestion and absorption. (K) **CSO 1.2:** To gain information on the different types of nutrients and their digestion and absorption. (K+U) **CSO 1.3:** To learn and understand the structural oragnization of the digestive tract. (K+U) **CSO 1.4:** To learn about the different enzymes involved in the process of digestion. (K+U) **CSO 1.5:** To understand how carbohydrates are digested and absorbed. (U) **CSO 1.6:** To learn how proteins are digested and absorbed. (U) **CSO 1.7:** To understand how fats are digested and absorbed. (U) **CSO 1.8:** To learn about the neural control of digestion. (U) **CSO 1.9:** To learn and understand how hormones control the secretion of	**9**	**20**	

		enzymes in the gastrointestinal tract. (U)			
Unit 2: Physiology of Respiration	Histology of trachea and lungs; Mechanism of respiration; Dissociation curves and factors influencing it; Carbon monoxide poisoning; Control of respiration	**CSO 2.1:** To learn about the basics of respiration and its types. (K) **CSO 2.2:** To learn about the structure of the respiratory tract. (K) **CSO 2.3:** To differentiate between external and internal respiration. (U) **CSO 2.4:** To understand the mechanism of breathing. (U) **CSO 2.5:** To learn about the mechanism of respiration. (U) **CSO 2.6:** To learn the concept of oxygen dissociation curve. (K+U) **CSO 2.7:** To study the transport of oxygen from lungs to tissues. (U) **CSO 2.8:** To understand the transport of carbon dioxide from tissue to the lungs. (K+U) **CSO 2.9:** To learn and gain information on carbon monoxide poisoning. (K+U) **CSO 2.10:** To learn about the different factors influencing or controlling the process of respiration. (K+U)	**9**	**20**	
Unit 3: Renal Physiology	Structure of kidney and its functional unit; Mechanism of urine formation; Regulation of water balance	**CSO 3.1:** To learn the basics of kidney and its functions. (K) **CSO 3.2:** To learn about the structure of kidney. (K) **CSO 3.3:** To learn about the structure of a nephron. (K) **CSO 3.4:** To learn about the mechanism of urine formation. (U) **CSO 3.5:** To study and understand the countercurrent system of kidneys. (U)	**9**	**20**	

		CSO 3.6: To learn the concept of osmoregulation. (K) **CSO 3.7:** To understand the maintenance of water balance by kidneys. (K+U) **CSO 3.8:** To learn about the maintenance of electrolyte balance by kidney. (K+U) **CSO 3.9:** To learn about the hormonal control of renal function. (U)			
Unit 4: Blood	Components of blood and their functions; Structure and functions of Haemoglobin Blood groups: Rh factor, ABO and MN Haemostasis: Blood clotting system; Haemopoiesis	**CSO 4.1:** To learn about the basics of blood. (K) **CSO 4.2:** To learn about the different components of blood. (K) **CSO 4.3:** To gain information on the functions of the different components of blood. (U) **CSO 4.4:** To understand the structure of Haemoglobin and its functions. (K+U) **CSO 4.5:** To learn about the different types of blood groups. (K+U) **CSO 4.6:** To learn the concept of Rh factor and MN. (K) **CSO 4.7:** To understand the concept of haemostasis. (U) **CSO 4.8:** To learn about the mechanism of blood clotting and the steps involved. (K+U) **CSO 4.9:** To learn about haemopoisis. (K+U)	**9**	**20**	
Unit 5: Physiology of Heart	Coronary circulation; Structure and working of conducting myocardial fibers Electrocardiogram, Blood Pressure and Its regulations, Cardiac cycle, Cardiac output and	**CSO 5.1:** To learn the basics of heart and the circulatory system. (K) **CSO 5.2:** To understand the structure of heart. (U) **CSO 5.3:** To learn about the different vessels and the circulation of blood through it. (U) **CSO 5.4:** To learn and understand the different	**9**	**20**	

	its regulations.	types of circulation. (K+U) **CSO 5.5:** To understand the concept of cardiac cycle. (U) **CSO 5.6:** To learn about the regulation of heartbeat. (K+U) **CSO 5.7:** To define and understand the working of ECG. (K+U) **CSO 5.8:** To learn about blood pressure and the factors that control it. (K+U) **CSO 5.9:** To understand the significance of ECG. (U+A) **CSO 5.10:** To gain information on the regulation of cardiac cycle. (U)			

NAME OF THE PAPER, CODE : ANIMAL PHYSIOLOGY: LIFE SUSTAINING SYSTEM, ZOC 5.3 (P)
Number of Credit : 01
Number of Hours of Lecture : 30

PRACTICALS **50 Marks**

1. Determination of ABO Blood group and Rh factor
2. Estimation of haemoglobin using Sahli's haemoglobinometer
3. Preparation of haemin crystals
4. Recording of blood pressure using a sphygmomanometer
5. Examination of sections of mammalian Oesophagus, Stomach, Duodenum, Ileum, rectum, liver, trachea, lung, kidney.

SUGGESTED READINGS:

1. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. W.B. Saunders Company.

2. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons,

3. Victor P. Eroschenko (2008). diFiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott W. & Wilkins.

NAME OF THE PAPER (CODE) : **DEVELOPMENTAL BIOLOGY (ZOC 6.1)**
Number of Credit : **03**
Number of Hours of Lecture : **45**

COURSE OBJECTIVES (COs)

The following are the Course Objectives (COs) for the paper **DEVELOPMENTAL BIOLOGY**:

CO 1:	To study and understand the historical perspective and basic concepts of developmental biology.
CO 2:	To learn about early embryonic development.
CO 3:	To understand about late embryonic development.
CO 4:	To understand the post embryonic development.
CO 5:	To understand the implications of developmental biology.

COURSE SPECIFIC OBJECTIVES (CSOs)

Unit & Title	Unit Contents	Course Specific Objective (CSOs)	Lecture Hours	Marks	LOs
UNIT 1 INTRODUCTION	Historical perspective and basic concepts: Phases of development, Cell-Cell interaction, Pattern formation, Differentiation and growth, Differential gene Expression.	**CSO 1.1:** To explain Historical perspective and basic concepts: Phases of development (U) **CSO 1.2:** To discuss Cell-Cell interaction (U) **CSO 1.3:** To describe Pattern formation (K) **CSO 1.4:** To explain Differentiation and growth (U) **CSO 1.5:** To identify Differential gene expression (K)	**9**	**20**	
UNIT 2 Early Embryonic Development	Gametogenesis, Spermatogenesis, Oogenesis; Types of eggs, Egg membranes; Fertilization (External and Internal): Changes in gametes, Blocks to polyspermy; Planes and patterns of cleavage; Types of Blastula.	**CSO 2.1:** To outline Gametogenesis (K) **CSO 2.2:** To describe Spermatogenesis (K) **CSO 2.3:** To describe Oogenesis (K) **CSO 2.4:** to characterize Types of eggs (U) **CSO 2.5:** to explain Egg membranes (U) **CSO 2.6:** to elaborate Fertilization (External	**9**	**20**	

		and Internal): Changes in gametes (U) **CSO 2.7:** to explain Blocks to polyspermy (U) **CSO 2.8:** to classify Planes and patterns of cleavage (U) **CSO 2.9:** to describe Types of Blastula (K)			
UNIT 3 **Late Embryonic Development**	Fate of Germ Layers; Extra-embryonic membranes in birds; Implantation of embryo in humans, Placenta (Structure, types and functions of placenta)	**CSO 3.1:** to classify Fate of Germ Layers (U) **CSO 3.2:** to discuss Extra-embryonic membranes in birds. (U) **CSO 3.3:** to describe Implantation of embryo in humans (K) **CSO 3.4:** to discuss Placenta (Structure, types and functions of placenta) (U)	**9**	**20**	
UNIT 4 **Post Embryonic Development**	Metamorphosis: Changes, hormonal regulations in amphibians and insects; Regeneration: Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each); Ageing: Concepts and Theories	**CSO 4.1:** to define Metamorphosis. (K) **CSO 4.2:** to outline Changes, hormonal regulations in amphibians and insects (K) **CSO 4.3:** to define Regeneration (A) **CSO 4.4:** to outline Modes of regeneration (K) **CSO 4.5:** to explain epimorphosis regeneration with one example (U). **CSO 4.6:** to discuss morphallaxis regeneration with one example. (U) **CSO 4.7:** to describe compensatory regeneration with one example. (U).	**9**	**20**	

		CSO 4.8: to define Ageing (K).			
UNIT 5 Implications of Developmental Biology	Teratogenesis: Teratogenic agents and their effects on embryonic development; In vitro fertilization, Stem cell (ESC), Amniocentesis	**CSO 5.1:** to define Teratogenesis (K) **CSO 5.2:** to elaborate Teratogenic agents and their effects on embryonic development (U) **CSO 5.3:** to explain In vitro fertilization. (U) **CSO 5.4:** to elaborate Stem cell (ESC). (U) **CSO 5.5:** to explain Amniocentesis. (U)	**9**	**20**	

NAME OF THE PAPER, CODE : DEVELOPMENTAL BIOLOGY, ZOC 6.1 (P)
Number of Credit : 01
Number of Hours of Lecture : 30

PRACTICAL **50 Marks**

1. Study of whole mounts and sections of developmental stages of frog through permanent slides: Cleavage stages, blastula, gastrula, neurula, tail-bud stage, tadpole (external and internal gill stages).
2. Study of whole mounts of developmental stages of chick through permanent slides: Primitive streak (13 and 18 hours), 21, 24, 28, 33, 36, 48, 72, and 96 hours of incubation (Hamilton and Hamburger stages)
3. Study of different sections of placenta (photomicrograph/ slides)
4. Project report on Drosophila culture/chick embryo development.

SUGGESTED READINGS:

1. Gilbert, S. F. (2010). Developmental Biology, IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA
2. Balinsky B. I. and Fabian B. C. (1981). An Introduction to Embryology, V Edition, International Thompson Computers Press
3. Kalthoff (2008). Analysis of Biological Development, II Edition, McGraw-Hill Publisher

NAME OF THE PAPER (CODE) : **EVOLUTIONARY BIOLOGY (ZOC-6.2)**
Number of Credit : **03**
Number of Hours of Lecture : **45**

COURSE OBJECTIVES (COs)

The following are the Course Objectives (COs) for the paper **Evolutionary biology**:

CO 1:	To inculcate in students about the evolution of life on Earth.
CO 2:	To create interest in students about the evidences of evolution.
CO 3:	To create an understanding among students, the genetics of population.
CO 4:	To inculcate and create interest among students in the understanding of product of evolution.
CO 5:	To let the students acquire the knowledge of origin and evolution of man, construction and interpretation of phylogenetic tree.

COURSE SPECIFIC OBJECTIVES (CSOs)

Unit & Title	Unit Contents	Course Specific Objective (CSOs)	Lecture Hours	Marks	LOs
UNIT 1 Life's Beginnings	Chemogeny, RNA world, Biogeny, Origin of photosynthesis, Evolution of eukaryotes Historical review of evolutionary concept: Lamarckism, Darwinism, Neo-Darwinism	**CSO 1.1:** to define Chemogeny. (K) **CSO 1.2:** to elaborate the Chemical evolution. (U) **CSO 1.3:** to understand about RNA world. (U) **CSO 1.4:** to describe biogeny. (U) **CSO 1.5:** to discuss about Origin of photosynthesis. (U) **CSO 1.6:** to explain about Evolution of eukaryotes. (U) **CSO 1.7:** to relate historical review of evolutionary concept. (A) **CSO 1.8:** to discuss about Lamarckism. (U) **CSO 1.9:** to interpret Darwinism. (A) **CSO 1.10:** to discuss Neo-Darwinism. (U)	9	20	
UNIT 2 Evidences of Evolution	Fossil record (types of fossils, transitional forms, geological time scale. evolution of horse, three domains of life, neutral theory of molecular evolution	**CSO 2.1:** to define Fossil record. (K) **CSO 2.2:** to describe the types of fossils. (U) **CSO 2.3:** to correlate transitional forms as evidence of connecting link in evolution. (A)	9	20	

		CSO 2.4: to discuss geological time scale. (U) **CSO 2.5:** to explain about evolution of horse. (U) **CSO 2.6:** To illustrate the three domains of life. (A) **CSO 2.7:** to define molecular evolution. (K) **CSO 2.8:** to explain about the neutral theory of molecular evolution. (U)			
UNIT 3 Population genetics	Hardy-Weinberg Law (statement and derivation of equation, application of law to human Population) Natural selection (concept of fitness, selection coefficient, derivation of one unit of selection for a dominant allele, genetic load, Genetic Drift, founder's effect, bottleneck phenomenon; Role of Migration and Mutation in changing allele frequencies.	**CSO 3.1:** to discuss about population genetics. (U) **CSO 3.2:** to explain about Hardy-Weinberg Law. (U) **CSO 3.3**: To derive HW equation. (A) **CSO 3.4:** to apply HWE to human Population. (A) **CSO 3.5:** To discuss about Natural selection. (U) **CSO 3.6:** to understand concept of fitness. (U) **CSO 3.7:** to analyse selection coefficient. (A) **CSO 3.8:** to derive one unit of selection for a dominant allele) (A) **CSO 3.9:** to define the genetic load, Genetic Drift, founder's effect, bottleneck phenomenon. (K) **CSO 3.10:** to explain the genetic load, Genetic Drift, founder's effect, bottleneck phenomenon. (U) **CSO 3.11:** to illustrate the role of Migration in changing allele frequencies. (A) **CSO 3.12:** To express how mutation changes allele frequencies. (A)	9	20	
UNIT 4 **Product of evolution**	Micro evolutionary changes (inter-population variations, clines, races) Species concept, Isolating mechanisms,	**CSO 4.1:** To define micro evolutionary changes. (K) **CSO 4.2:** To explain about Micro evolutionary changes. (U) **CSO 4.3:** to correlate inter-	9	20	

	modes of speciation—allopatric, sympatric; Adaptive radiation/macroevolution (exemplified by Galapagos finches)	population variations, clines, races. (A) **CSO 4.4:** to define Species concept. (K) **CSO 4.5:** to discuss about Species concept. (U) **CSO 4.6:** to understand Isolating mechanisms (U) **CSO 4.7:** to examine modes of speciation—allopatric. (A) **CSO 4.8:** to examine modes of speciation—sympatric. (A) **CSO 4.9:** to explain the Adaptive radiation/macroevolution (exemplified by Galapagos finches) (U)			
UNIT 5 Evolution of man and phylogenetic tree	Unique hominin characteristics contrasted with primate characteristics, primate-phylogeny from Dryopithecus leading to Homo sapiens, molecular analysis of human origin. Phylogenetic tree, Multiple Sequence alignment, construction of phylogenetic tree, interpretation of tree	**CSO 5.1:** To contrast Unique hominin characteristics with primate characteristics. (A) **CSO 5.2:** To explain the primate-phylogeny from *Dryopithecus* leading to *Homo sapiens*. (U) **CSO 5.3:** To explain the molecular analysis of human origin. (U) **CSO 5.4:** to define Phylogenetic tree. (K) **CSO 5.5:** to elaborate Phylogenetic tree. (U) **CSO 5.6:** to define Multiple Sequence alignment. (K) **CSO 5.7**: to understand and apply Multiple Sequence alignment. (U+A) **CSO 5.8:** to construct phylogenetic tree. (A) **CSO 5.9:** to interpret phylogenetic tree. (A)	9	20	

NAME OF THE PAPER, CODE : EVOLUTIONARY BIOLOGY, ZOC-6.2 (P)
Number of Credit : 01
Number of Hours of Lecture : 30

PRACTICAL **50 Marks**

1. Study of fossils from models/ pictures
2. Study of homology and analogy from suitable specimens
3. Study and verification of Hardy-Weinberg Law by chi square analysis
4. Demonstration of role of natural selection and genetic drift in changing allele frequencies using simulation studies
5. Graphical representation and interpretation of data of height/ weight of a sample of 100 humans in relation to their age and sex.

SUGGESTED READINGS

1. Ridley,M (2004) Evolution III Edition Blackwell publishing
2. Hall, B.K. and Hallgrimson, B (2008). Evolution IV Edition. Jones and Barlett Publishers.
3. Campbell, N.A. and Reece J.B (2011). Biology. IX Edition. Pearson, Benjamin, Cummings.
4. Douglas, J. Futuyma (1997). Evolutionary Biology. Sinauer Associates.
5. Pevsner, J (2009). Bioinformatics and Functional Genomics. II Edition Wiley-Blackwell

NAME OF THE PAPER (CODE) **: IMMUNOLOGY (ZOC-6.3)**
Number of Credit **: 03**
Number of Hours of Lecture **: 45**

COURSE OBJECTIVES (COs)

The following are the Course Objectives (COs) for the paper **Immunology**:

CO 1:	To create awareness and interest in students about the perspective of immunology and how the immune system operates in organisms.
CO 2:	To make the students understand innate and adaptive immunity.
CO 3:	To create an understanding among students, the structure and function of different classes of immunoglobulins and acquaint them with hybridoma technology.
CO 4:	To inculcate and create interest among students in the understanding of Major Histocompatibility Complex and Cytokines.
CO 5:	To help students gain knowledge and understanding about complement system, hypersensitivity and vaccines.

COURSE SPECIFIC OBJECTIVES (CSOs)

Unit & Title	Unit Contents	Course Specific Objective (CSOs)	Lecture Hours	Marks	LOs
UNIT 1 Overview of Immune System	Historical perspective of Immunology, Cells and organs of the immune system, barriers of immune system	**CSO 1.1:** to define the term Immunity and Immune system. (K) **CSO 1.2:** to describe the historical perspective of immunology. (U) **CSO 1.3:** to explain how immunology progress over time. (U) **CSO 1.4:** to illustrate the cells of the immune system. (A) **CSO 1.5:** to elaborate the organs of the immune system. (U) **CSO 1.6:** to demonstrate how anatomy act as barrier of immune system. (A) **CSO 1.7:** to understand how physiology act as barrier of immune system. (U)	7	16	
UNIT 2 Innate and Adaptive Immunity	Inflammation, Cell and molecules involved in innate immunity, Adaptive immunity (Cell	**CSO 2.1:** to define the term innate and adaptive immunity. (K) **CSO 2.2:** to discuss types of inflammation. (U) **CSO 2.3:** to explain how inflammation is vital to	12	26	

	mediated and humoral); Passive: Artificial and natural Immunity, Active: Artificial and natural Immunity, Immune dysfunctions (brief account of autoimmunity with reference to Rheumatoid Arthritis and tolerance, AIDS).	health. (U) **CSO 2.4:** to generalise Cell and involved in innate immunity. (A) **CSO 2.5:** to summarise the molecules involved in innate immunity (A) **CSO 2.6:** to define adaptive immunity. (K) **CSO 2.7:** to explain adaptive immunity. (U) **CSO 2.8:** to illustrate cell mediated immunity. (A) **CSO 2.9:** to illustrate humoral immunity. (A) **CSO 2.10:** to understand Passive: Artificial and natural Immunity. (U) **CSO 2.11:** to illustrate Active: Artificial and natural Immunity. (A) **CSO 2.12:** to define Immune dysfunctions. (K) **CSO 2.13:** to give a brief account of autoimmunity. (K) **CSO 2.14:** to cite a brief account on Rheumatoid Arthritis. (K) **CSO 2.15:** to define tolerance. (K) **CSO 2.16:** to discuss briefly on AIDS. (U)			
UNIT 3 Immunoglobulins	Structure and functions of different classes of immunoglobulins, Antigen- antibody interactions, Immunoassays (ELISA and RIA). Hybridoma technology: Monoclonal antibodies in therapeutics and diagnosis.	**CSO 3.1:** to define Immunoglobulins. (K) **CSO 3.2:** to explain the structure of Immunoglobulins. (U) **CSO 3.3:** to classify Immunoglobulins. (U) **CSO 3.4:** to explain the different structures of Immunoglobulins. (U) **CSO 3.5:** to illustrate the function of different classes of immunoglobulin. (A) **CSO 3.6:** to define antigen and antibody. (K) **CSO 3.7:** to discuss how	10	22	

		antigen-antibody interacts. (U) **CSO 3.8:** to illustrate different technique for the detection of antigen-antibody interaction. (A) **CSO 3.9:** to define Immunoassay. (K) **CSO 3.10:** to demonstrate the technique of ELISA. (A) **CSO 3.11:** to explain the technique of RIA. (U) **CSO 3.12:** to describe hybridoma technology. (U) **CSO 3.13:** to illustrate the use of Monoclonal antibodies in therapeutics. (A) **CSO 3.14:** to illustrate the use of Monoclonal antibodies in diagnosis. (A)			
UNIT 4 **Major Histocompatibility Complex and Cytokines**	Structure and functions of MHC molecules. Endogenous and exogenous pathways of antigen processing and presentation Properties and functions of cytokines, Therapeutics Cytokines	**CSO 4.1:** to define Major Histocompatibility Complex (MHC). (K) **CSO 4.2:** to define Cytokines. (K) **CSO 4.3:** to illustrate the structure of MHC. (A) **CSO 4.4:** to discuss the function of MHC. (U) **CSO 4.5:** to illustrate the Endogenous pathway of antigen processing and presentation. (A) **CSO 4.6:** to illustrate the exogenous pathway of antigen processing and presentation (A) **CSO 4.7:** to discuss the properties of cytokines. (U) **CSO 4.8:** to demonstrate the function of cytokines. (A) **CSO 4.9:** to interpret the use of cytokines in therapeutics. (A)	8	18	
UNIT 5	Components and	**CSO 5.1:** to define	8	18	

Complement System, Hypersensitivity and Vaccines	pathways of complement activation; Gell and Coombs' classification and brief description of various types of Hypersensitivities; Types of vaccines.	complement system. (K) **CSO 5.2:** to elaborate on various components of complement system. (U) **CSO 5.3:** to interpret the pathways of complement system activation. (A) **CSO 5.4:** to define hypersensitivity. (K) **CSO 5.5:** to classify hypersensitivity base on Gell and Coombs' classification. (U) **CSO 5.6:** to discuss Type I hypersensitivity. (U) **CSO 5.7:** to elaborate Type II hypersensitivity. (U) **CSO 5.8:** to illustrate Type III hypersensitivity. (A) **CSO 5.9:** to explain Type IV hypersensitivity. (U) **CSO 5.10:** to define vaccine. (K) **CSO 5.11:** to discuss types of vaccine.			

NAME OF THE PAPER, CODE : EVOLUTIONARY BIOLOGY, ZOC 6.2 (P)
Number of Credit : 01
Number of Hours of Lecture : 30

PRACTICAL 50 Marks

1. Demonstration of lymphoid organs.
2. Histological study of spleen, thymus and lymph nodes through slides/photographs
3. Preparation of stained blood film to study various types of blood cells.
4. Ouchterlony's double immuno-diffusion method.
5. ABO blood group determination.
6. Demonstration of Immuno-electrophoresis.

SUGGESTED READINGS

1. Kindt, T. J., Goldsby, R.A., Osborne, B. A. and Kuby, J (2006). *Immunology*, W.H. Freeman and Company, VI Edition.
2. David, M., Jonathan, B., David, R. B. and Ivan R. (2006). *Immunology*, Mosby, Elsevier Publication,
VII Edition.
3. Abbas, K. Abul and Lechtman H. Andrew (2003.) *Cellular and Molecular Immunology*, Saunders Publication, V Edition.

NAME OF THE PAPER : PRINCIPLES OF GENETICS (ZOC 6.4)
Number of Credit : 03
Number of Hours of Lecture : 45

COURSE OBJECTIVES (COs):

The following are the Course Objectives (COs) for the paper Principles of Genetics:

CO1:	To understand how nucleic acids transport genetic information and understand the experiments that showed the role of nucleic acids for genetic information.
CO2:	To learn how information are passed from generation to generation through the process of linkage and crossing over.
CO3:	To understand the concept of mutation and its importance.
CO4:	To learn about the phenomenon of sex determination and the factors that affects it.
CO5:	To understand the concept of transfer and uptake of genetic information between cells.

COURSE SPECIFIC OBJECTIVES (CSOs)

Unit & Title	Unit Contents	Course specific outcome (CSOs)	Lecture Hours	Marks	LOs
Unit 1: Mendelian Genetics and its Extension	Principles of inheritance, Incomplete dominance and co-dominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy; Sex-linked, sex-influenced and sex-limited characters inheritance.	**CSO 1.1:** To learn and define different terminologies in genetics. (K) **CSO 1.2:** To define genetics and learn about the experimental procedures of Mendel. (K+U) **CSO 1.3:** To learn the concept of principle of inheritance and tits limitations. (K+U) **CSO 1.4:** To study and understand the different crossing techniques involved in genetics. (K+U) **CSO 1.5:** To understand the laws of inheritance. (U) **CSO 1.6:** To learn the concept of genotype, phenotype, dominance and recessiveness. (U) **CSO 1.7:** To gain information on the chromosomal theory of inheritance. (K+U) **CSO 1.8:** To compare the parallelism between chromosomes and mendelian factors. (U+A) **CSO 1.9:** To understand the concept of incomplete	**9**	**20**	

		dominance and codominanace. (U) **CSO 1.10:** To learn about multiple alleles and pleiotropy. (U) **CSO 1.11:** To learn the concept of lethal genes and epistasis. (K+U) **CSO 1.12:** To learn about sex linked inheritance and its characteristics. (K+U) **CSO 1.13:** To learn about sex influenced traits and sex-limited traits. (K+U)			
Unit 2: Linkage, Crossing Over and Chromosomal Mapping	Linkage and crossing over, Cytological basis of crossing over, Models of recombination; Two factor and three factor crosses, Interference and coincidence, Somatic cell hybridization.	**CSO 2.1:** To define linkage and learn about the concept of linkage. (K) **CSO 2.2:** To understand the different types of linkages with examples. (U) **CSO 2.3:** To define crossing over and learn about its types. (K+U) **CSO 2.4:** To gain information on the factors influencing crossing over and its significance. (U) **CSO 2.5:** To understand the cytological basis of crossing over. (U+A) **CSO 2.6:** To understand the concept of two factor and three factor crosses. (U) **CSO 2.7:** To learn about the molecular mechanism of recombination. (U) **CSO 2.8:** To differentiate between conservative and site-specific recombination. (U) **CSO 2.9:** To explain and understand the Holliday model of recombination. (U) **CSO 2.10:** To learn about double strand break model of recombination. (U) **CSO 2.11:** To define somatic hybridisation, understand the steps involved and its	**9**	**20**	

		applications. (K+U+A)			
Unit 3: Mutations	Types of gene mutations (Classification), Types of chromosomal aberrations; Molecular basis of mutations in relation to UV light and chemical mutagens; Detection of mutations: CLB method, attached *X* method.	**CSO 3.1:** Introduction to mutation and its definition. (K) CSO 3.2: **To learn about the types** of mutation. (U) **CSO 3.3:** To learn about the molecular basis of gene mutation. (U) **CSO 3.4:** To learn about the importance of gene mutation. (U) **CSO 3.5:** To learn the concept of chromosomal aberrations. (K) **CSO 3.6:** To understand the different types of structural chromosomal aberration with examples. (U) **CSO 3.7:** To learn about the types of numeral chromosomal aberrations with examples. (U) **CSO 3.8:** To learn the molecular basis of gene mutation. (U) **CSO 3.9:** To study about the different physical agents that causes mutation. (U) **CSO 3.10:** To learn about the different types of chemical agents that causes gene mutation. (U) **CSO 3.11:** To learn about the different methods for detecting gene mutation. (U+A)	**9**	**20**	
Unit 4: Sex Determination, Extra-chromosomal Inheritance and Polygenic Inheritance	Chromosomal mechanisms of sex determination in Drosophila and Man; Criteria for extra-chromosomal inheritance, Mitochondrial	**CSO 4.1:** To define sex determination and understand the concept. (K) **CSO 4.2:** To gain information on chromosomal sex determination. (U) **CSO 4.3:** To learn about environmental sex determination. (U) **CSO 4.4:** To study sex	**9**	**20**	

	mutations in *Saccharomyces,* Infective heredity in *Paramecium* and Maternal effects; Polygenic inheritance with an example.	determination in Drosophila. (U) **CSO 4.5:** To study sex determination in humans. (U) **CSO 4.6:** To understand the concept of extra chromosomal inheritance. (K) **CSO 4.7:** To learn the criteria for extra chromosomal inheritance. (U) **CSO 4.8:** To study about plastid inheritance in *Mirabilis jalapa.* (U) **CSO 4.9:** To learn about cytoplasmic male sterility in maize. (U) **CSO 4.10:** To understand maternal effect in snail. (U) **CSO 4.11:** To study mitochondrial mutation in Saccharomyces with examples. (U) **CSO 4.12:** To learn about infective inheritance in Paramecium. (U) **CSO 4.13:** To study polygenic inheritance and their characteristics and examples. (U)			
Unit 5: Recombination in Bacteria and Viruses and Transposable Genetic Elements	Conjugation, Transformation, Transduction in Bacteriophage; Transposons in bacteria, Transposons in humans.	**CSO 5.1:** To learn the concept of conjugation in bacteria. (K) **CSO 5.2:** To learn about the different types of plasmids. (K) CSO 5.3: To understand the mechanism of conjugation and the different components. (U) **CSO 5.4:** To study the steps of and applications of bacterial conjugation. (U+A) **CSO 5.5:** To understand the concept of transformation. (K) **CSO 5.6:** To understand the principle and mechanism of bacterial transformation. (U) **CSO 5.7:** To learn the steps	**9**	**20**	

		involved in bacterial transformation. (U) **CSO 5.8:** To study Griffiths experiment as a model for bacterial transformation. (U) **CSO 5.9:** To define and learn the concept of transduction. (K+U) **CSO 5.10:** To differentiate between lytic and lysogenic cyles. (U) **CSO 5.11:** To learn about the different types of transductions and the steps involved. (U) **CSO 5.12:** To study about the types of transposons in humans. (U) **CSO 5.13:** To learn about the different types of transposons in bacteria. (U)			

NAME OF THE PAPER, CODE : PRINCIPLES OF GENETICS, ZOC 6.4 (P)
Number of Credit : 01
Number of Hours of Lecture : 30

PRACTICALS **50 Marks**

1. Chi-square analysis of the law of segregation using coins.
2. Linkage maps based on data from *Drosophila* crosses.
3. Study of human karyotype (normal and abnormal).
4. Pedigree analysis of some human inherited traits.
5. Chi-square analysis of the law of independent assortment using beads

SUGGESTED READINGS

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). *Principles of Genetics*. VIII Edition. Wiley India
2. Snustad, D.P., Simmons, M.J. (2009). *Principles of Genetics*. V Edition. John Wiley and Sons Inc
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). *Concepts of Genetics*. X Edition. Benjamin Cummings

NAME OF THE PAPER (CODE) : **REPRODUCTIVE BIOLOGY (ZOC 7.1)**
Number of Credit : **03**
Number of Hours of Lecture : **45**

COURSE OBJECTIVES (COs)

The following are the Course Objectives (COs) for the paper **Reproductive Biology:**

CO 1:	To make the students understand the gonadal hormones, mechanism of hormone action and sex differentiation.
CO 2:	To make students understand the functional anatomy of the male reproductive system.
CO 3:	To make students understand the functional anatomy of the female reproductive system.
CO 4:	To impart knowledge to the students about fertilization in human
CO 5:	To impart knowledge to the students about infertility in males and females, assisted reproductive technologies and modern contraceptive techniques.

COURSE SPECIFIC OBJECTIVES (CSOs)

Unit & Title	Unit Contents	Course Specific Objectives (CSOs)	Lecture Hours	Marks	LOs
UNIT 1 Reproductive Endocrinology	Gonadal hormones and mechanism of hormone action, steroids, glycoprotein hormones, and prostaglandins, hypothalamo – hypophyseal – gonadal axis, regulation of gonadotrophin secretion in male and female; Reproductive System: Development and differentiation of gonads, mechanism of sex differentiation.	**CSO 1.1:** to explain about Gonadal hormones. (U) **CSO 1.2:** to describe about the mechanism of hormone Action. (K) **CSO 1.3:** to explain on steroids. (U) **CSO 1.4:** to explain on glycoprotein hormones. (U) **CSO 1.5:** to explain on prostaglandins. (U) **CSO 1.6:** To discuss about hypothalamo – hypophyseal – gonadal axis. (U) **CSO 1.7:** to describe the regulation of gonadotrophin secretion in male and female. (K) **CSO 1.8:** to explain on the Reproductive System. (U) **CSO 1.9:** to elucidate the development of gonads. (A) **CSO 1.10:** to understand the differentiation of gonads. (U) **CSO 1.11:** to elaborate on the mechanism of sex differentiation. (U)	10	22	

UNIT 2 Functional anatomy of male reproduction	Histology of male reproductive system in human; Testis: Cellular functions; Spermatogenesis : kinetics and hormonal regulation; Androgen synthesis and metabolism; Epididymal function and sperm maturation; Accessory glands functions; Sperm transportation in male tract.	**CSO 2.1**: To outline the histology of male reproductive system in human. (K) **CSO 2.2:** To outline the histology of male reproductive system in rat. (K). **CSO 2.3:** To discuss Spermatogenesis, its kinetics and hormonal regulation. (U). **CSO 2.4:** To explain hormonal regulation of spermatogenesis. (U) **CSO 2.5:** To describe Androgen synthesis. (K) **CSO 2.6:** To describe metabolism of Androgen synthesis. (K) **CSO 2.7:** To explain the epididymal function. (U) **CSO 2.8:** to elaborate on sperm maturation. (U) **CSO 2.9:** To describe the accessory glands functions. (K) **CSO 2.10:** to illustrate sperm transportation in male tract. (K)	10	22	
UNIT 3 Functional anatomy of female reproduction	Histology of female reproductive system in human; Ovary: folliculogenesis, ovulation, corpus luteum formation and regression; Steroidogenesis and secretion of ovarian hormones; Reproductive cycles (rat and human) and their regulation.	**CSO 3.1:** To outline histology of female reproductive system in human. (K) **CSO 3.2:** To outline histology of female reproductive system in rat. (K) **CSO 3.3:** To explain on folliculogenesis, ovulation, corpus luteum formation and regression. (U) **CSO 3.4:** To explain on Steroidogenesis. (U) **CSO 3.5:** to describe the secretion of ovarian hormones. (K) **CSO 3.6:** To elaborate on the reproductive cycles of rat and their regulation. (U) **CSO 3.7:** To summarize on the reproductive cycles of human and their regulation. (A)	8	18	
UNIT 4 Fertilization	Ovum transport in the fallopian tubes; Sperm transport in the female tract, fertilization;	**CSO 4.1:** to explain ovum transport in the fallopian tube. (U) **CSO 4.2:** to explain sperm transport in the female tract and fertilization. (U) **CSO 4.3:** to describe the hormonal	8	18	

	Hormonal control of implantation; Hormonal regulation of gestation, foeto – maternal relationship; Mechanism of parturition; Lactation.	control of implantation. (K) **CSO 4.4:** to describe the hormonal regulation of gestation, foeto – maternal relationship. (K) **CSO 4.5:** to describe the hormonal regulation of foeto – maternal relationship. (K) **CSO 4.6:** to explain on the mechanism of parturition. (U) **CSO 4.7:** to explain on the mechanism of lactation. (U)			
UNIT 5 Reproductive Health	Infertility in male and female: causes, diagnosis and management; Assisted Reproductive Technology: sex selection, sperm banks, frozen embryos, in vitro fertilization, ET, EFT, IUT, ZIFT, GIFT, ICSI, PROST; Modern contraceptive technologies; Demographic terminology used in family planning.	**CSO 5.1:** to explain on infertility in male - causes diagnostics and management. (U) **CSO 5.2**: to explain on infertility in female - causes diagnostics and management. (U) **CSO 5.3:** to define Assisted Reproductive Technology. (K) **CSO 5.4:** to explain on sex selection, sperm banks, (U) **CSO 5.5:** to explain on frozen embryo and in vitro fertilization. (U) **CSO 5.6:** to explain on ET, EFT. (U) **CSO 5.7:** to explain on IUT, ZIFT, GIFT. (U) **CSO 5.8:** to explain on ICSI, PROST. (U) **CSO 5.9:** to discuss on modern contraceptive technologies and its Demographic terminology used in family planning. (U)	9	20	

NAME OF THE PAPER, CODE : REPRODUCTIVE BIOLOGY, ZOC 7.1 (P)
Number of Credit : 01
Number of Hours of Lecture : 30

PRACTICAL **50 Marks**

1. Study of animal house: set up and maintenance of animal house, breeding techniques, care of normal and experimental animals.
2. Examination of vaginal smear from live rats.
3. Surgical techniques: principles of surgery in endocrinology- Ovariectomy and castration in rats.
4. Examination of histological sections from photomicrographs/ permanent slides of rat: testis, epididymis and accessory glands of male reproductive systems; Sections of ovary, fallopian tube, uterus (proliferative and secretory stages), cervix and vagina.
5. Sperm count and sperm motility in rat.
6. Study of modern contraceptive devices

SUGGESTED READINGS:

• Austin, C.R. and Short, R.V. reproduction in Mammals. Cambridge University Press.
• Degroot, L.J. and Jameson, J.L. (eds). Endocrinology. W.B. Saunders and Company.
• Knobil, E. et al. (eds). The Physiology of Reproduction. Raven Press Ltd.
• Hatcher, R.A. et al. The Essentials of Contraceptive Technology. Population Information

NAME OF THE PAPER (CODE) : ENDOCRINOLOGY (ZOC 7.2)
Number of Credit : 03
Number of Hours of Lecture : 45

COURSE OBJECTIVES (COs)

The following are the Course Objectives (COs) for the paper **Endocrinology:**

CO 1:	To have developed understanding on introduction to endocrinology
CO 2:	To have developed basic knowledge about pineal gland
CO 3:	To inculcate knowledge about the pituitary gland
CO 4:	To have developed the understanding of the peripheral endocrine glands
CO 5:	To impart knowledge about the regulation of hormone action

COURSE SPECIFIC OBJECTIVES (CSOs)

Unit & Title	Unit Contents	Course Specific Objectives (CSOs)	Lecture Hours	Marks	LOs
UNIT 1 Introduction to Endocrinology	History of endocrinology, Classification, Characteristic and Transport of Hormones, Neurosecretions and Neurohormones	**CSO 1.1:** to discuss about the history of endocrinology. (U) **CSO 1.2:** to define hormone. (K) **CSO 1.3:** to explain on the classification of hormones. (U) **CSO 1.4:** to explain on the characteristics of hormones. (U) **CSO 1.5:** to explain on the transport of hormones. (U) **CSO 1.6:** to explain on neurosecretions and neurohormones. (U) **CSO 1.7**: to explain on neurohormones. (U)	9	20	
UNIT 2 Pineal gland	Structure of pineal gland, Secretions and their functions in biological rhythms and reproduction. Structure of hypothalamus, Hypothalamic nuclei and their functions,	**CSO 2.1:** to describe the structure of pineal gland. (K) **CSO 2.2:** to explain the secretions of pineal gland. (U) **CSO 2.3:** to discuss the functions of pineal gland in biological rhythms. (U) **CSO 2.4:** to discuss the functions of pineal gland in reproduction. (U) **CSO 2.5:** to describe the structure of hypothalamus and its function. (K) **CSO 2.6:** to describe the structure of	9	20	

	Regulation of neuroendocrine glands, Feedback mechanisms	hypothalamic nuclei and its function. (K) **CSO 2.7:** to discuss on the regulations of neuroendocrine glands. (U) **CSO 2.8:** to explain on the feedback mechanism of the neuroendocrine glands. (U)			
UNIT 3 Pituitary gland	Structure of pituitary gland, Hormones and their functions, Hypothalamo-hypophysial portal system, Disorders of pituitary gland	**CSO 3.1:** to describe the structure of the pituitary gland. (K) **CSO 3.2**: to explain on hormones and their functions. (U) **CSO 3.3:** to explain on Hypothalamo-hypophysial portal System. (U) **CSO 3.4:** to discuss on the disorders of pituitary gland. (U)	6	14	
UNIT 4 Peripheral Endocrine Glands	Structure, Hormones, Functions and Regulation of Thyroid gland, Parathyroid, Adrenal, Pancreas, Ovary and Testis Hormones in homeostasis	**CSO 4.1:** to define peripheral endocrine glands. (K) **CSO 4.2:** to describe the structure of thyroid gland. (K) **CSO 4.3:** to explain on the function and regulations of the thyroid gland. (U) **CSO 4.4:** to describe the structure of the parathyroid gland. (K) **CSO 4.5:** to explain on the function and regulations of the parathyroid gland. (U) **CSO 4.6:** to describe the structure of the adrenal gland(K) **CSO 4.7:** to explain on the function and regulations of the adrenal gland. (U) **CSO 4.8:** to describe the structure of the pancreas. (K) **CSO 4.9:** to explain on the function and regulations of the pancreas. (U) **CSO 4.10:** to describe the structure of the ovary. (K) **CSO 4.11:** to explain on the function and regulations of the Ovary. (U) **CSO 4.12**: to describe Testis hormone in homeostasis. (K)	12	26	

UNIT 5 Regulation of Hormone Action	Hormone action at Cellular level: Hormone receptors, transduction and regulation; Hormone action at Molecular level: Molecular mediators, Genetic control of hormone action.	**CSO 5.1:** to describe hormone action at cellular level. (K) To explain about Hormone action at Cellular level **CSO 5.2:** To discuss about hormone receptors, transduction and regulation. (U) **CSO 5.3:** To describe the hormone action at Molecular level. (K) **CSO 5.4:** To explain about the Molecular mediators. (U) **CSO 5.5:** To explain the Genetic control of hormone action. (U)	9	20	

NAME OF THE PAPER, CODE : ENDOCRINOLOGY, ZOC 7.2 (P)
Number of Credit : 01
Number of Hours of Lecture : 30

PRACTICAL **50 Marks**

1. Dissect and display of Endocrine glands in laboratory bred rat
2. Study of the permanent slides of all the endocrine glands
3. Demonstration of hypophysectomy in fishes.
4. Designing of primers of any hormone/gene.
5. Demonstration of thyroidectomy in rats/mice.
6. Demonstration of adrenalectomy in rats/mice

SUGGESTED READINGS

1. General Endocrinology C. Donnell Turner Pub- Saunders Toppan
2. Endocrinology: An Integrated Approach; Stephen Nussey and Saffron Whitehead. Oxford: BIOS Scientific Publishers; 2001.
3. Hadley, M.E. and Levine J.E. 2007. Endocrinology, 6th Edition. Pearson Prentice-Hall, Pearson Education Inc., New Jersey.
4. Vertebrate Endocrinology by David O. Norris,

NAME OF THE PAPER (CODE) : RESEARCH METHODOLOGY (RM 7)
Number of Credit : 03
Number of Hours of Lecture : 45

COURSE OBJECTIVES (COs)

The following are the Course Objectives (COs) for the paper Research Methodology

CO 1:	To understand the concept of research and types of research.
CO 2:	To acquire knowledge about various research designs.
CO 3:	To learn about different methods of data collection, analysis and biological problems.
CO 4:	To learn the art of scientific writing and its presentation.
CO 5:	To be aware of various ethical issues relating to research.

COURSE SPECIFIC OBJECTIVES (CSOs)

Unit & Title	Unit Contents	Course Specific Objective (CSOs)	Lecture Hours	Marks	LOs
UNIT 1 Foundations of Research	Meaning, Objectives, Motivation: Research Methods vs Methodology. Types of Research: Analytical vs Descriptive, Quantitative vs Qualitative, Basic vs Applied.	**CSO 1.1:** To explain about Meaning, Objectives, Motivation of research (U). **CSO 1.2:** To discuss about Research Methods and Methodology (U). **CSO 1.3:** To explain types of Research (U). **CSO 1.4:** to define Analytical research. (K) **CSO 1.5:** to explain descriptive research. (U) **CSO 1.6:** To compare Analytical and Descriptive, **CSO 1.7:** to analyse Quantitative and Qualitative. (A) **CSO 1.8:** to contrast basic and Applied research. (A)	**6**	**14**	
UNIT 2 **Research Design**	Need for research design: Features of good design, Important concepts related to good design-Observation and Facts, Prediction and Explanation, Development of Models. Developing a research plan: Problem identification, Experimentation,	**CSO 1:** To explain about need for research design (U) **CSO 2.2:** To discuss about Features of good design. (U) **CSO 2.3:** To illustrate important concepts related to good design-Observation and Facts, Prediction and Explanation. (A) **CSO 2.4**: to understand the development of Models. (U). **CSO 2.5:** To explain about developing a research plan. (U) **CSO 2.6:** To explain the Problem identification,	**9**	**20**	

	Determining experimental and sample designs.	**CSO 2.7:** to solve problems relating to Experimentation. (A) **CSO 2.8:** to determine experimental and sample designs. (A)			
UNIT 3 Data Collection, Analysis and Biological problems	Observation and Collection of Data: Methods of data collection- Sampling Methods, Data Processing and Analysis Strategies. Imaging of tissue specimens and application of scale bars. The art of field photography. History: Key biology research areas, Model organisms in biology (A Brief overview)- Genetics, Physiology, Biochemistry, Molecular Biology, Cell Biology, Genomics.	**CSO 3.1:** To explain about Observation and Collection of Data (U). **CSO 3.2:** To discuss about methods of data collection. (U) **CSO 3.3:** To explain the imaging of tissue specimens and field photography. (U) **CSO 3.4:** to discuss about the key biology research areas, Model organisms in biology (U). **CSO 3.5:** to discuss a brief overview of Genetics, Physiology, Biochemistry, Molecular Biology, Cell Biology, Genomics (U).	**12**	**26**	
UNIT 4 The art of scientific writing and its presentation	Numbers, units, abbreviations and nomenclature used in scientific writing. Technical Reports and Thesis writing, Preparation of Tables and Bibliography, Power point presentation, Poster presentation, Data Presentation using digital technology.	**CSO 4.1:** To explain about Numbers, units, abbreviations and nomenclature used in scientific writing (U). **CSO 4.2:** to describe technical reports(K) **CSO 4.3:** to define thesis writing (K) **CSO 4.4:** to explain types thesis writing (U) **CSO 4.5:** to describe Preparation of Tables and Bibliography (K). **CSO 4.6:** to explain Power point presentation (U) **CSO 4.7:** to discuss preparation of poster presentation (U) **CSO 4.8:** to explain data presentation using digital technology. (U)	**9**	**20**	
UNIT 5	Intellectual property	**CSO 5.1:** To explain about	**7**	**16**	

Ethical Issues	Rights, Commercialization, Copy Right, Royalty, Patent law Plagiarism, Citation, Acknowledgement.	Intellectual property Rights. (U). **CSO 5.2:** To discuss about Commercialization, Copy Right, Royalty, Patent law (U). **CSO 5.3:** To describe about Plagiarism, Citation and Acknowledgement. (U).			

NAME OF THE PAPER, CODE : RESEARCH METHODOLOGY, RM 7 (P)
Number of Credit : 01
Number of Hours of Lecture : 30

PRACTICAL **50 Marks**

1. Experiments based on chemical calculations.
2. Experiments based on research design.
3. The art of imaging of samples through foldscope and field photography.
4. Poster making on defined topics.
5. Technical writing on topics assigned.

SUGGESTED READINGS

- Anthony, M, Graziano, A.M. and Raulin, M.L. 2009. Research Methods: A Process of Inquiry, Allyn and Bacon.
- Walliman, N. 2011.Research Methods- The Basics. Taylor and Francis, London, New York.
- Wadhera, B.L.: Law Relating to Patents, Trade Marks, Copyright Designs and Geographical Indications, 2002, Universal Law publishing.
- C.R.Kothari: Research Methodology, New Age International, 2009
- Coley, S.M. and Scheinberg, C.A. 1990, "Proposal writing". Stage Publications.

NAME OF THE PAPER (CODE) **: Biology of Insecta (ZOC 8.1)**
Number of Credit **: 03**
Number of Hours of Lecture **: 45**

COURSE OBJECTIVES (COs):

The following are the Course Objectives (COs) for the paper **Biology of Insecta**:

CO1:	To attain a solid foundation in insect biology, including general entomology, basic systematic and biodiversity.
CO2:	To gain information on the morphology of insects.
CO3:	To understand the unique anatomical and physiological characteristics features of insects.
CO4:	To conduct studies related to all aspects of ecology related to insect-borne diseases.
CO5:	To carry out studies on the identification and taxonomy of vectors and evaluate the status of the associated group of insects.

COURSE SPECIFIC OBJECTIVES (CSOs)

Unit & Title	Unit Contents	Course specific outcome (CSOs)	Lecture Hours	Marks	LOs
Unit 1: Introduction and Insect Taxonomy	General Features of Insects; Distribution and Success of Insects on the Earth; Basis of insect classification; Classification of insects up to orders.	**CSO 1.1:** Introduction to insects. (K) **CSO 1.2:** To understand the basis of classification of insects. (U) **CSO 1.3:** To classify insecta up to orders. (K) **CSO 1.4:** To study the characteristic features of the subclass apterygota. (K+U) **CSO 1.5:** To study the features of insect orders ephemeroptera, odonota, orthoptera, dicyoptera, phasmida and plecopters. (K+U) **CSO 1.6:** To learn the features of isoptera, zoraptera, embioptyera, dermaptera, pscoptera. (K+U) **CSO 1.7:** To study the features of mallophaga, aneupleura, thysanoptera, hemiptera and Grylloblattoidea. (K+U) **CSO 1.8:** To study the features of Neuroptera, Coleoptera, Strepsiptera, Mecoptera and Trichoptera. (K+U) **CSO 1.9:** To study the features of Lepidoptera, Hymenoptera, Diptera and Siphonaptera. (K+U) **CSO 1.10:** To study the different reasons for the success of insects. (U)	**9**	**20**	

Unit 2: General Morphology of Insects	External Features; Head – Eyes, Types of antennae, Mouth parts w.r.t. feeding habits; Thorax: Wings and wing articulation, Types of Legs adapted to diverse habitat; Abdominal appendages and genitalia.	**CSO 2.1:** Introduction to different body parts of insects. (K) **CSO 2.2:** To study the different parts of insect head. (K+U) **CSO 2.3:** To learn about the structure of thorax of insects. (K) **CSO 2.4:** To study the structure of wings. (U) **CSO 2.5:** To study the structure of abdomen of insects. (K+U) **CSO 2.6:** To study the structure of male and female genitalia of insects. (K+U) **CSO 2.7:** To discuss the structure of insect legs. (K) **CSO 2.8:** To differentiate the types of legs of insects. (U) **CSO 2.9:** To discuss the structure and types of mouthparts of insects. (K+U) **CSO 2.10:** To discuss the structure and types of antennae of insects. (K+U)	**9**	**20**	
Unit 3: Physiology of Insects: body systems	Structure and physiology of: Integumentary, Digestive, Excretory, Circulatory, Respiratory and Reproductive systems.	**CSO 3.1:** To learn the basics of integumentary system of insects. (K) **CSO 3.2:** To discuss the structure of insect cuticle. (K) **CSO 3.3:** To discuss the components of insect cuticle. (U) **CSO 3.4:** To study different integument modifications. (U) **CSO 3.5:** To discuss the digestive system of insects. (U) **CSO 3.6:** To discuss the movement of food through insect gut. (U) **CSO 3.7:** To learn about the excretory system of insects. (U) **CSO 3.8:** To discuss the circulatory system of insects. (U) **CSO 3.9:** To discuss the respiratory system of insects. (U) **CSO 3.10:** To discuss the male reproductive system of insects. (U) **CSO 3.11:** To discuss the female reproductive system of insects. (U)	**9**	**20**	

Unit 4: Physiology of Insects: endocrine systems and sensory receptors	Structure and function: Endocrine and nervous system; Sensory receptors Growth and metamorphosis	**CSO 4.1:** Introduction to endocrine system of insects. (K) **CSO 4.2:** To discuss and learn about the different cells and glands of endocrine system of insects. (K+U) **CSO 4.3:** Introduction to nervous system of insects. (K) **CSO 4.4:** To learn about the central nervous system of insects. (U) **CSO 4.5:** To study the stomodeal nervous system of insects. (U) **CSO 4.6:** Introduction to sensory receptors of insects. (K) **CSO 4.7:** To discuss the different types of receptors in insects. (U) **CSO 4.8:** To study the different types of metamorphosis in insects. (K+U) **CSO 4.9:** To learn the concept of endocrine control of moulting in insects. (U) **CSO 4.10:** To discuss the characteristics of moulting hormones in insects. (U)	**9**	**20**	
Unit 5: Insect Society and Insects as Vectors	Group of social insects and their social life; Social organization and social behaviour (w.r.t. any one example); Insects as mechanical and biological vectors, Brief discussion on houseflies and mosquitoes as important insect vectors.	**CSO 5.1:** Introduction to social life in insects. (K) **CSO 5.2:** To discuss the different types of social insects. (U) **CSO 5.3:** To study the general characteristics of social insects. (U) **CSO 5.4:** To discuss the importance of sociality in insects. (U) **CSO 5.5:** To discuss the social organisation of termites. (U) **CSO 5.6:** To discuss the social organisation of bees. (U) **CSO 5.7:** To learn the concept of swarming and formation of new colonies in bees. (U) **CSO 5.8:** To discuss the social structure of ants. (U) **CSO 5.9:** To learn the concept of formation of new colonies in ants. (U)	**9**	**20**	

NAME OF THE PAPER, CODE : Biology of Insecta, ZOC 8.1 (P)
Number of Credit : 01
Number of Hours of Lecture : 30

PRACTICAL 50 Marks

1. Study of different kinds of antennae, legs and mouth parts of insects.
2. Morphological studies of various castes of *Apis.*
3. Study of any insect pests and their damages.
4. Study of any three beneficial insects and their products.
5. Study of insect spiracles.
6. Field study of insects and submission of a project report on the insect diversity.

SUGGESTED READINGS

1. A general text book of entomology, Imms, A. D., Chapman & Hall, UK
2. The Insects: Structure and function, Chapman, R. F., Cambridge University Press, UK
3. Principles of Insect Morphology, Snodgrass, R. E., Cornell Univ. Press, USA
4. Introduction to the study of insects, Borror, D. J., Triplehorn, C. A., and Johnson, N. F., M Saunders College Publication, USA

NAME OF THE PAPER (CODE) : PARASITOLOGY (ZOC 8.2)
Number of Credit : 03
Number of Hours of Lecture : 45

COURSE OBJECTIVES (COs)
The following are the course objectives for the paper Parasitology

CO 1	To provide students with knowledge concerning biological, epidemiological and ecological aspects of parasites causing diseases to humans.
CO 2	To enable students to understand the pathogenesis, clinical presentations and complications of parasitic diseases.
CO 3	To enable students to reach diagnosis and know the general outline of treatment, prevention and control of parasitic platyhelminth's infections.
CO 4	To enable students to reach diagnosis and know the general outline of treatment, prevention and control of parasitic nematodes infections.
CO 5	To make the students aware of importance of controlling parasitic arthropoda and vertebrates.

COURSE SPECIFIC OBJECTIVES (CSOs)

Unit & Title	Unit Contents	Course Specific Objective (CSOs)	Lecture Hours	Marks	LOs
Unit 1: Introduction to Parasitology	Brief introduction of Parasitism, Parasite, Parasitoid and Vectors (mechanical and biological vector), Host parasite relationship	**CSO 1.1:** To explain a brief introduction of Parasitism. (U) **CSO 1.2:** To define Parasite, Parasitoid and Vectors and discuss its matters (mechanical and biological vector). (K+U) **CSO 1.3:** To explain about host parasite relationship. (U)	**5**	**12**	
Unit 2: Parasitic Protists	Study of Morphology, Life-Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Entamoeba histolytica*, *Giardia intestinalis* and *Leishmania donovani.*	**CSO 2.1:** To study about Morphology, Life Cycle, Prevalence, Epidemiology of Entamoeba histolytica. (U) **CSO 2.2:** To Study the Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Entamoeba histolytica* (U) **CSO 2.3:** To study about Morphology, Life Cycle, Prevalence, Epidemiology of *Giardia intestinal*is (U) **CSO 2.4:** To study the Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Giardia intestinalis (U)* **CSO 2.5:** To study about	**10**	**22**	

		Morphology, Life Cycle, Prevalence, Epidemiology of *Leishmania donovani* (U) **CSO 2.6:** To study about the Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Leishmania donovani*. *(U)*			
Unit 3: Parasitic Platyhelminthes	Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Fasciolopsis buski*, *Schistosoma haematobium* and *Taenia solium*.	**CSO 3.1:** To Study about Morphology, Life Cycle, Prevalence, Epidemiology of *Fasciolopsis buski (U)* **CSO 3.2:** To study the Pathogenicity, Diagnosis, Prophylaxis and Treatment of F*asciolopsis buski (U)* **CSO 3.3:** To Study about Morphology, Life Cycle, Prevalence, Epidemiology of *Schistosoma haematobium (U)* **CSO 3.4:** To study the Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Schistosoma haematobium (U)* **CSO 3.5:** To Study about Morphology, Life Cycle, Prevalence, Epidemiology of *Taenia solium. (U)* **CSO 3.6:** To study the Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Taenia solium. (U)*	**9**	**20**	
Unit 4: Parasitic Nematodes	Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Wuchereria bancrofti* and *Trichinella spiralis*. Study of structure, life cycle and importance of *Meloidogyne* (root knot nematode),	**CSO 4.1:** To Study about Morphology, Life Cycle, Prevalence, Epidemiology of Wucheria bancrofti (U) **CSO 4.2:** To study about Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Wuchereria bancrofti*. (U) **CSO 4.3:** To Study about Morphology, Life Cycle, Prevalence, Epidemiology of Trichinella spiralis. (U) **CSO 4.4:** To study about Pathogenicity, Diagnosis, Prophylaxis and Treatment of Trichinella spiralis. (U)	**12**	**26**	

	Pratylencus (lesion nematode).	**CSO 4.5:** To Study about structure, life cycle and importance of Meloidogyne (root knot nematode), Pratylencus (lesion nematode). (U)			
Unit 5: Parasitic Arthropoda and Vertebrates	Biology, importance and control of ticks, *Pediculus humanus* (head and body louse), *Xenopsylla cheopis* and *Cimex lectularius* A brief account of parasitic vertebrates; Cookicutter Shark, Hood Mockingbird and Vampire bat.	**CSO 5.1:** To explain about Biology, importance and control of ticks, Pediculus humanus (head and body louse), Xenopsylla cheopis and Cimex lectularius (U) **CSO 5.2:** To give a brief account of parasitic vertebrates; Cookicutter Shark, Hood Mockingbird and Vampire bat. (U)	**9**	**20**	

NAME OF THE PAPER, CODE : PARASITOLOGY, ZOC 8.2 (P)
Number of Credit : 01
Number of Hours of Lecture : 30

PRACTICAL **50 Marks**

1. Study of life stages of *Entamoeba histolytica*, *Trypanosoma gambiense*, *Leishmania donovani* through permanent slides/micro photographs.
2. Study of adult and life stages of *Fasciolopsis buski* and *Taenia solium* through permanent slides/micro photographs.
3. Study of adult and life stages of *Wuchereria bancrofti* and *Trichinellaspiralis* through permanent slides/micro photographs.
4. Study of plant parasitic root knot nematode, *Meloidogyne* from the soil sample.
5. Study of *Pediculus humanus* (Head louse and Body louse), *Xenopsylla cheopis* and *Cimex lectularius* through permanent slides/ photographs.
6. Study of nematode/cestode parasites from the intestines of Poultry bird. [Intestine can be procured from poultry/market as a by-product.
7. Submission of a brief report on external parasites of economically important mammals.

SUGGESTED READINGS:

• Arora, D. R and Arora, B. (2001) Medical Parasitology. II Edition. CBS Publications and Distributors
• Parija, S. C. Textbook of medical parasitology, protozoology & helminthology (Text and colour Atlas), II Edition, All India Publishers & Distributers, Medical Books Publishers, Chennai, Delhi
• K. D. Chatterjee (2009). Parasitology: Protozoology and Helminthology. XIII Edition, CBS Publishers & Distributors (P) Ltd**.**

NAME OF THE PAPER (CODE) : **FISH AND FISHERIES (ZOC- 8.3)**
Number of Credit : **03**
Number of Hours of Lecture : **45**

COURSE OBJECTIVES (COs)

The following are the Course Objectives (COs) for the paper Fish and Fisheries:

CO 1:	To make the students understand the general classification of Fishes and its habitat.
CO 2:	To make students understand the different morphology and physiology which will help them to identify fish species.
CO 3:	To inculcate knowledge in students about different types of fisheries its law and regulations
CO 4:	To impart knowledge to the students about different aquaculture techniques
CO 5:	To have developed the understanding of fish diseases and processing of fish.

COURSE SPECIFIC OBJECTIVES (CSOs)

Unit & Title	Unit Contents	Course Specific Objectives (CSOs)	Lecture Hours	Marks	LOs
UNIT 1 Introduction and Classification	General description of fish; Account of systematic classification of fishes (up to classes); Classification based on feeding habit, habitat and manner of reproduction.	**CSO 1.1:** to characterize the general classification of Fishes up to classes. (U) **CSO 1.2:** to enumerate the classification of fishes based on feeding habit. (K) **CSO 1.3:** to describe the habitat of fishes (K) **CSO 1.4:** to describe the manner of reproduction in fishes	8	18	
UNIT 2 Morphology and Physiology	Types of fins and their modifications; Locomotion in fishes; Types of Scales, Use of scales in Classification and determination of age of fish; Gills and gas	**CSO 2.1:** to classify the different types of fins and their modifications. (U) **CSO 2.2:** to explain the locomotion in fishes. (U) **CSO 2.3:** to list out the type of scales in fishes. (K) **CSO 2.4:** to identify the classification of fish age through scales. (A) **CSO 2.5:** to outline the different types of gills and gas exchange in	10	22	

	exchange; Swim Bladder: Types and role in Respiration; Osmoregulation in Elasmobranchs; Reproductive strategies (special reference to Indian fishes); Electric organs; Parental care; Migration	fish. (K) **CSO 2.6:** to elaborate on the role of swim bladder in fishes for respiration. (U) **CSO 2.7:** to discuss on the osmoregulation in Elasmobranchs. (U) **CSO 2.8:** to explain the electric organ in fishes. (U) CSO 2.9: to describe parental care in fishes. (K) **CSO 2.10:** to discuss on the migration in fishes. (U)			
UNIT 3 Fisheries	Inland Fisheries; Marine Fisheries; Fishing crafts and Gears; Depletion of fisheries resources; Application of remote sensing and GIS in fisheries; Fisheries law and regulations	**CSO 3.1:** to define Inland fisheries and Marine fisheries. (K) **CSO 3.2:** to explain the different types of fishing crafts and gears. (U) **CSO 3.3**: to discuss on the depletion of resources in fisheries. (U) **CSO 3.4:** to explain the application of remote sensing and GIS in fisheries. (U) **CSO 3.5:** to discuss on the fisheries law and regulations. (U)	9	20	
UNIT 4 Aquaculture	Sustainable Aquaculture; Extensive, semi-intensive and intensive culture of fish; Pen and cage culture; Polyculture; Composite fish culture; Induced breeding of fish; Preparation and maintenance of fish aquarium; Preparation of compound diets for fish; Role of	**CSO 4.1:** to define sustainable aquaculture. (K) **CSO 4.2:** to explain on the Extensive, semi-intensive and intensive culture of fish. (U) **CSO 4.3:** to explain on the Pen and cage culture in fish. (U) **CSO 4.4:** to explain on polyculture in fishes. (U) **CSO 4.5:** to explain on the Composite culture in fish. (U) **CSO 4.6:** to describe induced breeding in fish. (K) **CSO 4.7:** to explain on the preparation and maintenance of fish aquarium. (U) **CSO 4.8**: to explain on the preparation of compound diets for fish. (U)	9	20	

	water quality in aquaculture.	**CSO 4.9:** to disuss on the role of water quality in aquaculture. (U)			
UNIT 5 Fish diseases and processing of fish	Bacterial, viral and parasitic; Preservation and processing of harvested fish, Fishery by-products	**CSO 5.1:** To describe the bacterial diseases in Fish. (K) **CSO 5.2**: To explain on the viral diseases in Fish. (U) **CSO 5.3:** To explain on the parasitic diseases in Fish. (U) **CSO 5.4:** To discuss on the preservation and processing of harvested fish. (U) **CSO 5.5:** To describe on fishery by - products. (K)	9	20	

NAME OF THE PAPER, CODE : FISH AND FISHERIES, ZOC- 8.3 (P)
Number of Credit : 01
Number of Hours of Lecture : 30

PRACTICAL **50 Marks**

1. Study of *Petromyzon*, *Myxine*, *Pristis*, *Chimaera, Exocoetu*, *Hippocampus*, *Gambusia, Labeo, Heteropneustes, Anabas.*
2. Morphometric and meristic characters of fishes.
3. Study of different types of scales (through permanent slides/ photographs).
4. Study of indigenous fish catching gears and methods.
5. Water quality criteria for Aquaculture: Assessment of pH, conductivity, Total solids, Total dissolved solids
6. Submission of a brief report on hill stream fishes.

SUGGESTED READINGS

1. Q Bone and R Moore, Biology of Fishes, Talyor and Francis Group, CRC Press, U.K.
2. D. H. Evans and J. D. Claiborne, The Physiology of Fishes, Taylor and Francis Group, CRC Press, UK
3. von der Emde, R.J. Mogdans and B.G. Kapoor.The Senses of Fish: Adaptations for the Reception of Natural Stimuli, Springer, Netherlands.
4. C.B.L. Srivastava, Fish Biology, Narendra Publishing House.
5. S.S. Khanna and H.R. Singh, A text book of Fish Biology and Fisheries, Narendra Publishing House

INTER DISCIPLINARY MINOR PAPERS (IDM)

NAME OF THE PAPER (CODE) **: Biology of Non-Chordates I (ZOM 1)**
Number of Credit **: 03**
Number of Hours of Lecture **: 45**

COURSE OBJECTIVES (COs):

The following are the Course Objectives (COs) for the paper **Biology of Non-Chordates I**:

CO 1	Learn about various aspects of Protista and Parazoa
CO 2	Understand about Porifera world
CO 3	To classify and understand Cnidaria
CO 4	To inculcate among the students about classification, characters and pathogenicity of Platyhelminthes.
CO 5	To inculcate among the students about classification, characters and parasitic adaptation of Nemathelminths.

COURSE SPECIFIC OBJECTIVES (CSOs)

Unit & Title	Unit Contents	Course specific outcome (CSOs)	Lecture Hours	Marks	LOs
Unit 1: Protista and Parazoa	General characteristics and classification up to classes; Study of Euglena, Amoeba and Paramecium. Life-cycle and pathogenicity of Plasmodium vivax. Nutrition, Locomotion and Reproduction in Protista	**CSO 1.1:** To explain the general characteristics of Protista and Parazoa. (U) **CSO 1.2:** To classify Protista and Parazoa up to classes. (U) **CSO 1.3:** To explain about Euglena. (U) **CSO 1.4:** To explain about Amoeba. (U) **CSO 1.5:** To explain about Paramecium. (U) **CSO 1.6:** To explain about the Life-cycle and pathogenicity of *Plasmodium vivax*. (U) **CSO 1.7:** To understand about Nutrition in Protista. (U) **CSO 1.8:** To explain Locomotion in Protista. (U) **CSO 1.9:** To describe about Reproduction in Protista. (K)	**14**	**30**	
Unit 2: Porifera	General characteristics and classification up to classes; Canal system and spicules in sponges (Sycon)	**CSO 2.1:** To explain about the general characteristics and classification of Porifera up to classes;(U) **CSO 2.2:** To explain about the different types Canal system (U)	**7**	**16**	

		CSO 2.3: To define Spicules and explain the different types of spicules in sponges (K+U) **CSO 2.4:** To illustrate the economic importance of sponges. (A)			
Unit 3: Cnidaria	General characteristics and classification up to classes; Polymorphism in Cnidaria. Corals and Coral reefs	**CSO 3.1:** To explain about the general characteristics and classification of Cnidaria up to classes (U) **CSO 3.2:** To explain about Polymorphism in Cnidaria. (U) **CSO 3.3:** To define Corals and Coral reefs. (K) **CSO 3.4:** To explain the different types of coral reefs (U) **CSO 3.5:** To illustrate the economic importance of Coral reefs in everyday life. (A)	**9**	**20**	
Unit 4: Platyhelminthes	General characteristics and classification up to orders; Life-cycle and pathogenicity of Fasciola hepatica	**CSO 4.1:** To explain about general characteristics and classification of Platyhelminthes up to orders(U) **CSO 4.2:** To explain about the Life-cycle of Fasciola hepatica. (U) **CSO 4.3:** To explain about pathogenicity of Fasciola hepatica. (U)	**6**	**14**	
Unit 5: Nemathelminthes	General characteristics and classification up to classes;Life-cycle and pathogenicity of Ascaris lumbricoidesParasitic adaptation in helminthes	**CSO 5.1:** To explain about the general characteristics and classification of Nemathelminthes up to classes (U) **CSO 5.2:** To explain about the Life-cycle of Ascaris lumbricoides (U) **CSO 5.3:** To explain about the Parasitic-adaptation in helminthes. (U) **CSO 5.4:** To explain about the pathogenicity of Ascaris lumbricoides (U)	**9**	**20**	

NAME OF THE PAPER, CODE : Biology of Non-Chordates I, ZOM 1 (P)
Number of Credit : 01
Number of Hours of Lecture : 30

PRACTICALS **50 Marks**

1. Study of whole mount of Euglena, Amoeba and Paramecium, Binary fission and conjugation in Paramecium
2. Study of Sycon (T.S and L.S), Hyalonema, spongilla
3. Study of Physalia, Millepora, Aurelia, Tubipora, Corallium, Alcyonium, Gorgonia, Metridium, Pennatula, Meandrina, Madrepora
4. Study of adult Fasciola hepatica and their life-cycle (Slides/micro-photographs)
5. Study of Ascaris lumbricoides and its life stages (Slides/ micro-photographs)

SUGGESTED READINGS

1. Barnes, R.S.K., Calow, P., Olive, P. J. W., Golding, D.W. and Spicer, J.I. (2002)
2. E.L. JORDAN and P.S. VERMA Invertebrate Zoology

NAME OF THE PAPER (CODE) : **Biology of Non-Chordates II (ZOM 2)**
Number of Credit : **03**
Number of Hours of Lecture : **45**

COURSE OBJECTIVES (COs):

The following are the Course Objectives (COs) for the paper **Biology of Non-Chordates II**:

CO 1	To help students understand the meaning of Coelomates and its Evolution
CO 2	To make students understand the differences between Excretion and Locomotion in Annelida.
CO 3	To learn about the social life of different insects
CO 4	To make students aware about the characteristics and morphological features of diverse animals.
CO 5	To make students understand the different types of water-vascular systems in Echinodermata.

COURSE SPECIFIC OBJECTIVES (CSOs)

Unit & Title	Unit Contents	Course specific outcome (CSOs)	Lecture Hours	Marks	LOs
Unit 1: Introduction to Coelomates	Evolution of Coelom and Metamerism.	**CSO 1.1:** To explain about Evolution of Coelom(U) **CSO 1.2:** To explain about Metamerism (U)	**4**	**10**	
Unit 2: Annelida	General Characteristics and classification up to classes; Excretion and locomotion in Annelida.	**CSO 2.1:** To explain about the general Characteristics and classification of Annelida up to classes. (U) **CSO 2.2:** To explain about Excretion in Annelida (U) **CSO 2.3:** To explain about locomotion in Annelida (U)	**6**	**14**	
Unit 3: Arthropoda	General characteristics and classification up to classes; Respiration in Arthropoda Metamorphosis in Insects; Social life in Bees and Termites.	**CSO 3.1:** To explain about the general characteristics and classification of Arthropoda up to classes. (U) **CSO 3.2:** To explain about respiration in Arthropoda (U) **CSO 3.3:** To explain about metamorphosis in Insects (U) **CSO 3.4:** To explain about social life in Bees(U) **CSO 3.5:** To study about social life of Termites. (U)	**12**	**26**	
Unit 4: Mollusca	General characteristics and classification up	**CSO 4.1:** To explain about general characteristics and classification up to classes(U) **CSO 4.2:** To explain about	**14**	**30**	

	to classes; Respiration in Mollusca Torsion and Detorsion in Gastropods Pearl formation in Bivalves	respiration in Mollusca (U) **CSO 4.3:** To explain about Torsion and Detorsion in Gastropods (U) **CSO 4.4:** To explain about Pearl formation in Bivalves (U)			
Unit 5: Echinodermata	General characteristics and classification up to classes; Water- vascular system in Asteroidea Larval forms in Echinodermata.	**CSO 5.1:** To explain about the general characteristics and classification of Echinodermata up to classes. (U) **CSO 5.2:** To define Water-vascular system in Asteroidea and its functions. (K) **CSO 5.3:** To study the different types of water-vascular system in Asteroidea. (U) **CSO 5.4:** To explain about Larval forms in Echinodermata. (U)	**9**	**20**	

NAME OF THE PAPER, CODE : Biology of Non-Chordates II, ZOM 2 (P)
Number of Credit : 01
Number of Hours of Lecture : 30

PRACTICAL **50 Marks**

1. Study of following specimens:
   Annelids- Aphrodite, Nereis, Heteronereis, Sabella, Serpula, Chaetopterus, Pheritima, Hirudinaria
   Arthropoda- Limulus, Palamnaeus, Palaemon, Balanus, Sacculina, Scolopendra, Julus, Peripatus.
   Mollusca- Chiton, Dentalium, Pila, Doris, Helix, Unio, Pinctada, Sepia, Nautilus
   Echinodermates- Pentaceros/Asterias, Clypeaster, Echinus, Cucumaria and Antedon
2. Study of digestive system, Septal nephridia and pharyngeal nephridia of earthworm
3. T.S. through pharynx, gizzard, and typhlosolar intestine of earthworm

SUGGESTED READINGS

4. Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition
5. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates; A New Synthesis, III Edition, Blackwell Science
6. Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson

NAME OF THE PAPER (CODE) : **Life of Chordates (ZOM 3)**
Number of Credit : **03**
Number of Hours of Lecture : **45**

COURSE OBJECTIVES (COs):

The following are the Course Objectives (COs) for the paper **Life of Chordates**:

CO 1	To provide scope and historical background of chordates.
CO 2	To impart knowledge regarding basic concepts of origin of chordates and to make the students understand the characteristics and classification of animals with notochord.
CO 3	To help the students differentiate between Pisces and Amphibian.
CO 4	To help the students differentiate between Reptiles and Aves
CO 5	To create interest among students by understanding various mechanisms involved in thriving survival of the animals within their geographical realms.

COURSE SPECIFIC OBJECTIVES (CSOs)

Unit & Title	Unit Contents	Course specific outcome (CSOs)	Lecture Hours	Marks	LOs
Unit 1: Introduction to chordates and Protochordata	General characteristics and outline classification of Chordates General characteristics of Hemichordata, Urochordata and Cephalochordata Study of larval forms in Protochordates	**CSO 1.1:** To explain about the general characteristics and outline classification of Chordates (U) **CSO 1.2:** To explain about the general characteristics of Hemichordata, Urochordata and Cephalochordata. (U) **CSO 1.3:** To define Protochordates and explain about the larval forms in Protochordates. (K+U)	**9**	**20**	
Unit 2: Origin of Chordata and Agnatha	Echinoderm theory of origin of chordates; Advanced features of vertebrates over Protochordata; General characteristics and classification of Cyclostomes up to class	**CSO 2.1:** To explain about Echinoderm theory of origin of chordates (U) **CSO 2.2:** To explain about advanced features of vertebrates over Protochordata (U) **CSO 2.3:** To explain about general characteristics and classification of Cyclostomes up to class (U)	**9**	**20**	
Unit 3: Pisces and Amphibia	General characteristics of Chondrichthyes	**CSO 3.1:** To explain about general characteristics of Chondrichthyes and Osteichthyes	**9**	**20**	

	and Osteichthyes, Classification up to orders; Migration, Osmoregulation and Parental care in Fishes.General characteristics and classification up to orders; Parental care in Amphibians	and Classification up to orders. (U) **CSO 3.2:** To explain about Migration and its types in fishes. (U) **CSO 3.3:** To explain Osmoregulation in fishes. (u) **CSO 3.4:** To explain Parental care in Fishes. (U) **CSO 3.5:** To explain about general characteristics and classification of amphibia up to orders (U) **CSO 3.6:** To explain about Parental care in Amphibians (U)			
Unit 4: Reptilia and Aves	General characteristics and classification up to order; Poison apparatus and Biting mechanism in snakes. General characteristics and classification up to order; Flight adaptation and Migration in birds.	**CSO 4.1:** To explain about General characteristics and classification of Reptilia up to order. (U) **CSO 4.2:** To explain about Poison apparatus and Biting mechanism in snakes. (U) **CSO 4.3:** To explain about general characteristics and classification of Aves up to order (U) **CSO 4.4:** To explain about Flight adaptation in birds. (U) **CSO 4.5:** To explain about Migration in birds. (U	**9**	**20**	
Unit 5: Mammals and Zoogeography	General characteristics and classification up to order; Affinities of Prototheria; Zoographical realms, Theories pertaining to distribution of animals, Continental drift theory, Distribution of vertebrates in different realms.	**CSO 5.1:** To explain about general characteristics and classification of Mammals. (U) **CSO 5.2:** To explain the Affinities with Prototheria. (U) **CSO 5.3:** To explain about Zoographical realms. (U) **CSO 5.4:** To explain the Theories pertaining to distribution of animals. (U) **CSO 5.5:** To explain Continental drift theory. (U) **CSO 5.6:** To explain the Distribution of vertebrates in different realms. (U)	**9**	**20**	

NAME OF THE PAPER, CODE : Life of Chordates, ZOM 3 (P)
Number of Credit : 01
Number of Hours of Lecture : 30

PRACTICAL **50 Marks**

1. **Protochordata:** Balanoglossus, Herdmania, Permanent slides of Herdmania spicules
2. **Agnatha:** Petromyzon, Myxine
3. **Fishes:** Scoliodon, Sphyrna, Pristis, Torpedo, Chimaera, Heteropneustes, Labeo, Hippocampus, Tetradon, Anabas
4. **Amphibia:** Ichthyophis, Necturus, Bufo, Hyla, Alytes, Salamandra
5. **Reptilia:** Chelone, Hemidactylus, Varanus, Bungarus, Vipera, Naja, Identification of poisonous and non-poisonous snakes
6. **Aves:** Study of six common birds from different orders. Types of beaks and claws
7. **Mammalia:** Sorex, Funambulus, Loris, Herpestes, Erinaceous.

SUGGESTED READINGS:

1. Young, J.Z. (2004). The life of Vertebrates III Edition. Oxford university press.
2. Pough H. Vertebrate life, VIII Edition, Pearson International.
3. Darlington P.J. The geographical Distribution of Animals, R.E. Krieger Pub Co.

NAME OF THE PAPER (CODE) **: Animal Physiology-I (ZOM 4)**
Number of Credit **: 03**
Number of Hours of Lecture **: 45**

COURSE OBJECTIVES (COs):

The following are the Course Objectives (COs) for the paper **Animal Physiology-I**:

CO1:	To integrate an understanding on the reproductive system and their hormonal control.
CO2:	To provide students with a basic understanding of the structure and functions of different types of tissues.
CO3:	To study the fundamental processes and mechanisms that serve and control the various functions of the body such as neurons.
CO4:	To explore the basic physiological principles common to animals, relating to structure and functions of muscular system.
CO5:	To provide a course of study on the endocrine system and the interactions between physiological systems.

COURSE SPECIFIC OBJECTIVES (CSOs)

Unit & Title	Unit Contents	Course specific outcome (CSOs)	Lecture Hours	Marks	LOs
Unit 1: Tissues, Bone and Cartilage	Structure, classification and functions of epithelial tissue, connective tissue, muscular tissue and nervous tissue; Structure and types of bones and cartilages, Ossification and resorption.	**CSO 1.1:** To learn about the different types of tissues in animals. (K) **CSO 1.2:** To learn about the structure of epithelial tissue. (K) **CSO 1.3:** To differentiate the different types of epithelial tissues and their functions. (U) **CSO 1.4:** To learn about the structure of connective tissue. (K) **CSO 1.5:** To differentiate the different types of connective tissues and their functions. (U) **CSO 1.6:** To gain knowledge on the structure of muscular tissue. (K) **CSO 1.7:** To learn and understand the different type of muscular tissues and their functions. (U) **CSO 1.8:** To study about the structure, types and functions of nervous tissue. (K+U) **CSO 1.9:** To study about the structure and types of cartilage. (K) **CSO 1.10:** To learn about bones and its types. (K) **CSO 1.11:** To gain information on the concept of ossification. (U)	**9**	**20**	

		CSO 1.12: To understand the process of bone resorption. (U)			
Unit 2: Nervous System	Structure of neuron, resting membrane potential, Origin of action potential and its propagation across nerve fibers; Types of synapses; Synaptic transmission and, Neuromuscular junction; Reflex action and its types - reflex arc.	**CSO 2.1:** To define neuron and understand its structure. (K+U) **CSO 2.2:** To differentiate the different types of neurons and their functions. (U) **CSO 2.3:** To understand the resting membrane potential of neurons. (U) **CSO 2.4:** To learn the concept of action potential of neuron. (U) **CSO 2.5:** To understand the concept of synapses in neurons. (U) **CSO 2.6:** To learn about the concept of reflex action, reflex arc. (K) **CSO 2.7:** To learn about the mechanism of reflex action and its significance. (U+A) **CSO 2.8:** To gain information on the structure of mammalian ear and its functions and working. (K+U) **CSO 2.9:** To learn about the structure and working of mammalian eye. (K+U)	**9**	**20**	
Unit 3: Muscle	Histology of different types of muscle; Ultra structure of skeletal muscle; Molecular and chemical basis of muscle contraction; Characteristics of muscle twitch; Motor unit, summation and tetanus; Physiology of hearing and vision.	**CSO 3.1:** To learn the basics of muscle tissue and its types. (K) **CSO 3.2:** To learn about the structure and function of skeletal muscle. (K+U) **CSO 3.3:** To learn the structure and function of smooth muscle. (K+U) **CSO 3.4:** To understand the structure and function of cardiac muscle. (K+U) **CSO 3.5:** To learn about the ultrastructure of skeletal muscle. (U) **CSO 3.6:** To understand the mechanism of muscle contraction. (U) **CSO 3.7:** To learn the concept of muscle twitch and the stages involved. (K+U) **CSO 3.8:** To gain information on	**9**	**20**	

		motor unit, wave summation. (K+U) **CSO 3.9:** To understand the phenomenon of tetanus and its types. (K+U)			
Unit 4: Reproductive System	Histology of testis and ovary; Physiology of male and female reproduction; Methods of contraception in male and female.	**CSO 4.1:** To learn the basic concepts of reproductive system and its importance. (K) **CSO 4.2:** To learn the basics of the male reproductive system. (K) **CSO 4.3:** To learn about the structure and histology of testes. (K+U) **CSO 4.4:** To gain information and learn on the hormonal control of testicular function. (U) **CSO 4.5:** To learn the basics of the female reproductive system. (K) **CSO 4.6:** To learn about the structure and histology of ovary. (K+U) **CSO 4.7:** To learn about gametogenesis- spermatogenesis and oogenesis. (U) **CSO 4.8:** To understand the structure of sperm and ovum. (U) **CSO 4.9:** To learn and understand the menstrual cycle. (U) **CSO 4.10:** To gain information and learn on the endocrine control of menstrual cycle. (U) **CSO 4.11:** To learn about different contraceptives methods used. (U+A) **CSO 4.12:** To learn about the concept of medical termination of pregnancy. (U+A)	**9**	**20**	
Unit 5: Endocrine System	Histology of endocrine glands - pineal, pituitary, thyroid, parathyroid, pancreas, adrenal; Hypothalamus (neuroendocrine gland) - control	**CSO 5.1:** To gain information on endocrine glands. (K) **CSO 5.2:** To study and understand the structure of hypothalamus and pituitary gland. (K+U) **CSO 5.3:** To learn about the different hormones secreted by pituitary gland. (K+U) **CSO 5.4:** To study about the structure, hormones secreted and functions of pineal gland. (K+U)	**9**	**20**	

	of endocrine system.	**CSO 5.5:** To learn about the structure, hormones and functions of thyroid gland. (K+U) **CSO 5.6:** To study about the structure, hormones and functions of parathyroid gland. (K+U) **CSO 5.7:** To learn about the structure, hormones and regulation of blood sugar by pancreas. (K+U) **CSO 5.8:** To learn about the structure, hormones and functions of adrenal gland. (K+U) **CSO 5.9:** To understand the hypothalamic control of pituitary gland. (U)			

NAME OF THE PAPER, CODE : Animal Physiology-I, ZOM 4 (P)
Number of Credit : 01
Number of Hours of Lecture : 30

PRACTICALS **50 Marks**

1. Recording of simple muscle twitch with electrical stimulation (or Virtual)
2. Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee jerk reflex)
3. Preparation of temporary mounts: Squamous epithelium, Striated muscle fibres and nerve cells
4. Study of permanent slides of Mammalian skin, Cartilage, Bone, Spinal cord, Nerve cell, Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid
5. Microtomy: Preparation of permanent slide of any five mammalian (Goat/white rat) tissues

SUGGESTED READINGS:

1. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company.
2. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons
3. Victor P. Eroschenko. (2008). diFiore's Atlas of Histology with Functionalcorrelations. XII Edition. Lippincott W. & Wilkins.

NAME OF THE PAPER (CODE) **: Animal Physiology-II (ZOM 5)**
Number of Credit **: 03**
Number of Hours of Lecture **: 45**

COURSE OBJECTIVES (COs):

The following are the Course Objectives (COs) for the paper **Animal Physiology-II**:

CO1:	To study about the structural organization and functions of gastrointestinal tract and the process of digestion and absorption.
CO2:	To give knowledge on the physiology of respiration.
CO3:	To give information on the physiology of excretory system and its mechanism.
CO4:	To study about the structural organization of heart and its components.
CO5:	To give knowledge on the mechanism of circulatory system and its importance.

COURSE SPECIFIC OBJECTIVES (CSOs)

Unit & Title	Unit Contents	Course specific outcome (CSOs)	Lecture Hours	Marks	LOs
Unit 1: Physiology of Digestion	Structural organization and functions of gastrointestinal tract; Digestion and absorption of nutrients; Hormonal control of secretion of enzymes in Gastrointestinal tract.	**CSO 1.1:** To learn about the concept of digestion and absorption. (K) **CSO 1.2:** To gain information on the different types of nutrients and their digestion and absorption. (K+U) **CSO 1.3:** To learn and understand the structural organization of the digestive tract. (K+U) **CSO 1.4:** To learn about the different enzymes involved in the process of digestion. (K+U) **CSO 1.5:** To understand how carbohydrates are digested and absorbed. (U) **CSO 1.6:** To learn how proteins are digested and absorbed. (U) **CSO 1.7:** To understand how fats are digested and absorbed. (U) **CSO 1.8:** To learn about the neural control of digestion. (U) **CSO 1.9:** To learn and understand how hormones control the secretion of enzymes in the gastrointestinal tract. (U)	**9**	**20**	
Unit 2:	Histology of	**CSO 2.1:** To learn about the	**9**	**20**	

Physiology of Respiration	trachea and lungs; Mechanism of respiration; Dissociation curves and factors influencing it; Carbon monoxide poisoning; Control of respiration	basics of respiration and its types. (K) **CSO 2.2:** To learn about the structure of the respiratory tract. (K) **CSO 2.3:** To differentiate between external and internal respiration. (U) **CSO 2.4:** To understand the mechanism of breathing. (U) **CSO 2.5:** To learn about the mechanism of respiration. (U) **CSO 2.6:** To learn the concept of oxygen dissociation curve. (K+U) **CSO 2.7:** To study the transport of oxygen from lungs to tissues. (U) **CSO 2.8:** To understand the transport of carbon dioxide from tissue to the lungs. (K+U) **CSO 2.9:** To learn and gain information on carbon monoxide poisoning. (K+U) **CSO 2.10:** To learn about the different factors influencing or controlling the process of respiration. (K+U)			
Unit 3: Renal Physiology	Structure of kidney and its functional unit; Mechanism of urine formation; Regulation of water balance	**CSO 3.1:** To learn the basics of kidney and its functions. (K) **CSO 3.2:** To learn about the structure of kidney. (K) **CSO 3.3:** To learn about the structure of a nephron. (K) **CSO 3.4:** To learn about the mechanism of urine formation. (U) **CSO 3.5:** To study and understand the countercurrent system of kidneys. (U) **CSO 3.6:** To learn the concept of osmoregulation. (K) **CSO 3.7:** To understand the maintenance of water balance by kidneys. (K+U) **CSO 3.8:** To learn about the maintenance of electrolyte balance by kidney. (K+U) **CSO 3.9:** To learn about the	**9**	**20**	

		hormonal control of renal function. (U)			
Unit 4: Blood	Components of blood and their functions; Structure and functions of Haemoglobin Blood groups: Rh factor, ABO and MN Haemostasis: Blood clotting system; Haemopoiesis	**CSO 4.1:** To learn about the basics of blood. (K) **CSO 4.2:** To learn about the different components of blood. (K) **CSO 4.3:** To gain information on the functions of the different components of blood. (U) **CSO 4.4:** To understand the structure of Haemoglobin and its functions. (K+U) **CSO 4.5:** To learn about the different types of blood groups. (K+U) **CSO 4.6:** To learn the concept of Rh factor and MN. (K) **CSO 4.7:** To understand the concept of haemostasis. (U) **CSO 4.8:** To learn about the mechanism of blood clotting and the steps involved. (K+U) **CSO 4.9:** To learn about haemopoisis. (K+U)	**9**	**20**	
Unit 5: Physiology of Heat	Coronary circulation; Structure and working of conducting myocardial fibers Electrocardiogram, Blood Pressure and Its regulations, Cardiac cycle, Cardiac output and its regulations.	**CSO 5.1:** To learn the basics of heart and the circulatory system. (K) **CSO 5.2:** To understand the structure of heart. (U) **CSO 5.3:** To learn about the different vessels and the circulation of blood through it. (U) **CSO 5.4:** To learn and understand the different types of circulation. (K+U) **CSO 5.5:** To understand the concept of cardiac cycle. (U) **CSO 5.6:** To learn about the regulation of heartbeat. (K+U) **CSO 5.7:** To define and understand the working of ECG. (K+U) **CSO 5.8:** To learn about blood pressure and the factors that control it. (K+U) **CSO 5.9:** To understand the significance of ECG. (U+A)	**9**	**20**	

		CSO 5.10: To gain information on the regulation of cardiac cycle. (U)			

NAME OF THE PAPER, CODE : Animal Physiology-II, ZOM 5 (P)
Number of Credit : 01
Number of Hours of Lecture : 30

PRACTICALS **50 Marks**

1. Determination of ABO Blood group and Rh factor
2. Estimation of haemoglobin using Sahli's haemoglobinometer
3. Preparation of haemin crystals
4. Recording of blood pressure using a sphygmomanometer
5. Examination of sections of mammalian Oesophagus, Stomach, Duodenum, Ileum, rectum, liver, trachea, lung, kidney.

SUGGESTED READINGS:

1. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. W.B. Saunders Company.
2. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons,
3. Victor P. Eroschenko (2008). diFiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott W. & Wilkins.

NAME OF THE PAPER (CODE) : **Reproductive Biology of Animals (ZOM 6)**
Number of Credit : **03**
Number of Hours of Lecture : **45**

COURSE OBJECTIVES (COs):

The following are the Course Objectives (COs) for the paper **Reproductive Biology of Animals**:

CO1:	To make the students understand gonadal hormones, mechanism of hormone action and sex differentiation.
CO2:	To make students understand the functional anatomy of the male reproductive system.
CO3:	To make students understand the functional anatomy of the female reproductive system.
CO4:	To impart knowledge to the students about fertilization in human.
CO5:	To impart knowledge to the students about infertility in males and females, assisted reproductive technologies and modern contraceptive techniques.

COURSE SPECIFIC OBJECTIVES (CSOs)

Unit & Title	Unit Contents	Course specific outcome (CSOs)	Lecture Hours	Marks	LOs
Unit 1 Reproductive Endocrinology	Gonadal hormones and mechanism of hormone action, steroids, glycoprotein hormones, and prostaglandins, hypothalamo – hypophyseal – gonadal axis, regulation of gonadotrophin secretion in male and female; Reproductive System: Development and differentiation of gonads, mechanism of sex differentiation.	**CSO 1.1:** to explain about Gonadal hormones. (U) **CSO 1.2:** to describe about the mechanism of hormone Action. (K) **CSO 1.3:** to explain on steroids, glycoprotein hormones, and prostaglandins. (U) **CSO 1.4:** To discuss about hypothalamo – hypophyseal – gonadal axis. (U) **CSO 1.5:** to describe the regulation of gonadotrophin secretion in male and female. (K) **CSO 1.6:** to explain on the Reproductive System, Development and differentiation of gonads. (U) **CSO 1.7:** to elaborate on the mechanism of sex differentiation. (U)	**10**	**22**	
UNIT 2 Functional anatomy of male reproduction	Histology of male reproductive system in human; Testis: Cellular functions; Spermatogenesis: kinetics and	**CSO 2.1:** To outline the histology of male reproductive system in human. (K) **CSO 2.2:** To outline the histology of male reproductive system in rat. (K). **CSO 2.3:** To discuss Spermatogenesis, its kinetics and	**10**	**22**	

	hormonal regulation; Androgen synthesis and metabolism; Epididymal function and sperm maturation; Accessory glands functions; Sperm transportation in male tract.	hormonal regulation. (U). **CSO 2.4:** To describe Androgen synthesis and its metabolism. (K) **CSO 2.5:** To explain the epididymal function and sperm maturation. (U) **CSO 2.6:** To describe the accessory glands functions and sperm transportation in male tract. (K)			
Unit 3 Functional Anatomy of Female Reproduction	Histology of female reproductive system in human; Ovary: folliculogenesis, ovulation, corpus luteum formation and regression; Steroidogenesis and secretion of ovarian hormones; Reproductive cycles (rat and human) and their regulation.	**CSO 3.1:** To outline histology of female reproductive system in human. (K) **CSO 3.2:** To outline histology of female reproductive system in rat. (K) **CSO 3.3:** To explain on folliculogenesis, ovulation, corpus luteum formation and regression. (U) **CSO 3.4:** To explain on Steroidogenesis. (U) **CSO 3.5:** to describe the secretion of ovarian hormones. (K) **CSO 3.6:** To elaborate on the reproductive cycles of rat and their regulation. (U) **CSO 3.7:** To elaborate on the reproductive cycles of human and their regulation. (U)	**8**	**18**	
Unit 4 Fertilization	Ovum transport in the fallopian tubes; Sperm transport in the female tract, fertilization; Hormonal control of implantation; Hormonal regulation of gestation, foeto – maternal relationship; Mechanism of parturition;	**CSO 4.1:** to explain ovum transport in the fallopian tube. (U) **CSO 4.2:** to explain sperm transport in the female tract and fertilization. (U) **CSO 4.3:** to describe the hormonal control of implantation. (K) **CSO 4.4:** to describe the hormonal regulation of gestation, foeto – maternal relationship. (K) **CSO 4.5:** to describe the hormonal regulation of foeto – maternal relationship. (K) **CSO 4.6:** to explain on the mechanism of parturition. (U)	**8**	**18**	

	Lactation.	**CSO 4.7:** to explain on the mechanism of lactation. (U)			
Unit 5 Reproductive Health	Infertility in male and female: causes, diagnosis and management; Assisted Reproductive Technology: sex selection, sperm banks, frozen embryos, in vitro fertilization, ET, EFT, IUT, ZIFT, GIFT, ICSI, PROST; Modern contraceptive technologies; Demographic terminology used in family planning.	**CSO 5.1:** to explain on infertility in male - causes diagnostics and management. (U) **CSO 5.2:** to explain on infertility in female - causes diagnostics and management. (U) **CSO 5.3:** to define Assisted Reproductive Technology. (K) **CSO 5.4:** to explain on sex selection, sperm banks, (U) **CSO 5.5:** to explain on frozen embryo and in vitro fertilization. (U) **CSO 5.6:** to explain on ET, EFT. (U) **CSO 5.7:** to explain on IUT, ZIFT, GIFT. (U) **CSO 5.8:** to explain on ICSI, PROST. (U) **CSO 5.9:** to discuss on modern contraceptive technologies and its Demographic terminology used in family planning. (U)	**9**	**20**	

NAME OF THE PAPER, CODE : Reproductive Biology of Animals, ZOM 6 (P)
Number of Credit : 01
Number of Hours of Lecture : 30

PRACTICAL **50 Marks**

1. Study of animal house: set up and maintenance of animal house, breeding techniques, care of normal and experimental animals.2. Examination of vaginal smear rats from live animals.
3. Surgical techniques: principles of surgery in endocrinology- Ovarectomy, castration and vasectomy in rats.
4. Examination of histological sections from photomicrographs/ permanent slides of rat: testis, epididymis and accessory glands of male reproductive systems; Sections of ovary, fallopian tube, uterus (proliferative and secretory stages), cervix and vagina.
5. Sperm count and sperm motility in rat.
6. Study of modern contraceptive devices

SUGGESTED READINGS:

1. Austin, C.R. and Short, R.V. reproduction in Mammals. Cambridge University Press.
2. Degroot, L.J. and Jameson, J.L. (eds). Endocrinology. W.B. Saunders and Company.
3. Knobil, E. et al. (eds). The Physiology of Reproduction. Raven Press Ltd.
4. Hatcher, R.A. et al. The Essentials of Contraceptive Technology. Population Information

NAME OF THE PAPER (CODE) : **Introductory Endocrinology (ZOM 7)**
Number of Credit : **03**
Number of Hours of Lecture : **45**

COURSE OBJECTIVES (COs):

The following are the Course Objectives (COs) for the paper **Introductory Endocrinology**:

CO1:	To have developed understanding on introduction to endocrinology
CO2:	To have developed basic knowledge about pineal gland
CO3:	To inculcate knowledge about the pituitary gland
CO4:	To have developed the understanding of the peripheral endocrine glands
CO5:	To impart knowledge about the regulation of hormone action

COURSE SPECIFIC OBJECTIVES (CSOs)

Unit & Title	Unit Contents	Course specific outcome (CSOs)	Lecture Hours	Marks	LOs
Unit 1: Introduction to Endocrinology	History of endocrinology, Classification, Characteristic and Transport of Hormones, Neurosecretions and Neurohormones	**CSO 1.1:** to discuss about the history of endocrinology. (U) **CSO 1.2:** to define hormone. (K) **CSO 1.3:** to explain on the classification of hormones. (U) **CSO 1.4:** to explain on the characteristics of hormones. (U) **CSO 1.5:** to explain on the transport of hormones. (U) **CSO 1.6:**to explain on neurosecretions and neurohormones. (U)	**9**	**20**	
Unit 2: Pineal gland	Structure of pineal gland, Secretions and their functions in biological rhythms and reproduction. Structure of hypothalamus, Hypothalamic nuclei and their functions, Regulation of neuroendocrine glands, Feedback mechanisms	**CSO 2.1:** to describe the structure of pineal gland. (K) **CSO 2.2:** to explain the secretions of pineal gland. (U) **CSO 2.3:** to discuss the functions of pineal gland in biological rhythms. (U) **CSO 2.4:** to discuss the functions of pineal gland in reproduction. (U) **CSO 2.5:** to describe the structure of hypothalamus and its function. (K) **CSO 2.6:** to describe the structure of hypothalamic nuclei and its function. (K) **CSO 2.7:** to discuss on the regulations of neuroendocrine glands. (U) **CSO 2.8:** to explain on the	**9**	**20**	

		feedback mechanism of the neuroendocrine glands. (U)			
Unit 3: Pituitary gland	Structure of pituitary gland, Hormones and their functions, Hypothalamo-hypophysial portal system, Disorders of pituitary gland	**CSO 3.1:** to describe the structure of the pituitary gland. (K) **CSO 3.2:** to explain on hormones and their functions. (U) **CSO 3.3:** to explain on Hypothalamo-hypophysial portal System. (U) **CSO 3.4:** to discuss on the disorders of pituitary gland. (U)	**6**	**14**	
Unit 4: Peripheral Endocrine Glands	Structure, Hormones, Functions and Regulation of Thyroid gland, Parathyroid, Adrenal, Pancreas, Ovary and Testis Hormones in homeostasis	**CSO 4.1:** to define peripheral endocrine glands. (K) **CSO 4.2:** to describe the structure of thyroid gland. (K) **CSO 4.3:** to explain on the function and regulations of the thyroid gland. (U) **CSO 4.4:** to describe the structure of the parathyroid gland. (K) **CSO 4.5:** to explain on the function and regulations of the parathyroid gland. (U) **CSO 4.6:** to describe the structure of the adrenal gland(K) **CSO 4.7:** to explain on the function and regulations of the adrenal gland. (U) **CSO 4.8:** to describe the structure of the pancreas. (K) **CSO 4.9:** to explain on the function and regulations of the pancreas. (U) **CSO 4.10:** to describe the structure of the ovary. (K) **CSO 4.11:** to explain on the function and regulations of the Ovary. (U) **CSO 4.12:** to describe Testis hormone in homeostasis. (K)	**12**	**26**	
Unit 5: Regulation of Hormone Action	Hormone action at Cellular level: Hormone receptors, transduction and regulation; Hormone action at Molecular	**CSO 5.1:** to describe hormone action at cellular level. (K) To explain about Hormone action at Cellular level **CSO 5.2:** To discuss about hormone receptors, transduction and regulation. (U) **CSO 5.3:** To describe the	**9**	**20**	

	level: Molecular mediators, Genetic control of hormone action	hormone action at Molecular level. (K) **CSO 5.4:** To explain about the Molecular mediators. (U) **CSO 5.5:** To explain the Genetic control of hormone action. (U)			

NAME OF THE PAPER, CODE : Introductory Endocrinology, ZOM 7 (P)
Number of Credit : 01
Number of Hours of Lecture : 30

PRACTICALS **50 Marks**

1. Dissect and display of Endocrine glands in laboratory bred rat*
2. Study of the permanent slides of all the endocrine glands
3. Demonstration of hypophysectomy in fishes.
4. Designing of primers of any hormone/gene.
5. Demonstration of thyroidectomy in rats/mice.
6. Demonstration of adrenalectomy in rats/mice

SUGGESTED READINGS

1. General Endocrinology C. Donnell Turner Pub- Saunders Toppan
2. Endocrinology: An Integrated Approach; Stephen Nussey and Saffron Whitehead.Oxford: BIOS Scientific Publishers; 2001.
3. Hadley, M.E. and Levine J.E. 2007. Endocrinology, 6th Edition. Pearson Prentice-Hall, Pearson Education Inc., New Jersey.
4. Vertebrate Endocrinology by David O. Norris,

NAME OF THE PAPER (CODE) : **BASICS OF IMMUNOLOGY (ZOM-8)**
Number of Credit : **03**
Number of Hours of Lecture : **45**

COURSE OBJECTIVES (COs)

The following are the Course Objectives (COs) for the paper **Basics of immunology**:

CO 1:	To create awareness and interest in students about the perspective of immunology and how the immune system operates in organisms.
CO 2:	To make the students understand innate and adaptive immunity.
CO 3:	To create an understanding among students, the structure and function of different classes of immunoglobulins and acquaint them with hybridoma technology.
CO 4:	To inculcate and create interest among students in the understanding of Major Histocompatibility Complex and Cytokines.
CO 5:	To help students gain knowledge and understanding about complement system, hypersensitivity and vaccines.

COURSE SPECIFIC OBJECTIVES (CSOs)

Unit & Title	Unit Contents	Course Specific Objective (CSOs)	Lecture Hours	Marks	LOs
UNIT 1 Overview of Immune System	Historical perspective of Immunology, Cells and organs of the immune system, barriers of immune system	**CSO 1.1:** to define the term Immunity and Immune system. (K) **CSO 1.2:** to describe the historical perspective of immunology. (U) **CSO 1.3:** to explain how immunology progress over time. (U) **CSO 1.4:** to illustrate the cells of the immune system. (A) **CSO 1.5:** to elaborate the organs of the immune system. (U) **CSO 1.6:** to demonstrate how anatomy act as barrier of immune system. (A) **CSO 1.7:** to understand how physiology act as barrier of immune system. (U)	7	16	
UNIT 2 Innate and Adaptive Immunity	Inflammation, Cell and molecules involved in innate immunity, Adaptive immunity (Cell mediated and	**CSO 2.1:** to define the term innate and adaptive immunity. (K) **CSO 2.2:** to discuss types of inflammation. (U) **CSO 2.3:** to explain how inflammation is vital to health. (U)	12	26	

	humoral); Passive: Artificial and natural Immunity, Active: Artificial and natural Immunity, Immune dysfunctions (brief account of autoimmunity with reference to Rheumatoid Arthritis and tolerance, AIDS).	**CSO 2.4:** to generalise Cell and involved in innate immunity. (A) **CSO 2.5:** to summarise the molecules involved in innate immunity (A) **CSO 2.6:** to define adaptive immunity. (K) **CSO 2.7:** to explain adaptive immunity. (U) **CSO 2.8:** to illustrate cell mediated immunity. (A) **CSO 2.9:** to illustrate humoral immunity. (A) **CSO 2.10:** to understand Passive: Artificial and natural Immunity. (U) **CSO 2.11:**to illustrate Active: Artificial and natural Immunity. (A) **CSO 2.12:** to define Immune dysfunctions. (K) **CSO 2.13:** to give a brief account of autoimmunity. (K) **CSO 2.14:** to cite a brief account on Rheumatoid Arthritis. (K) **CSO 2.15:** to define tolerance. (K) **CSO 2.16:** to discuss briefly on AIDS. (U)			
UNIT 3 Immunoglobulins	Structure and functions of different classes of immunoglobulins, Antigen- antibody interactions, Immunoassays (ELISA and RIA). Hybridoma technology: Monoclonal antibodies in therapeutics and diagnosis.	**CSO 3.1:** to define Immunoglobulins. (K) **CSO 3.2:** to explain the structure of Immunoglobulins. (U) **CSO 3.3:** to classify Immunoglobulins. (U) **CSO 3.4:** to explain the different structures of Immunoglobulins. (U) **CSO 3.5:** to illustrate the function of different classes of immunoglobulin. (A) **CSO 3.6:** to define antigen and antibody. (K) **CSO 3.7:** to discuss how antigen-antibody interacts.	10	22	

		(U) **CSO 3.8:** to illustrate different technique for the detection of antigen-antibody interaction. (A) **CSO 3.9:**to define Immunoassay. (K) **CSO 3.10:** to demonstrate the technique of ELISA. (A) **CSO 3.11:**to explain the technique of RIA. (U) **CSO 3.12:** to describe hybridoma technology. (U) **CSO 3.13:** to illustrate the use of Monoclonal antibodies in therapeutics. (A) **CSO 3.14:** to illustrate the use of Monoclonal antibodies in diagnosis. (A)			
UNIT 4 **Major Histocompatibility Complex and Cytokines**	Structure and functions of MHC molecules. Endogenous and exogenous pathways of antigen processing and presentation Properties and functions of cytokines, Therapeutics Cytokines	**CSO 4.1:** to define Major Histocompatibility Complex (MHC). (K) **CSO 4.2:** to define Cytokines. (K) **CSO 4.3:** to illustrate the structure of MHC. (A) **CSO 4.4:** to discuss the function of MHC. (U) **CSO 4.5:** to illustrate the Endogenous pathway of antigen processing and presentation. (A) **CSO 4.6:** to illustrate the exogenous pathway of antigen processing and presentation (A) **CSO 4.7:** to discuss the properties of cytokines. (U) **CSO 4.8:** to demonstrate the function of cytokines. (A) **CSO 4.9:** to interpret the use of cytokines in therapeutics. (A)	8	18	
UNIT 5 **Complement System, Hypersensitivity**	Components and pathways of complement activation;	**CSO 5.1:** to define complement system. (K) **CSO 5.2:** to elaborate on various components of	8	18	

and Vaccines	Gell and Coombs' classification and brief description of various types of Hypersensitivities; Types of vaccines.	complement system. (U) **CSO 5.3:** to interpret the pathways of complement system activation. (A) **CSO 5.4:** to define hypersensitivity. (K) **CSO 5.5:** to classify hypersensitivity base on Gell and Coombs' classification. (U) **CSO 5.6:** to discuss Type I hypersensitivity. (U) **CSO 5.7:** to elaborate Type II hypersensitivity. (U) **CSO 5.8:** to illustrate Type III hypersensitivity. (A) **CSO 5.9:** to explain Type IV hypersensitivity. (U) **CSO 5.10:**to define vaccine. (K) **CSO 5.11:** to discuss types of vaccine.			

NAME OF THE PAPER, CODE : BASICS OF IMMUNOLOGY, ZOM 8 (P)
Number of Credit : 01
Number of Hours of Lecture : 30

PRACTICAL 50 Marks

1. Demonstration of lymphoid organs.
2. Histological study of spleen, thymus and lymph nodes through slides/photographs
3. Preparation of stained blood film to study various types of blood cells.
4. Ouchterlony's double immuno-diffusion method.
5. ABO blood group determination.
6. Demonstration of Immuno-electrophoresis.

* The experiments can be performed depending upon usage of animals in UG courses.

SUGGESTED READINGS

1. Kindt, T. J., Goldsby, R.A., Osborne, B. A. and Kuby, J (2006). *Immunology*, VI Edition. W.H. Freeman and Company.
2. David, M., Jonathan, B., David, R. B. and Ivan R. (2006). *Immunology*, VII Edition, Mosby, Elsevier Publication.
3. Abbas, K. Abul and Lechtman H. Andrew (2003.) *Cellular and Molecular Immunology.* V Edition. Saunders Publication.

NAME OF THE PAPER (CODE) **: Insect Vectors and Diseases (ZOM-9)**
Number of Credit **: 03**
Number of Hours of Lecture **: 45**

COURSE OBJECTIVES (COs)

The following are the Course Objectives (COs) for the paper **Insect Vectors and Diseases:**

CO 1:	To conduct studies related to all aspects of ecology related to insect-borne diseases.
CO 2:	Study the major diseases caused by vector borne pathogens.
CO 3:	Understand the major concepts of Flea-borne diseases
CO 4:	Understand the basic biology of major insect vectors.
CO 5:	To learn about Hempitera as Disease Vectors.

COURSE SPECIFIC OBJECTIVES (CSOs)

Unit & Title	Unit Contents	Course Specific Objective (CSOs)	Lecture Hours	Marks	LOs
UNIT 1 **Concept of Vectors and Insects as Vectors**	Brief introduction of Carrier and Vectors (mechanical and biological vector), Reservoirs, Host-vector relationship, Adaptations as vectors, Host Specificity. Detailed features of orders with insects as vectors – Diptera, Siphonaptera, Siphunculata, Hemiptera	**CSO 1.1:** To explain brief introduction of Carrier and Vectors (mechanical and biological vector). (U). **CSO 1.2:** To explain about Reservoirs, Host-vector relationship. (U). **CSO 1.3:** To discuss about adaptations as vectors, Host Specificity. (U). **CSO 1.4:** To explain about detailed features of orders with insects as vectors – Diptera, Siphonaptera, Siphunculata, Hemiptera. (U).	**9**	**20**	
UNIT 2 **Dipteran as Disease Vectors**	Dipterans as important insect vectors – Mosquitoes, Sand fly, Houseflies; Study of mosquito-borne diseases – Malaria, Dengue; Control of mosquitoes Study of sand fly-borne diseases – Visceral Leishmaniasis,	**CSO2.1:** To explain about Dipterans as important insect vectors – Mosquitoes, Sand fly, Houseflies. (U) **CSO 2.2:** To explain mosquito-borne diseases –Malaria, Dengue; Control of mosquitoes. (U) **CSO 2.3:** To explains and fly-borne diseases – Visceral Leishmaniasis,	**18**	**38**	

	Phlebotomus fever; Control of Sand fly Study of house fly as important mechanical vector, Myiasis, Control of house fly.	Phlebotomus fever; Control of Sand fly. (U) **CSO 2.4:** To discuss house fly as important mechanical vector, Myiasis, Control of house fly (U).			
UNIT 3 Siphonaptera as Disease Vectors	Study of Flea-borne diseases – Plague, Typhus fever; Control of fleas.	**CSO 3.1:**to discuss Study Flea-borne diseases – Plague, Typhus fever(U). **CSO 3.2:** To explain about Control of fleas (U).	**6**	**14**	
UNIT4 Siphunculata as Disease Vectors	Study of louse-borne diseases –Typhus fever, Phthiriasis; Control of human louse.	**CSO 4.1:**to explain louse-borne diseases – Typhus fever, Phthiriasis(U). **CSO 4.2:** To discuss about Control of human louse. (U)	**6**	**14**	
UNIT 5 Hempitera as Disease Vectors	Blood-sucking bugs; Chagas disease, Bed bugs as mechanical vectors, Control and prevention measures	**CSO5.1:** To discuss about Blood-sucking bugs. (U). **CSO 5.2:** to explain*about Chagas disease* (U). **CSO 5.3:** to explain*Bed bugs as mechanical vectors*(U). **CSO 5.4:**o discuss about Control and prevention measures. (U).	**6**	**14**	

NAME OF THE PAPER, CODE : Insect Vectors and Diseases, ZOM-9 (P)
Number of Credit : 01
Number of Hours of Lecture : 30

PRACTICAL **50 Marks**

1. Study of different kinds of mouth parts of insects
2. Study of following insect vectors through permanent slides/ photographs: *Aedes, Culex, Anopheles, Pediculus humanus capitis, Pediculus humanus corporis, Phithirus pubis, Xenopsyllacheopis, Cimex lectularius, Phlebotomus argentipes, Musca domestica*, through permanent slides/ photographs
3. Study of three diseases transmitted by insect vectors.
4. Submission of a project report on any one of the insect vectors and disease transmitted.

SUGGESTED READINGS 1. Imms, A.D. (1977).

1. A General Text Book of Entomology. Chapman & Hall, UK
2. Chapman, R.F. (1998). The Insects: Structure and Function. IV Edition, Cambridge University Press, UK
3. Pedigo L.P. (2002). Entomology and Pest Management. Prentice Hall Publication 4. Mathews, G. (2011). Integrated Vector Management: Controlling Vectors of Malaria and Other Insect Vector Borne Diseases. Wiley-Blackwell

NAME OF THE PAPER (CODE) **: Animal Diversity (ZOM 10)**
Number of Credit **: 03**
Number of Hours of Lecture **: 45**

COURSE OBJECTIVES (COs):

The following are the Course Objectives (COs) for the paper **Animal Physiology-I**:

CO1:	This course gives a framework for understanding the diversity within different groups.
CO2:	To understand the importance of animal kingdom in the context of hierarchy and their role in ecological development.
CO3:	To provide an overview of the invertebrate and vertebrate animals including nematodes, flatworms, arthropods, Mollusca, fishes, amphibians, reptiles, birds and mammals.
CO4:	To give an overview of the general features of different classes of animals.
CO5:	To provide information on the different adaptation by different group of animals.

COURSE SPECIFIC OBJECTIVES (CSOs)

Unit & Title	Unit Contents	Course specific outcome (CSOs)	Lecture Hours	Marks	LOs
Unit 1: Protista, Porifera	General characters of Protozoa; Life cycle of Plasmodium General characters and canal system in Porifera	**CSO 1.1:** To learn the fundamentals of animal classification. (K) **CSO 1.2:** To learn the basics of protozoa. (K) **CSO 1.3:** To study the general characteristics of protozoa. (K+U) **CSO 1.4:** To give an introduction to plasmodium. (K) **CSO 1.5:** To study the general features of plasmodium. (K) **CSO 1.6:** To understand the life cycle of plasmodium. (U) **CSO 1.7:** To study the pathogenicity of plasmodium. (U) **CSO 1.8:** To learn the general characteristics of porifera. (K) **CSO 1.9:** To study the canal system in porifera. (U)	**9**	**20**	
Unit 2: Acoelomates, Pseudocoelomates	General characters of Helminthes; Life cycle of Taenia solium	**CSO 2.1:** To give an introduction to helminthes. (K) **CSO 2.2:** To study the general features of	**9**	**20**	

	General characters of Nemathelminthes Parasitic Adaptation	helminthes. (K) **CSO 2.3:** To learn the basics on Taenia solium. (K) **CSO 2.4:** To study the general characters of Taenia solium. (K) **CSO 2.5:** To study the life cycle of Taenia solium. (U) **CSO 2.6:** To understand the pathogenicity of Taenia solium. (U) **CSO 2.7:** To study the general features of nemathelminthes. (K) **CSO 2.8:** To understand the parasitic adaptations in nemhelminthes. (U)			
Unit 3: Arthropoda, Mollusca	General characters. Social life in insects General characters of mollusca; Pearl formation	**CSO 3.1:** To give an introduction to insects. (K) **CSO 3.2:** To learn and study the general characters of insects. (K) **CSO 3.3:** To understand sociality in insects. (U) **CSO 3.4:** To study the different types of social organisation in insects. (U) **CSO 3.5:** To learn basics on molluscs. (K) **CSO 3.6:** To study the general features of mollusc. (K) **CSO 3.7:** To understand the phenomenon of pearl formation. (U)	**9**	**20**	
Unit 4: Protochordata, Pisces and Amphibia	Salient features Osmoregulation, Migration of fishes General characters, Parental care in Amphibian	**CSO 4.1:** To give an introduction to tetrapods. (K) **CSO 4.2:** To learn the basics of osmoregulation. (K) **CSO 4.3:** To study the salient features of osmoregulation. (K) **CSO 4.4:** To understand the different types of osmoregulatory mechanisms in different	**9**	**20**	

		animals. (U) **CSO 4.5:** To study the general features of fishes. (K) **CSO 4.6:** To learn the phenomenon of migration in fishes. (U) **CSO 4.7:** To study the general features of amphibians. (K) **CSO 4.8:** To understand the concept of parental care in amphibians. (U)			
Unit 5: Reptiles, Aves and Mammalia	General characters of Reptiles, Aves and Mammals Flight adaptation in birds Terrestrial adaptation in reptiles	**CSO 5.1:** To give an introduction to terrestrial animals. (K) **CSO 5.2:** To study the general features of reptiles. (K) **CSO 5.3:** To understand the poison apparatus and biting mechanism in snakes. (U) **CSO 5.4:** To study the general features of aves. (K) **CSO 5.5:** To understand the flight adaptation and migration in aves. (U) **CSO 5.6:** To understand the terrestrial adaptations in reptiles. (U) **CSO 5.7:** To study the general characters of mammals. (K)	**9**	**20**	

NAME OF THE PAPER, CODE : Animal Diversity, ZOM 10 (P)
Number of Credit : 01
Number of Hours of Lecture : 30

PRACTICALS **50 Marks**

1. Study of following specimens:
   Non-Chordates: Euglena, Paramecium, Sycon, Physalia, Tubipora, Metridium, Taenia, Ascaris, Peripatus, Limulus, Dentallium, Chiton, Millipeda, Centipede.
   Chordates: Balanoglossus, Petromyzon, Hippocampus, Salamander, Naja, Viper, any three common birds.
2. Study of following Permanent Slides:
   Ascaris (male and female), T.S. of Earthworm passing through Pharynx, gizzard and thyplosolar intestine. T.S and L.S. of sycon
3. Temporary mounts of Unstained mounts of Placoid, cycloid and Ctenoid scales.

SUGGESTED READINGS:

1. Barnes, R.D. (1992) Invertebrate Zoology. Saunders College Pub. USA.
2. Ruppert, Fox and Barnes (2006) Invertebrate Zoology. A functional
3. Evolutionary Approach 7th Edition, Thomson Books/Cole

SKILL ENHANCEMENT COURSES

NAME OF THE PAPER (CODE) : BEE-KEEPING AND ITS MANAGEMENT (ZOS 1)
Number of Credit : 02
Number of Hours of Lecture : 30

COURSE OBJECTIVES (COs)

The following are the Course Objectives (COs) for the paper **Bee-keeping and its management:**

CO 1	To inculcate importance of Bee keeping and Honey processing.
CO 2	To teach techniques of construction of Bee Hives and its maintenance.
CO 3	To disseminate information on economic aspects of honeybee.

COURSE SPECIFIC OBJECTIVES (CSOs)

Unit & Title	Unit Contents	Course Specific Objective (CSOs)	Lecture Hours	Marks	LOs
Unit1 History, Biology and Rearing of Bees	History of Bee keeping – Scope and importance – Classification of honey bee species. Biology and life history of Honey bee. Bee colony – social organization, bee communication, swarming, pheromone. Selection of Bee Species for Apiculture, Bee Keeping Equipment. Bee hive – structure and types, Artificial Bee rearing (Apiary), Beehives- Newton and Langstroth Tools and extraction of honey.	**CSO 1.1:** To explain about History of Bee keeping. (U) **CSO 1.2:** To discuss about Scope and importance. (U) **CSO 1.3:** To learn classification of honey bee species. (K) **CSO 1.4:** To study Biology and life history of Honey bee. (U) **CSO 1.5:** To explain Bee colony, social organization, bee communication (U) **CSO 1.6:** To define the terms swarming and pheromone and its functions. (K) **CSO 1.7:** To explain about Selection of Bee Species for Apiculture. (U) **CSO 1.8:** To discuss Bee Keeping Equipment. (U) **CSO 1.9:** To explain about Bee hive – structure and types, Artificial Bee rearing (Apiary). (U) **CSO 1.10:** To study about Beehives- Newton and Langstroth (U) **CSO 1.11:** To illustrate Tools and extraction of honey.	14	24	
Unit 2 Management,	Site selection of apiculture, flora of	**CSO 2.1:** To explain about Site selection of apiculture,	8	13	

Diseases and enemies	apiculture – nectar, non-nectar and pollen plants, modern method of apiculture, Care and management of apiary. Diseases of Honey bee – Symptoms and control measures. Bee enemies.	flora of apiculture (U) **CSO 2.2:** To define nectar, non-nectar and pollen plants (K) **CSO 2.3:** To study the economic importance of nectars, non-nectars and pollen plants(U) **CSO 2.4:** To explain about modern method of apiculture. (U) **CSO 2.5:** To discuss about Care and management of apiary. (U) **CSO 2.6**: To describe diseases of Honey bee – Symptoms and control measures. (U) **CSO 2.7:** To explain Bee enemies (U)			
Unit 3 **Economy and Entrepreneurship**	Products and its uses: Honey, Bee wax, Bee venom, Pollen, Royal jelly, Propolis – Chemical composition, nutritional and medical value of honey. Marketing aspects of bee products. Bee Keeping Industry status in India, Recent Efforts. Pollination support through beekeeping -Role of honeybees in ecosystem	**CSO 3.1:** To study about Products and its uses: Honey, Bee wax, Bee venom, Pollen, Royal jelly, Propolis. (K) **CSO 3.2:** To explain about Chemical composition, nutritional and medical value of honey. (U) **CSO 3.3:** To explain about Marketing aspects of bee products. (U) **CSO 3.4:** To discuss Bee Keeping Industry status in India, Recent Efforts. (U) **CSO 3.5:** To explain about Pollination support through beekeeping. (U) **CSO 3.6**: To discuss the role of honeybees in ecosystem. (U)	8	13	

SUGGESTED READINGS:

1. Bisht D.S., Apiculture, ICAR Publication.
2. Fundamentals of Bee keeping –Sathe. T.V., 2006, Daya Publishing House Pvt. Ltd., New Delhi.
3. Bee Keeping in India, Ghosh. G.K., 1998, APH Publishing, New Delhi.

NAME OF THE PAPER (CODE) : Introduction to Vermiculture (ZOS 2)
Number of Credit : 02
Number of Hours of Lecture : 30

COURSE OBJECTIVES (COs)

The following are the Course Objectives (COs) for the paper **Introduction to Vermiculture:**

CO 1:	To make the students understand the morphology and biology of earthworm
CO 2:	To inculcate knowledge in students about habitat ecology of earthworm and to understand the general vermiculture
CO 3:	To make the students understand the differences between *Eisenia eugeniae* and *Eudrilus eugeniae*. To make the students understand vermicompost technology.

COURSE SPECIFIC OBJECTIVES (CSOs)

Unit & Title	Unit Contents	Course Specific Objectives (CSOs)	Lecture Hours	Marks	LOs
Unit 1: Morphology and Biology of earthworm	Taxonomic position, external features- shape, size, colour, segmentation, setae & clitellum, Body wall, coelom. Reproductive system - Male & Female, copulation, cocoon formation & fertilization, development of earth worm	**CSO 1.1:** to explain on the taxonomic position of earthworm. (U) **CSO 1.2:** to describe the external features of an earthworm. (K) **CSO 1.3:** to describe on the male and female reproductive system of an earthworm. (K) **CSO 1.4:** to explain on the copulation, cocoon formation and fertilization of an earthworm. (U) **CSO 1.5:** to elaborate on the development of earthworm. (U)	6	10	
UNIT 2 Habitat Ecology and General Vermiculture	Burrowers, Casts, Nocturnal, Poikilothermal Ecological grouping – Epigeic species, Endogeic species and Anecics (self-study). Introduction to vermiculture: Definition, history, economic importance,	**CSO 2.1:** to define epigenic species with examples. (U) **CSO 2.2:** to define endogenic species with examples. (U) **CSO 2.3:** to define anecics species with examples. (U) **CSO 2.4:** to define Vermiculture (U) **CSO 2.5:** to explain on the history and economic	12	20	

	their values in maintenance of soil structure Significance in biotransformation of the residues and production of organic fertilizers	importance of an earthworm. (K) **CSO 2.6:** to explain the value of earthworm in maintaining soil structure. (K) **CSO 2.7:** to enumerate the significance in biotransformation of the residues. (K) **CSO 2.8:** to describe the production of organic fertilizers. (K)			
UNIT 3 Comparative study of Eisenia eugeniae and Eudrilus eugeniae,Vermicompost technology (methods and products)	Taxonomy, Anatomy. Physiology and Reproduction. Vermicompost technology (methods and products)- Construction of vermicompost pits. Large and small scale vermicompost for commercial and home gardens. Harvesting and processing of worm cast (Vermicompost) can be given as self-study (4hrs)	**CSO 3.1:** to explain on the taxonomic position of Eisenia eugeniae and Eudrilus eugeniae. (U) **CSO 3.2**: to describe the physiology of Eisenia eugeniae and Eudrilus eugeniae. (K) **CSO 3.3:** to describe the reproduction of Eisenia eugeniae and Eudrilus eugeniae. (K) **CSO 3.4:** to outline the construction of vermicompost pits. (K) **CSO 3.5:** to describe large and small scale vermicompost for commercial and home gardens. **CSO 3.6:** To explain on the harvesting and processing of worm cast.	12	20	

SUGGESTED READINGS:

1. Jordan & Verma.2009. Invertebrate Zoology, Chand & Company Ltd.
2. Bhatnagar & Patla.2007. Earthworm vermiculture and vermin-composting, Kalyani Publishers, New Delhi.
3.. Edwards, C.A & P.J Bohlen. 1996. Biology and ecology of earthworms III Edn. Chapman & Hall N.Y.U.S.A.
4. Aravind Kumar, 2005. Verms & Vermi technology, A.P.H. Publishing Corporation, New Delhi.
5. Mary Violet Christy,2008. Vermi technology, MJP Publishers, Chennai.

NAME OF THE PAPER (CODE) : SERICULTURE (ZOS 3)
Number of Credit : 03
Number of Hours of Lecture : 30

COURSE OBJECTIVES (COs)

The following are the Course Objectives (COs) for the paper **Sericulture:**

CO 1:	To impart knowledge to the students about Sericulture and make students understand the biology of Silkworms
CO 2:	To inculcate knowledge in students about rearing of Silkworms
CO 3:	To make students understand on pests and diseases affecting Silkworm and to inculcate knowledge in students about Entrepreneurship in Sericulture

COURSE SPECIFIC OBJECTIVES (CSOs)

Unit & Title	Unit Contents	Course Specific Objectives (CSOs)	Lecture Hours	Marks	LOs
UNIT 1: Introduction and Biology of Silkworm	Sericulture: Definition Types of Silkworms, Mulberry and Non-mulberry Sericulture. Life-cycle of Bombyx mori Structure of silk glands and secretion of Silk	**CSO 1.1:** to define Sericulture. (K) **CSO 1.2:** to explain on the different types of Silkworms. (U) **CSO 1.3:** to discuss on Mulberry and Non- Mulberry sericulture. (U) **CSO 1.4:** to elaborate on the life cycle of Bombyx mori (K) **CSO 1.5:** to describe the structure of silk glands. (U) **CSO 1.6:** to describe the secretion of silk. (U)	8	12	
UNIT 2 Rearing of Silkworms	Selection of mulberry variety and establishment of mulberry garden; Rearing house and rearing appliances; Disinfectants: Formalin, bleaching powder Silkworm rearing technology: Early age and Late age rearing	**CSO 2.1:** To explain about Selection of mulberry variety and establishment of mulberry garden (U) **CSO 2.2:** To describe about rearing house and rearing appliances. (K) **CSO 2.3:** To explain about disinfectants: Formalin, bleaching powder. (U) **CSO 2.4:** To discuss about Silkworm rearing technology. (U) **CSO 2.5:** To explain about	10	18	

	Spinning, harvesting and storage of cocoons	Early age and Late age rearing. (U) **CSO 2.6:** To explain about Spinning, harvesting and storage of cocoons. (U)			
UNIT 3: Pests and Diseases and Entrepreneu r ship in Sericulture	Pathogenesis of silkworm diseases Control and Prevention of pest and diseases. Prospects of sericulture in India, Sericulture industry in different states. Potential in mulberry and non-mulberry sericulture. visit to various sericulture centers.	**CSO 3.1:** To explain about Pathogenesis of silkworm diseases. (U) **CSO 3.2:** To discuss about Control and Prevention of pest and diseases. (U) **CSO 3.3:** To explain about Prospects of sericulture in India. (U) **CSO 3.4:** To discuss about Sericulture industry in different states. (U) **CSO 3.5:** To describe about the potential in mulberry and non-mulberry Sericulture. (K) **CSO 3.6:** To explore various sericulture centers. (A)	12	20	

SUGGESTED READINGS:

1. Rome. 1976. Manual on Sericulture; Food and Agricultural organization.
2. Director of Ptg., Stn. & Pub. 1956. Silkworm Rearing and Diseases of Silkworm. Govt. Press, Bangalore
3. Ed. M. S. Jolly, Director, CSR & TI, Mysore. Appropriate Sericulture Techniques.
4. M. N. Narasimhanna, CSB, Bangalore. 1988.Manual of Silkworm Egg Production.
5. Wupang—Chun and Chen Da-Chung. Rome 1988. Silkworm Rearing; Pub. By FAO,

NAME OF THE PAPER (CODE) : PISCICULTURE (ZOS 4)
Number of Credit : 02
Number of Hours of Lecture : 30

COURSE OBJECTIVES (COs)

The following are the Course Objectives (COs) for the paper **Pisciculture:**

CO 1:	To study and understand taxonomy and biodiversity of fishes
CO 2:	To understand the physiology of fishes and to make the students aware of how to construct fish farm
CO 3:	To make the students learn about preservation and processing of fishes and Biotechnology

COURSE SPECIFIC OBJECTIVES (CSOs)

Unit & Title	Unit Contents	Course Specific Objective (CSOs)	Lecture Hours	Marks	LOs
UNIT 1 Taxonomy and Biodiversity	Classification of living fishes (up to orders), Fish diversity in India, Status of indigenous and exotic fish species, conservation of fish germplasm. Body form and locomotion: Morphological adaptation to hill stream and river.	**CSO 1.1:** To explain about classification of living fishes. (U) **CSO 1.2:** To discuss about Fish diversity in India. (K) **CSO 1.3:** To describe about Status of indigenous and exotic fish species. (K) **CSO 1.4**: To explain about conservation of fish germplasm. (U) **CSO 1.5:** To discuss about Body form and locomotion. (K). **CSO 1.6:** To explain about Morphological adaptation to hill stream and river. (U)	6	10	
UNIT 2 Physiology and Fish farm construction	Respiration: Mechanism of gaseous exchange and accessory respiratory organs. Excretion: Osmotic regulation, acid base balance, salt and water balance in fresh water. Reproduction: Gametogenesis, reproductive system in teleosts. Pre-stocking and post-stocking management, management of	**CSO 2.1:** To explain about Respiration. (U) **CSO 2.2:** To discuss about mechanism of gaseous exchange and accessory respiratory organs. (K) **CSO 2.3:** To describe about Osmotic regulation, acid base balance, salt and water balance in fresh water. (K) **CSO 2.4:** to explain about reproduction (U) **CSO 2.5:** to elaborate about gametogenesis. (U) **CSO 2.6:** to explain reproductive system in teleost. (U)	14	24	

	nursery and rearing ponds, Composite fish culture, Integrated fish culture, Aquatic weeds and their control.	**CSO 2.7:** To explain about Pre-stocking and post-stocking management (U) **CSO 2.8:** To discuss about management of nursery and rearing ponds. (U) **CSO 2.9:** to describe about Composite fish culture. (K) **CSO 2.10:** To explain about Integrated fish culture. (U) **CSO 2.11:** To discuss about Aquatic weeds and their control. (U)			
UNIT 3 Preservation and processing of fishes and Biotechnology	Fish spoilage, Nutritive value of fish, value added products of fish, water pollution and its effect on fishes, fishing gears. Development and application of transgenic species, Induced breeding and cryopreservation of gametes, Hybridization.	**CSO 3.1:** To explain about Fish spoilage. (U) **CSO 3.2:** To discuss about Nutritive value of fish. (K) **CSO 3.3:** To explain value added products of fish (U). **CSO 3.4:** To explain about water pollution and its effect on fishes, (U). **CSO 3 .5**: to explain on fishing gears (U). **CSO 3.6:** to define transgenic species (K) **CSO 3.7:** To explain about Development and application of transgenic species. (U) **CSO 3.8:** To discuss about Induced breeding. (K) **CSO 3.9:** to explain cryopreservation of gametes. (U) **CSO 3.10:** to explain Hybridization. (U)			

SUGGESTED READINGS

1. Q Bone and R Moore, Biology of Fishes, Talyor and Francis Group, CRC Press, U.K.
2. J.R. Norman, A history of Fishes, Hill and Wang Publishers
3. S.S. Khanna and H.R. Singh, A text book of Fish Biology and Fisheries, Narendra Publishing House
4. C.B.L. Srivastava, Fish Biology, Narendra Publishing
5. R.J. and B.G. Kapoor. The Senses of Fish: Adaptations for the Reception of Natural Stimuli, Springer, Netherlands.

NAME OF THE PAPER (CODE) : FOOD, NUTRITION AND HEALTH (ZOS 5)
Number of Credit : 02
Number of Hours of Lecture : 30

COURSE OBJECTIVES (COs)

The following are the Course Objectives (COs) for the paper **Food, nutrition and health:**

CO 1:	To make students understand the basic concept of food and nutritional biochemistry.
CO 2:	To gain knowledge regarding health and importance of food hygiene.
CO 3:	To make the students, learn about food safety and standards.

COURSE SPECIFIC OBJECTIVES (CSOs)

Unit & Title	Unit Contents	Course Specific Objective (CSOs)	Lecture Hours	Marks	LOs
UNIT 1 Basic concept of food and Nutritional Biochemistry	Food Components and food-nutrients Concept of a balanced diet, nutrient needs and dietary pattern for various groups- adults, pregnant and nursing mothers, infants, school children, adolescents and elderly. Carbohydrates, Lipids, Proteins- Definition, Classification, their dietary source and role Vitamins- Fat-soluble and Water-soluble vitamins- their dietary source and importance Minerals- Iron, calcium, phosphorus and iodine: their dietary source and importance, their biological functions.	**CSO 1.1:** To explain about Food Components. (U). **CSO 1.2:** To outline food-nutrients (U). **CSO 1.3:** To explain Concept of a balanced diet (U). **CSO 1.4:** To outline nutrient needs and dietary pattern for adults (U). **CSO 1.5:** to describe nutrient needs and dietary pattern for pregnant and nursing mothers (K) **CSO 1.6:** to explain nutrient needs and dietary pattern for infants (U). **CSO 1.7:** to explain nutrient needs and dietary pattern for school children (U) **CSO 1.8:** to outline nutrient needs and dietary pattern for adolescents and elderly (K). **CSO 1.9:** To explain about Carbohydrates, Lipids, Proteins. (U) **CSO 1.10:** To define, Classify, their dietary source and role (K) **CSO 1.11:** To describe Vitamins- Fat-soluble and Water-soluble vitamins- their dietary source and	11	18	

		importance. (K) **CSO 1.12**: To explain about Minerals- Iron, calcium, phosphorus and iodine: their dietary source and importance, their biological functions. (U)			
UNIT 2 **Health and Food hygiene**	Introduction to health- Definition and concept of health Major nutritional Deficiency diseases- Protein Energy Malnutrition (kwashiorkor and marasmus), Vitamin A deficiency disorders and Iodine deficiency disorders- their causes, symptoms, treatment and prevention. Common ailments- cold, cough, and fevers, their causes and treatment. Potable water- sources and methods of purification at domestic level Food and Water borne infections: Bacterial infection: Typhoid fever, dysentery Parasitic infection: taeniasis their transmission, causative agent, sources of infection, symptoms and prevention Brief account of food spoilage: Causes of food spoilage and their preventive measures.	**CSO 2.1:** to define health (U). **CSO 2.2**: to explain Definition and concept of health. (U) CSO 2.3: To explain about Major nutritional Deficiency diseases- Protein Energy Malnutrition (kwashiorkor and marasmus), Vitamin A deficiency disorders and Iodine deficiency disorders- their causes, symptoms, treatment and prevention (U) **CSO 2.4:** to discuss about Common ailments- cold, cough, and fevers, their causes and treatment. (U). **CSO 2.5:** To explain about Potable water- sources and methods of purification at domestic level. (U). **CSO 2.6:** To discuss about Food and Water borne infections: Bacterial infection: Typhoid fever, dysentery. (U) **CSO 2.7:** To explain about Parasitic infection: taeniasis their transmission, causative agent, sources of infection, symptoms and prevention (U) **CSO 2.8:** To outline brief account of food spoilage: Causes of food spoilage and their preventive measures (K).	13	22	
UNIT 3 **Food Safety and Standard**	Food quality assurance- Introduction to	**CSO 3.1:** To explain about Food quality assurance. (U).	6	10	

	quality assurance; Principles of Quality assurance. Food packaging-Functions of food packaging, requirement for effective food packaging, food packaging materials and forms, safety of food packaging.	**CSO 3.2:** To discuss about quality assurance. (U). **CSO 3.3:** To describe Principles of Quality assurance. (K). **CSO 3.4:** To discuss about Food Packaging-Functions of food packaging, requirement for effective food packaging, food packaging materials and forms, safety of food packaging (U).			

SUGGESTED READINGS:

1. Mudambi, SR and Rajagopal, MV. (2007). Fundamentals of Foods, Nutrition and Diet Therapy; Fifth Ed; New Age International Publishers
2. Srilakshmi B. (2007). Food Science; Fourth Ed; New Age International (P) Ltd.
3. Bamji MS, Rao NP, and Reddy V. (2009) Text Book of Human Nutrition; Oxford & IBH Publishing Co. Pvt Ltd.
4. Wardlaw GM, Hampl JS. (2007). Perspectives in Nutrition; Seventh Ed; McGraw Hill.
5. Lakra P, Singh MD. (2008). Textbook of Nutrition and Health; First Ed; Academic Excellence.

NAME OF THE PAPER (CODE) : MEDICAL DIAGNOSTICS (ZOS 6)
Number of Credit : 02
Number of Hours of Lecture : 30

COURSE OBJECTIVES (COs)
The following are the Course Objectives (COs) for the paper Medical Diagnostics

CO 1:	To make the students understand the importance of medical diagnostics and methods used in urine analysis.
CO 2:	To have developed the understanding of methods used in the analysis of blood
CO 3:	To impart knowledge to the students about non- infectious diseases and infectious diseases its diagnosis, symptoms and prevention

COURSE SPECIFIC OBJECTIVES (CSOs)

Unit & Title	Unit Contents	Course Specific Objectives (CSOs)	Lecture Hours	Marks	LOs
UNIT 1 Introduction and Diagnostic Methods Used for Urine Analysis	Introduction to Medical Diagnostics and its Importance. Urine Analysis: Physical characteristics; Abnormal constituents	**CSO 1.1:** to define medical diagnostics. (K) **CSO 1.2:** To discuss the importance of Medical Diagnostics. (U) **CSO 1.3:** to explain on urine analysis. (U) **CSO 1.4:** to list the physical characteristics of urine analysis. (K) **CSO 1.5:** to explain abnormal constituents of urine analysis. (U)	6	10	
UNIT 2 Diagnostic Methods Used for analysis of Blood	Blood composition, Preparation of blood smear and Differential Leucocyte Count (D.L.C) using Leishman's stain, Platelet count using haemocytometer, Erythrocyte Sedimentary Rate (E.S.R), Packed Cell Volume (P.C.V.)	**CSO 2.1:** to outline on blood composition. (K) **CSO 2.2:** to explain on the preparation of blood smear. (U) **CSO 2.3:** to explain on the preparation Differential Leucocyte Count (D.L.C) using Leishman's stain. (U) **CSO 2.4**: to describe Platelet count using haemocytometer. (K) **CSO 2.5:** to explain Erythrocyte Sedimentary Rate (E.S.R). (U) **CSO 2.6:** to explain Packed Cell Volume (P.C.V.). (U)	12	20	
UNIT-3 Non-infectious	Causes, types, symptoms, complications,	**CSO 3.1:** to define non-infectious diseases. (K) **CSO 3.2:** to explain on the	12	20	

Diseases and Infectious Diseases	diagnosis and prevention of Diabetes (Type I and Type II), Hypertension (Primary and secondary), Testing of blood glucose using Glucometer/kit. Causes, types, symptoms, diagnosis and prevention of Tuberculosis and Hepatisis. Types (Benign/Malignant) , X-Ray of Bone fracture, MRI and CT-Scan (using photographs)	causes, types, symptoms, complications, diagnosis and prevention of Diabetes (Type I and Type II). (U) **CSO 3.3:** to explain on the causes, types, symptoms, complications, diagnosis and prevention of Hypertension (Primary and secondary). (U) **CSO 3.4:** to understand testing of blood glucose using Glucometer/kit. (K) **CSO 3.5:** to define infectious diseases. (K) **CSO 3.6:** to explain on the Causes, types, symptoms, diagnosis and prevention of Tuberculosis. (U) **CSO 3.7:** to explain on the Causes, types, symptoms, diagnosis and prevention of Hepatisis. (U) **CSO 3.8:** to explain on the types of benign tumour. (U) **CSO 3.9:** to explain on the types of malignant tumour. (U) **CSO 3.10:** to illustrate X-Ray bone structure through photographs. (A) **CSO 3.11:** to illustrate and demonstrate MRI through photographs. (A) **CSO 3.12:** to illustrate CT-Scan through photographs. (A)			

SUGGESTED READINGS:

1. Park, K. (2007), Preventive and Social Medicine, B.B. Publishers
2. Cheesbrough M., A Laboratory Manual for Rural Tropical Hospitals, A Basis for Training Courses
3. Guyton A.C. and Hall J.E. Textbook of Medical Physiology, Saunders
4. Robbins and Cortan, Pathologic Basis of Disease, VIII Edition, Saunders
5. Prakash, G. (2012), Lab Manual on Blood Analysis and Medical Diagnostics, S. Chand and Co. Ltd.