



**PSGR
Krishnammal College for Women**



DEPARTMENT OF ZOOLOGY

**CHOICE BASED CREDIT SYSTEM (CBCS)
LEARNING OUTCOMES- BASED CURRICULAR FRAMEWORK (LOCF)**

**MASTER OF SCIENCE IN ZOOLOGY
2024 – 2026 BATCH
(I , II & III SEMESTERS)**



PROGRAMME LEARNING OUTCOMES

After completion of the programme, the student will be able to

PLO1: Acquire sound knowledge in Zoology for critical thinking, learning and research

PLO2: Develop professional skills and soft skills through technical training, communication and presentation

PLO3: Identify, formulate, and solve biological problems and also contribute to the community through academic, governmental and non-governmental organization

PLO4: Integrate the courses such as taxonomy, cell biology, evolution, biochemistry, physiology, developmental biology, molecular biology, genomics, microbiology and immunology for a successful career.

PLO5: Imbibe entrepreneurial skills by transforming the knowledge obtained from “lab to land” from the courses such as pisciculture, apiculture and sericulture

PROGRAMME SPECIFIC OUTCOME

The students at the time of graduation will

PSO1: Have a deeper understanding of the nature and basic concepts of taxonomy, Molecular cell biology, Immunology, Biochemistry, Physiology and applied zoology.

PSO2: Understand the molecular basis of a cell and compare the developmental processes involved in different organisms.

PSO3: Gain knowledge about research methodologies and skills of problem solving methods.

PSO4: Analyze the relationships among animals and plants through plant-animal interactions and apply the knowledge in agriculture in pest management and control.

PSO5: Gain entrepreneurial skills in various fields of Zoology including Apiculture, Sericulture, and Pisciculture.



MASTER OF SCIENCE IN ZOOLOGY

CHOICE-BASED CREDIT SYSTEM (CBCS)

LEARNING OUTCOMES - BASED CURRICULUM FRAMEWORK (LOCF)

SYLLABUS & SCHEME OF EXAMINATION
2024-2026 BATCH

SEM	Course Code	Course Title	Course Type	Instruction Hours/Week	Contact Hours	Tutorial Hours	Duration of Examination	Examination Marks			Credits
								CA	ESE	TOTAL	
I	MZO2401	Paper I- Phylogeny, Systematics and Functional organization of Invertebrates	CC	5	73	2	3	25	75	100	4
I	MZO2302	Paper II – Evolution and Animal Behaviour	CC	5	73	2	3	25	75	100	4
I	MZO2303	Paper III - Developmental Biology	CC	5	73	2	3	25	75	100	4
I	MZO2404	Paper IV – Molecular Cell Biology	CC	5	73	2	3	25	75	100	4
I	MZO2305	Paper V- Ecosystem Services and Sustainable Environmental management	CC	4	58	2	3	25	75	100	4
II	MZO2306	Phylogeny, Systematics and Functional organization of Chordates	CC	5	73	2	3	25	75	100	4

II	MZO2307	Biochemistry	CC	5	73	2	3	25	75	100	4
II / III	MZO23CEA	Animal Physiology (OR)	CC	6	88	2	-	100	-	100	5
	MZO2308 +	Entomology +		4 +	58	2	3	25	75	100	4
	MZO23S1	Research Methodology	GC	2	30		3	-	100	100	2
II	MZO2309 /	Introduction to Forensic Science /	DSE	4	58	2	3	25	75	100	4
	MZO2310	Bioanalytical tools and Bioinformatics									
	MZC22A1	Clinical Microbiology, Biochemistry and Parasitology	GC	4	60		3	-	100	100	4
II	MZO23P1	Core Practical-I	CC	3	45	-	3	25	75	100	4
II	MZO23P2	Core Practical-II	CC	3	45	-	3	25	75	100	4
III	MZO2311	Immunology	CC	5	73	2	3	25	75	100	4
III	MZO2312	Entomology +	CC	4	58	2	3	25**	75	100	4
	+ MZO23S1	Research Methodology	GC	2	30	-	3	-	100	100	2
III	MZO2313	Molecular Endocrinology and Reproductive physiology	CC	5	73	2	3	25	75	100	4
III	MZO2314	Agricultural and Industrial Zoology /	DSE	4	58	2	3	25	75	100	4
	/ MZO2315	Genomics Metagenomics									
III	MZO23P3	Core Practical - III	CC	4	60	-	4	25	75	100	4
III	MZO23P4	Core Practical - IV	CC	4	60	-	4	25	75	100	4
III	MNM22CS2	Cyber Security II	AECC	2	30	-	-	100	-	100	Gr.
III	MZO24COM	Comprehensive Examination	GC	-	-	-	-	100	-	100	Gr.

I- III	17MONL1	Online Course *	ACC	SS	-	-	-	-	-		
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** : Open book test

* : Students completing online course through NPTEL and IIT MUMBAI will get a credit of 1, for others completed status will be given.

SS : Self study

EXAMINATION SYSTEM

Pattern:

Semester system will be followed. A semester consists of a minimum of 90 working days excluding the days of conduct of ESE. There will be Continuous Internal Assessment (CA) to evaluate the performance of students in each course and the End Semester Examination will be held at the end of every semester.

Continuous Internal Assessment CA – Theory

The weightage assigned to various components of the CA is as follows

Core & Elective

CIA Test	5 Marks (conducted for 45 marks after 50 days – 3 units)
Model Exam	7 Marks (Conducted for 75 marks after 85 days (Each Unit 15 Marks)
Seminar/Assignment/Quiz	5 Marks
Class Participation	5 Marks
Attendance	3 Marks (Attendance 75% - 80% - 1 Mark, 81% - 90% - 2 Marks, 91% - 100% - 3 Marks)

Total :25 Marks

Practical

Lab Performance	7 marks
Regularity	5 marks
Model Exam	10 marks
Attendance	3 marks

Total: 25 Marks

Cyber security II

Quiz	60 Marks
Case study	20 Marks
poster	20 Marks

Total:100 Marks

Open book Test

CIA Test Pattern 4 (4 out of 6) x 15 Marks = **60 Marks**

Open book examination to be provided for any one core course. Questions/problems to be solved by applying concepts. Questions with direct book answers to be avoided.

End semester Examination- Theory

5 x 15 = 75 Marks

Core & Elective

Question from each unit comprising of

One question with a weightage of 2 Marks	2 x 5=10
One question with a weightage of 5 Marks (Internal Choice at the same CLO level)	5 x 5 =25
One question with a weightage of 8 Marks (Internal Choice at the same CLO level)	8 x 5 =40

ESE Practical Pattern

The End Semester Examination will be conducted for a maximum of 75 marks respectively with a maximum of 15 marks for the record and other submissions if any.

RUBRICS

Assignment/ Seminar

Maximum - 20 Marks (converted to 4 marks)

Criteria	4 Marks	3 Marks	2 Marks	1 Mark
Focus Purpose	Clear	Shows awareness	Shows little awareness	No awareness
Main idea	Clearly presents a main idea.	Main idea supported throughout	Vague sense	No main idea
Organization: Overall	Well planned	Good overall organization	There is a sense of organization	No sense of organization
Content	Exceptionally well presented	Well presented	Content is sound	Not good
Style: Details and Examples	Large amounts of specific examples and detailed description	Some use of examples and detailed descriptions	Little use of specific examples and details	No use of examples

CLASS PARTICIPATION

Maximum - 20 Marks (converted to 5 marks)

Criteria	5 Marks	4 Marks	3 Marks	2 Marks	1 Mark	Points scored
Level of Engagement in Class	Student proactively contributes to class by offering ideas and asks questions more than once per class.	Student proactively contributes to class by Offering ideas and Asks Questions once per Class	Student contributes to class and asks questions occasionally	Student rarely contributes to class by offering ideas and asking no questions	Student never contributes to class by offering ideas	
Listening Skills	Student listens when others talk, both in groups and in class. Student incorporates or builds off of the ideas of others.	Student Listens When others talk, both in groups and in class.	Student listens when others talk in groups and in class occasionally	Student does not listen when others talk, both in groups and in class.	Student does not listen when others talk, both in groups and in class. Student often interrupts when others speak.	
Behavior	Student almost never displays disruptive behavior during class	Student Rarely Displays disruptive Behaviour During Class	Student occasionally displays disruptive behavior during class	Student often displays disruptive behavior during class	Student almost always displays disruptive behavior during class	
Preparation	Student is almost always prepared for class with required class materials	Student is Usually Prepared for class With Required Class Materials	Student is occasionally prepared for class with required class materials	Student is rarely prepared for class with required class materials	Student is almost never prepared for class.	
					Total	

MAPPING OF PLOs WITH CLOs

COURSE	PROGRAMME OUTCOMES				
	PLO1	PLO2	PLO3	PLO4	PLO5
COURSE – MZO2401					
CLO1	S	S	S	M	M
CLO2	S	S	S	S	M
CLO3	S	S	S	S	M
CLO4	S	S	S	S	M
CLO5	S	S	S	S	M
COURSE – MZO2302					
CLO1	S	S	M	M	M
CLO2	S	S	M	M	M
CLO3	S	S	S	S	M
CLO4	S	S	S	S	M
CLO5	S	S	S	M	M
COURSE –MZO2303					
CLO1	S	S	S	S	M
CLO2	S	S	S	S	M
CLO3	S	S	S	S	M
CLO4	S	S	S	S	M
CLO5	S	S	S	M	M
COURSE –MZO2404					
CLO1	S	S	S	S	S
CLO2	S	S	S	S	M
CLO3	S	S	S	S	M
CLO4	S	S	S	S	M
CLO5	S	S	S	S	M
COURSE – MZO2305					
CLO1	M	S	S	S	S
CLO2	S	S	S	S	S
CLO3	M	S	S	S	S
CLO4	S	S	S	S	S
CLO5	S	S	S	S	S
COURSE – MZO2306					
CLO1	M	M	S	S	S
CLO2	S	S	S	S	S
CLO3	S	S	S	S	S
CLO4	S	S	S	S	S
CLO5	S	S	S	S	S
COURSE – MZO2307					
CLO1	S	S	S	S	S
CLO2	S	S	S	S	S
CLO3	S	S	S	S	S
CLO4	S	S	S	M	M
CLO5	S	S	S	M	M
COURSE – MZO23CEA					
CLO1	S	S	S	S	M
CLO2	S	S	S	S	M
CLO3	S	S	S	S	M
CLO4	S	S	S	M	M
CLO5	S	S	S	M	M

COURSE – MZO2308					
CLO1	S	S	S	S	S
CLO2	S	S	S	S	S
CLO3	S	S	S	M	M
CLO4	S	S	S	M	M
CLO5	S	S	S	M	M
COURSE – MZO2309					
CLO1	S	S	S	S	S
CLO2	S	S	S	S	S
CLO3	S	S	S	S	S
CLO4	S	S	S	M	M
CLO5	S	S	S	M	M
COURSE – MZO2310					
CLO1	S	S	S	S	S
CLO2	S	S	S	S	S
CLO3	S	S	S	S	S
CLO4	S	S	S	S	S
CLO5	S	S	S	M	M
COURSE – MZO23P1					
CLO1	S	S	S	S	S
CLO2	S	S	S	S	S
CLO3	S	S	S	S	S
CLO4	S	S	S	S	S
COURSE – MZO23P2					
CLO1	S	S	S	S	S
CLO2	S	S	S	S	S
CLO3	S	S	S	S	S
CLO4	S	S	S	S	S
COURSE – MZO2311					
CLO1	S	S	S	M	M
CLO2	S	S	S	M	M
CLO3	S	S	S	S	M
CLO4	S	S	S	S	M
CLO5	S	S	S	S	M
COURSE – MZO2312					
CLO1	S	S	S	S	S
CLO2	S	S	S	S	S
CLO3	S	S	S	M	M
CLO4	S	S	S	M	M
CLO5	S	S	S	M	M
COURSE – MZO2313					
CLO1	S	S	S	S	S
CLO2	S	S	S	S	S
CLO3	S	S	S	S	S
CLO4	S	S	S	M	M
CLO5	S	S	S	S	S
COURSE – MZO2314					
CLO1	M	M	S	S	S
CLO2	S	S	S	S	S
CLO3	S	S	S	S	S
CLO4	S	S	S	S	S
CLO5	S	S	S	S	S
COURSE – MZO2315					

CLO1	M	M	S	S	S
CLO2	S	S	S	S	S
CLO3	S	S	S	S	S
CLO4	S	S	S	S	M
CLO5	S	S	S	M	M
COURSE – MZO23P3					
CLO1	S	S	S	S	S
CLO2	S	S	S	S	S
CLO3	S	S	S	S	S
CLO4	S	S	S	M	S
COURSE – MZO23P4					
CLO1	S	S	S	S	S
CLO2	S	S	S	S	S
CLO3	S	S	S	M	S
CLO4	S	S	S	S	S

S- Strong; M-Medium

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDIT
MZO2401	PHYLOGENY, SYSTEMATICS AND FUNCTIONAL ORGANIZATION OF INVERTEBRATES	THEORY	73	2	-	4

Preamble

To introduce students, the principles and practice of phylogeny, the diversity of animals and understand the evolutionary relationships and taxonomic classification of animals as currently understood.

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Understand the importance of Principles of taxonomy, structure and functions, phylogenetic relationship, comparative analysis and affinities towards the lower phyla of invertebrates	K2
CLO2	Apply the taxonomic identification, species concept, DNA barcode and the structure and function of invertebrates in relation to locomotion, digestion and respiration, Affinities and Systematic Position of Minor Phyla	K3
CLO3	Analyze the speciation, Origin of Invertebrates and Phylogenetic interrelationships between Invertebrate phyla, Affinities and Systematic Position of Minor Phyla.	K4
CLO4	Describe the importance of taxonomy, structural organization of invertebrates, larval forms and to analyse the importance of hormones in developmental events of insects and crustaceans and Affinities and Systematic Position of Minor Phyla.	K5
CLO5	Collaborate on the Principles of taxonomy, structure and functions, phylogenetic relationship, Affinities and Systematic Position of Minor Phyla.	K6

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	S	S	S	M	M
CLO2	S	S	S	S	M
CLO3	S	S	S	S	M
CLO4	S	S	S	S	M
CLO5	S	S	S	S	M

S- Strong; M-Medium

PHYLOGENY, SYSTEMATICS AND FUNCTIONAL ORGANIZATION OF INVERTEBRATES

MZO2401 (73 Hrs)

UNIT I

(14 Hrs)

Principles of Taxonomy

Introduction to the science of taxonomy; rules of nomenclature. Principles of biological classification; the species category; the polytypic species; population systematic intraspecific categories. Methods of Biological classification: Taxonomic collection and the processes of identification, taxonomic characters; methods of arriving at taxonomic decisions on species level; preparation and use of taxonomic keys. Cytotaxonomy; Classical and modern methods- Typological, Phenetics, Evolutionary, Phylogenetic, Cladistics and Molecular Taxonomy. Phylocode, Tree of Life and Bar-coding of Life.

UNIT II

(15 Hrs)

Origin of Invertebrates and Phylogenetic interrelationships between Invertebrate phyla. Origin of Protists. Prokaryotes and Eukaryotes. Multi-cellularity -Edicaran and Burgess Shalefauna. Cambrian explosion- causes and consequences. Possible theories of metazoan origin. Symmetry, Coelom and Metamerism- evolutionary advantages. Porifera, Cnidaria- Polymorphism, Ctenophora, Acoelomata, Placozoa, Mesozoa and Pseudocoelomata evolutionary relationships and adaptive modifications only. Phylogenetic position of Molluscs, Adaptive Radiation in Molluscs and Annelids. Phylogeny of Arthropod- Monophyly and Polyphyly, Reasons for the success of Arthropods.

UNIT III

(14 Hrs)

Structure and function in Invertebrates

Locomotion: Flagella, Ciliary and amoeboid movement in Protozoa; Locomotion in relation to hydrostatics, coelom, metamerism, arthropodization. An outline of light mechanism in insects. Nutrition and Digestion: Patterns of feeding and digestion in lower metazoans, filter feeding in polychaeta, filter feeding and digestion in mollusca and deuterostoma; feeding diversity in insects and echinoderms. Respiration: Respiration and respiratory pigments in lower invertebrates, Organs of Respiration-Gills and lobophores, gills and lungs in mollusca and gills and tracheae in Arthropoda.

UNIT IV

(15 Hrs)

Comparative Structure and Functional Organization in invertebrates

Excretion: A study of structural and functional organization of excretory systems in various invertebrate groups; Nervous system: Plan of nervous systems in the Coelenterates,

Platyhelminthes, Annelids, Arthropods, Molluscs and Echinoderms. Trends in neural evolution. Photoreception and photosensitivity in non-chordate forms, Functional morphology of compound eye in arthropods. A survey of endocrinal structures and their hormones: role of neurosecretions and hormones in developmental events of insects and crustaceans, Invertebrate larvae and its significance: Larval forms of Platyhelminthes, Crustacea, Mollusca and Echinodermata.

UNIT V

(15 Hrs)

Affinities and Systematic Position of Minor Phyla

Interrelationship of important Pseudocelomate groups, Rotifera. Gastrotricha, Kinorhynca, Nematomorpha and Entoprocta. Affinities and evolutionary significance of the unsegmented lesser protostome phyla (Pirapulida, Echiuroidea and Sipunculida. Phylogenetic relationship between the coelomate phyla (Annelida, Onychopora, Arthropoda & Mollusca). Affinities and evolutionary significance of the Lophophorate coelomate phyla (Brachiopoda, Phoronida & Ectoprocta). Affinities of the invertebrate deuterostome phyla (Chaetognatha, Echinodermata, Pogonophora & Hemichordata), Invertebrates Fossils: Trilobites, Brachiopoda, Cephalopoda and Echinodermata.

Text Books:

S. No.	Authors	Title of the Book	Publishers	Year & Edition
1	Barnes, R. D	Invertebrate Zoology	Toppan International Co., NY	1982 (6 th Edn).
2	Barrington, E. J. W.	Invertebrate Structure and Functions	English Language Book Society.	1969 (2 nd Edn).
3.	Rupert E., Edward R. S., Fox and R. D. Barnes.	Invertebrate Zoology: A Functional Evolutionary Approach.	Thomson/Cole, Singapore.	1940 –1967 (1st Edn).

Reference Books:

S. No.	Authors	Title of the Book	Publishers	Year & Edition
1	Anderson, T. A.	Invertebrate Zoology	Oxford University Press, New Delhi.	2001 (2 nd Edn).
2	Hyman, L. H.	The Invertebrates (Vol I- VI)	McGraw-Hill Companies Inc. NY	2017 (8 th Edn).
3	Kapoor, V. C.	Theory and Practice of Animal Taxonomy	Oxford and IBH Publishing Co., Pvt. Ltd. New Delhi.	2008 (2 nd Edn).
4.	Mayr, E.	Principles of Systematic Zoology	McGraw Hill Book Company, Inc., NY	1996 (1 st Edn).
5.	Narendran, T. C.	An introduction to Taxonomy	Zoological Survey of India	2015 (7 th Edn).
6.	Pat, W.	Invertebrate Relationships- Patterns in Animal Evolution	Cambridge University Press	2006.
7.	Pechenik, J. A.	Biology of the Invertebrates	McGraw- Hill Companies, Inc. NY, USA.	1972.
8.	Gardiner, M. S. McGraw	Biology of Invertebrates	Hill Book Company, Inc., NY.	1969.
9.	Carter, G. S. A.	General Zoology of Invertebrates	Sidewick and Jackson Ltd., London	2001 (2 nd Edn).

Course Designers:

1. Dr. P. Susheela

2. Dr. S. Gandhimathy

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDIT
MZO2302	EVOLUTION AND ANIMAL BEHAVIOUR	THEORY	73	2	-	4

Preamble

To understand the major principles of evolutionary theory, and ranges from the origins of life through the evolution of plants and animals to the evolution of behaviour.

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Understand concepts and theories of Organic Evolution, and acquire knowledge in behavioural patterns in animals	K2
CLO2	Interpret how natural selection underpins the diversity of life on Earth, all biological processes and the influence of genes, environment and levels of selection on behavioural patterns	K3
CLO3	Associate the fundamental of evolution including diversity in genes that unify the biological sciences and group foraging.	K4
CLO4	Integrate the evolution on biological diversity, how natural selection acts upon animal behaviour and form the foundation for efforts in the conservation and protection of the earth's biodiversity.	K5
CLO5	Interpret the evolutionary process associate with theories, and molecular tools to assess animal behaviour like communication, aggression, cooperation while interacting with the environment.	K6

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	S	S	M	M	M
CLO2	S	S	M	M	M
CLO3	S	S	S	S	M
CLO4	S	S	S	S	M
CLO5	S	S	S	M	M

S- Strong; M-Medium

EVOLUTION AND ANIMAL BEHAVIOUR

MZO2302 (73 Hrs)

UNIT I

(14 Hrs)

Concepts of Evolution and Theories of Organic Evolution - Neo-Darwinism - Patterns and Trends in Evolution-Arguments of evolutionary ideas and evolutionary theories since Darwin. Geological time scale. Evolutionary Process- Mechanisms producing genetic diversity- Phenotypic diversity by the regulation of gene expression.

UNIT II

(14 Hrs)

Natural Selection and Adaptation-The concept of stabilizing selection, Disruptive selection, Frequency dependent selection, Balancing selection, Adaptation program, Neutral theory of evolution and neutralist- selectionist controversy.

UNIT III

(15 Hrs)

Gene Frequencies in Population-The Hardy-Weinberg principle and analysis of gene frequencies in natural population, Major factors influencing gene frequencies (migration, inbreeding), effects of selection and mutation on gene frequencies, Gene flow between subpopulations, genetic drift. - Molecular clock of evolution, Molecular phylogeny.

UNIT IV

(15 Hrs)

Classification of behavioural patterns: Gene, Environment and Behaviour/Levels of Selection: Individual vs Group Selection - Fundamentals of Behavioral Genetics and molecular tools - Genotype and Environment Interaction. Cooperation and conflict: Male-male competition and sexual selection - Elaborate ornaments: Fischer's hypothesis and Handicap hypothesis - Parent- offspring conflict - Range of cooperative behaviours and Prisoner's dilemma.

UNIT V

(15 Hrs)

Foraging: Optimal foraging theory - Foraging and predation risk: defense strategies against predators - Territoriality and Group foraging. Aggression: Aggressive behaviour- Game theory models and strategies. Sensory system and Communication: Signal content and structure - Orientation and cues.

Text Books:

S. No	Authors	Title of the Book	Publishers	Year & Edition
1	Stebbine, G. L.	Process of Organic Evolution	Prentice Hall India, New Delhi	1979.
2	Manning and Dawkins	An introduction to Animal Behavior	Cambridge Univ. Press.	1998 (5 th ed.)
3	Jha, A. P.	Genes and Evolution	John Publication, New Delhi.	1992.

Reference Books:

S. No.	Authors	Title of the Book	Publishers	Year & Edition
1	Awise, J. C.	Molecular Markers, Natural History and Evolution	Chapman and Hall, New York.	1993 (1 st ed.)
2	Vishwapremi, K. K. C.	Animal Behavior	Silver Line Publication	2011.
3	Moody, P. A.	Introduction to Evolution.	Harper International.	1978.
4	Minkoff, E. C.	Evolutionary Biology	Addison – Wesley, London.	1984.

Course Designer:

1. Dr. G. Sasikala

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDIT
MZO2303	DEVELOPMENTAL BIOLOGY	THEORY	73	2	-	4

Preamble

This course provides advanced study of the growth and development of multi-cellular organisms and can include analysing the processes governing simple development such as cell division, to more advanced topics such as reproduction.

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Recognize key mechanisms that determine cell fate and control development	K2
CLO2	Interpret the concepts involved in the determination, differentiation, and development of different tissues and organs	K3
CLO3	Compare and contrast the involvement of various signals, environmental cues and cells from birth to death of an organism.	K4
CLO4	Criticize the molecular bases and gene regulation in producing differential signals signals and the feedback mechanisms in various tissues	K5
CLO5	Investigate the ability of homogenous zygote to develop into a complete organism.	K6

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	S	S	S	S	M
CLO2	S	S	S	S	M
CLO3	S	S	S	S	M
CLO4	S	S	S	S	M
CLO5	S	S	S	M	M

S- Strong; M-Medium

DEVELOPMENTAL BIOLOGY

MZO2303 (73hrs)

UNIT I (14 Hrs)

Scope of Developmental Biology and Future impact-Principles of Developmental Biology - Potency, commitment, specification, induction, competence-Determination and differentiation; morphogenetic gradients; cell fate and cell lineages. Embryonic stem cells - Embryonic stem cells; Stem cell niches - Genomic equivalence and the cytoplasmic determinants.

UNIT II (14 Hrs)

Concept of Embryology– Gametogenesis, fertilization and early development: Primordial Germ cells - Production of gametes, prerequisites of fertilization- Zygote formation, cleavage, blastula formation, embryonic fields - Gastrulation and formation of germ layers in animals.

UNIT III (15 Hrs)

Embryogenesis Metamorphosis and organogenesis in model animal system: Axes, compartment formation and pattern formation in *Drosophila*. Wnt and cadherin pathways- Sea urchin axis specification and coiling genetics of snail embryos. Organogenesis – vulva formation in *Caenorhabditis elegans* - Mesoderm specification and metamorphosis in *Xenopus*- Neurulation in Zebra fish - Limb development and regeneration in vertebrates.

UNIT IV (15 Hrs)

Sex determination- Timing and gene expression in mammalian sex determination- Brain sex determination pathways in vertebrates and flies- Hormone disruptors and sex determination problems- Temperature-dependent sex determination in turtles.

UNIT V (15 Hrs)

Ageing and Senescence - Mitochondrial control of ageing-Insulin pathway control of ageing and possible relation to oxygen radicals - “Ageless” animals and environmental control of ageing- Senescence and cell death, Apoptosis in mammals and sea elegans. Environmental regulation of normal development - Molecular bases for environmental regulation of gene expression - Importance of symbionts in mammalian gut and immune system development - Predator- induced polyphenism and toxicity testing.

TEXT BOOKS

S. No.	Authors	Title of the Book	Publishers	Year & Edition
1	Gilbert, S. F.	Developmental Biology	Publisher-Sinauer Associates Inc, Massachusetts, USA.	2019 (12 th Edn)
2	Balinsky, B. I.	An Introduction to Embryology	Publisher – Thomas Asia Pvt. Ltd.	2004 (5 th Edn)

REFERENCE BOOKS

S. No.	Authors	Title of the Book	Publishers	Year & Edition
1	Kalthoff	Analysis of biological development	McGraw - Hill.	2000.
2	Wolpert, Beddington, Brockes, Jessell, Lawrence, Meyerowitz	Principles of Development	Oxford University Press, New Delhi, India.	2006 (3rd Ed.)

Course Designer

1. Dr. Charumathi Pushparaj
2. Dr. M. Sheeba

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDIT
MZO2404	MOLECULAR CELL BIOLOGY	THEORY	73	2	-	4

Preamble

Upon successful completion of this course the students will develop basic knowledge and skills in cell and molecular biology and become aware of the complexity and harmony of the cell. **Course**

Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Understand the cell structure, reproduction mechanism, and molecular events of prokaryotes and eukaryotes.	K ₂
CLO2	Apply the concepts of various models of plasma membrane, structure of cell organelles, DNA structure, chromosomal organization, the DNA mutations, and repair mechanisms.	K ₃
CLO3	Analyse the most important methods by which the cells transport molecules, communicate and how cells send signals and interpret the signals they receive and to Compare the structure, reproduction and process DNA replication and transcription in prokaryotes and Eukaryotes	K ₄
CLO4	Describe prokaryote and eukaryote with its evolutionary importance	K ₅
CLO5	Investigate various compounds involved in cell functioning.	K ₆

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	S	S	S	S	S
CLO2	S	S	S	S	M
CLO3	S	S	S	S	M
CLO4	S	S	S	S	M
CLO5	S	S	S	S	M

S- Strong; M-Medium

MOLECULAR CELL BIOLOGY MZO2404

(73 hrs)

UNIT I

(14 Hrs)

Cell structure permeability and transport

Prokaryotes and Eukaryotes, Cell wall structure of bacteria and eukaryotes, Plasma membrane structure and models, cell organelles; cell permeability– concentration gradient and partition coefficient, transport of molecules– active transport, passive transport with its types, ion channels with their types, and facilitated diffusions.

UNIT II

(14 Hrs)

Cell division, cell signaling and protein localization

Cell cycle and its regulation, Bacterial cell division, Eukaryotic cell division, mechanics of cell division– mitosis and meiosis; Cellular communication: General principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix. Cell signaling: Hormones and their receptors, cell surface receptors, signaling through G-protein coupled receptors, second messengers, regulation of signaling pathways, neurotransmission and its regulation, bacterial chemotaxis.

UNIT III

(15 Hrs)

Molecular structures of genes and chromosomes

Structure of DNA, Organization of genes and chromosomes: structure of chromatin, Histone proteins and chromosomes. Fine structure of gene (muton, recon), Introns, Exons, unique and repetitive DNA, heterochromatin, euchromatin, transposons. Molecular events of prokaryotic and eukaryotic chromosome organization. DNA mutation and repair mechanism.

UNIT IV

(15 Hrs)

Replication and transcription

DNA replication – Basic rules of replication– genes and enzymology of replication, processivity and fidelity of replication, semi conservative and rolling circle replication, termination of replication, importance of telomerase in eukaryotic replication– gene transfer mechanism in bacteria; Molecular events of Prokaryotic and Eukaryotic Transcription; RNA processing, capping, polyadenylation, splicing.

UNIT V

(15 Hrs)

Gene expression and regulation

Genetic code, Ribosome of prokaryote and eukaryote and its evolutionary importance; mechanism of translation – initiation, elongation and termination, Inhibitors of Translation. Post translational modification (methylation and histone modification). Regulation of gene expression – lac operon, trp operon, ara operon. Epigenetic Regulation and its role in disease occurrence.

TEXT BOOKS:

S. No.	Authors	Title of the Book	Publishers	Year & Edition
1	Benjamin Lewin	Gene IX	Jones and Bartlett publishers, New Delhi, India	2000.
2	Lodish, H., Berk, A., Zipurursky, S. L., Matsudaria, P., Baltimore D, and Darnell, J	Molecular Cell Biology	W. H. Free Man and Company, England	2000.
3	Alberts, B., Johnson, A., Lewis, J., Raff, M.,	Molecular Biology of the Cell	Garland Science, New York	2002

REFERENCE BOOKS

S. No.	Authors	Title of the Book	Publishers	Year & Edition
1	Gupta P K	Cell and Molecular Biology.	Rastogi Publications, Meerut	2013.
2	James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Losick	Molecular Biology of the Gene	Pearson	2008.
3	Watson, J. D., Hopkins, W. H, Roberts, J. W, Steitz, J. A, Weiner, A. M.	Molecular Biology of the Gene	Pearson	1987
4	David Freifelder.	Essentials of Molecular Biology	Narosa Publishing House	2000.

Course Designer**1. Dr. R. Yamuna**

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDIT
MZO2305	ECOSYSTEM SERVICES AND SUSTAINABLE ENVIRONMENTAL MANAGEMENT	THEORY	58	2	-	4

Preamble

To analyse and interpret the various types of Ecosystems and services with their management with respect to their components, energy levels, significance and the need in global level.

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Understand the structure, function, and types of ecosystem and its services rendered for sustainable development and how to protect fragile earth.	K ₂
CLO2	Analyze the Services rendered by various ecosystems and their significance and conservation strategies to protect wildlife and the environment.	K ₃
CLO3	Interpret the plant-animal interactions, adaptations of plants and animals to different ecosystems and the Ecosystem Services by Assessment and by the creation of databases interpretation and Decision Making – Case Studies	K ₄
CLO4	Integrate the ecosystem resources and its services, community participation in the sustainable environment management through interpretation of Environmental Protection Acts, Policies, and Programs	K ₅
CLO5	Interpret the different types of ecosystem and their services, conservation Policies, Acts, and practice recent Trends in Environmentally Sustainable Management by ways of Community Participation in resource management	K ₆

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	M	S	S	S	S
CLO2	S	S	S	S	S
CLO3	M	S	S	S	S
CLO4	S	S	S	S	S
CLO5	S	S	S	S	S

S- Strong; M-Medium

ECOSYSTEM SERVICES AND SUSTAINABLE ENVIRONMENTAL MANAGEMENT

MZO2305 (58 Hrs)

UNIT I

(11 hrs)

Introduction to Ecosystem and its components:

Ecosystems - productivity of Ecosystems - Limiting factors in ecosystems - Population – Structure, Meta Population theory- plant animal interaction- demography and Growth - Community structure and interrelations.

UNIT II

(11 hrs)

Ecological energetics and Types of ecosystem - laws governing energy transformation - concepts of free energy - enthalpy and entropy - freshwater ecosystems. - marine ecosystems. - estuary and terrestrial ecosystems. Adaptation: aquatic-Volant and desert adaptation.

UNIT III

(12 hrs)

Ecosystems Services

Introduction - Over view of ecosystem services - Conceptual bases - Provisioning services: Food, Raw material, Fresh water and Medicinal resources - Regulatory services: Climate, Air quality, Water Management.

Pollination and Biological control -Cultural services: Tourism and recreation – Global value of Ecosystem services- Ecosystems and sustainable human well- being – Threats to Ecosystem services – Human Impacts – Emerging contaminants - micro plastics- Ecological foot prints.

UNIT IV

(12 hrs)

Conservation of Ecosystem services

Sustainable Agriculture – Organic Farming - Conservation Policies and Programs – Global and Regional; MDG, SDG REDD+ - Indian Scenario – Environmental Protection Acts, Policies and Programs – Forest and Biodiversity protection programs. Carbon sequestration – biological-geological- technological – climate change and mitigation. Ecological sensitive areas – Western Ghats and its ecologically sensitive area - India's National Action Plan on Climate Change.

UNIT V

(12 hrs)

Recent Trends in Environmentally Sustainable Management

Industrial ecology and recycling industry. Role of natural products and bio-diversity in international trade, fundamentals of fossil fuels use, energy production and trade, energy balance and energy audit. Eco-marketing. Community Participation in Water Resource Management, Forest Resource Management, Energy Resource Management - Challenges in SD: Poverty, Decentralisation - Ethical Consumerism, Social Awareness- Role of GIS and remote sensing in environmental management

Text Books

S. No.	Authors	Title of the Book	Publishers	Year & Edition
1	Grunewald, Karsten, Bastian, Olaf	Ecosystem Services – Concept, Methods and Case Studies	Springer Publications	2015
2	McCarthy, D. & Morling, P.	A Guidance Manual for Assessing Ecosystem Services at Natura 2000 Sites.	Royal Society for the Protection of Birds: Sandy, Bedfordshire.	2014

Reference Books

S. No.	Authors	Title of the Book	Publishers	Year & Edition
1	Mark Everard	Ecosystem Services – Key issues:	Earth scan from Routledge.	(2015)

Course Designer

1. Dr. M. Sheeba

COURSE CODE	COURSE TITLE	Category	L	T	P	Credit
MZO2306	PHYLOGENY, SYSTEMATICS AND FUNCTIONAL ORGANIZATION OF CHORDATES	Theory	73	2	-	4

Preamble

To introduce the principles and practice of phylogeny, systematic and diversity of animals and understand the evolutionary relationships and taxonomic classification of animals as currently understood.

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Understand and identify the evolution of chordates from protochordates. Origin of jaws, how the fishes originated and amphibians evolved from Pisces, reptiles from amphibia and electroreception in fish	K2
CLO2	Determine the tendencies in elasmobranch evolution, extinction of reptiles, evolution of paired fins and limbs, Jaw kinetics in relation to feeding.	K3
CLO3	Interpret the Placoderms as ancient experiments in the evolution of the jawed vertebrates, Adaptive radiation in Amphibia, Crossopterigians, Evolution of aortic arches and portal systems, Origin of Jaw and modification of Jaw bones and types.	K4
CLO4	Assess or predict the importance or significance of Structural peculiarities of Cyclostomes, Structural and Functional adaptations of fishes, Birds as glorified reptiles, Evolution of man-relation of man with other primates, Evolution of portal systems, Special senses: Vomero-nasal organs in reptiles, and Functional and evolutionary significance of origin and modification of jaw bones	K5
CLO5	Analyse the functional and evolutionary significance of origin of jaw, jaw kinetics in relation to feeding. Comment on development of vertebral column in various tetrapods.	K6

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	M	M	S	S	S
CLO2	S	S	S	S	S
CLO3	S	S	S	S	S
CLO4	S	S	S	S	S
CLO5	S	S	S	S	S

S- Strong; M-Medium

PHYLOGENY, SYSTEMATICS AND FUNCTIONAL ORGANIZATION OF CHORDATES

MZO2306 (73 hrs)

UNIT I

(14 Hrs)

Introduction

Concept of Protochordata, Cephalochordata and Urochordata; Ostracoderms: Silurian and Devonian Ostracoderms. Evolutionary Position of Ostracoderms. Placoderms: Origin of Jaws- Placoderms as ancient experiments in the evolution of the jawed vertebrates. Structural peculiarities of Cyclostomes.

UNIT II

(14 Hrs)

Origin of Fishes and Amphibians

Overview of fish phylogeny- Chondrichthyes: Fossil history of Chondrichthyes, Tendencies in Elasmobranch evolution. Actinopterygii: Origin and evolution, Adaptive radiation of bony fishes. Structural and Functional adaptations of fishes. Evolution of modern Amphibians, diversity, distribution, status and threats. Adaptive radiation in Amphibia, Crossopterigians- A blueprint.

UNIT III

(15 Hrs)

Origin of Reptiles, Aves and Mammals

Reptiles – Evolution of Reptilia. Saurischian and Ornithischian Dinosaurs- Rhynchocephalia- Adaptive radiation of Reptiles. Conquest of land by Seymouria and related forms; Skull of reptiles and its importance in biosystematics. Mesozoic world of reptiles and extinction. Origin of birds: Fossil History of Birds. Palate in birds. Birds as glorified reptiles. Class Mammalia: Prototheria, Metatheria and Eutheria. Phylogeny of Mammalian orders. Adaptive radiation in mammals. Evolution of man-relation of man with other primates, fossil record of man's ancestry, Spheonodon as a living fossil.

UNIT IV

(15 Hrs)

Comparative anatomy of chordates

Development, structure and functions of vertebrate integumentary system and its derivatives; Origin and evolution of paired fins and limbs. Respiratory system: Characters of respiratory tissue, external and internal respiration. Evolution of aortic arches and portal systems. Blood circulation in various vertebrates groups. Heart and circulation in foetal and neonatal mammals. Evolution of portal systems. Special senses: Vomero-nasal organs in reptiles, electroreception in fish. Comparative anatomy of brain and spinal cord (CNS), peripheral and autonomous nervous system and lateral line system. Comparative account of electroreception.

UNIT V

(15 Hrs)

Comparative Vertebrate Osteology

Skeletal System: Origin of Jaw and modification of Jaw bones and types. Functional and evolutionary significance. Jaw kinetics in relation to feeding. Embryonic development of neurocranium, splanchnocranium and dermatocranium. Comparative account of jaw suspensorium and vertebral column. Embryonic development of Vertebra. Vertebral column of tetrapods- Atlas, Axis, Typical Vertebra, Thoracic vertebra, Trunk vertebra, Caudal vertebra of Dog fish and Bony fish, Frog, Varanus, Pigeon, and Rabbit.

TEXT BOOKS:

S.No.	Authors	Title of the Book	Publishers	Year & Edition
1	Nigam, H. C.	Biology of chordates	Vishal Publications	2017, (Revised 25 th Edition)
2	Colbert, E.H.	Evolution of the Vertebrates: A History of the Backboned Animals Through Time	Wiley Eastern Ltd	2011, (5 th Edition)
3	Kotpal R L	Modern Text Book Of Zoology Vertebrates	Rastogi Publication	2019, (5 th Edition)

REFERENCE BOOKS:

S.No.	Authors	Title of the Book	Publishers	Year & Edition
1	Jollie, M.	Chordate Morphology	Reinhold Publishing Corporation	2002, (1 st Edition)
2	Young, J.	Life of Vertebrates.	Clarendon Press, Oxford.	2004, (1 st Edition)
3	Beer, G.D.	Vertebrate Zoology	Sidgwich & Jackson	2011, (1 st Edition)
4	Mcewen, R. S.	Vertebrate Embryology	Oxford And Ibh Publications	2007, (1 st Edition)
5	Kent G.C and Carr R.K	Comparative Anatomy of the Vertebrates	C.V Mosby And Company	2000, (1 st Edition)

Course Designer:**1. Dr. P. Susheela**

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDIT
MZO2307	BIOCHEMISTRY	Theory	73	2	-	4

Preamble

This course addresses the students with basic physical and chemical principles that underlie physiological processes, adaptation of animals physiologically to environmental challenges

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1.	Understand basic principles of biochemistry, structure of chemical bonds, Structure of biomolecules like Carbohydrates, Proteins, Vitamins, Nuclei acids, enzymes and their significance in biological system.	K2
CLO2.	Apply the concepts of the biomolecules Metabolic pathways in energy production at cellular and molecular levels, regulation and disorders associated.	K3
CLO3.	Analyse how Charbohydrates, proteins, nucleic acids and vitamins influence the biological processes and their architecture;	K4
CLO4.	Describe the Chemistry of Biomolecules their synthesis and breakdown with clinical references.	K5
CLO5.	Integrate the knowledge of enzymes in various industries and interpret the mechanism of action of various drugs and their catalytic properties.	K6

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	S	S	S	S	S
CLO2	S	S	S	S	S
CLO3	S	S	S	S	S
CLO4	S	S	S	M	M
CLO5	S	S	S	M	M

S-Strong; M-Medium

BIOCHEMISTRY- MZO2307 (73 hrs)

UNIT I

(14 Hrs)

Principles of Biological chemistry: Structure of atoms, molecules and chemical bonds, Van der Waal's electrostatic, hydrogen bonding and hydrophobic interactions. Principles of biophysical chemistry (pH, buffer, dissociation and association constants) Physical constants, thermodynamics, Concept of free energy, Enthalpy, Entropy.

Water: Structure and physicochemical properties.

UNIT II

(14 Hrs)

Carbohydrates- structure, classification and function, Carbohydrate metabolism: Glycolysis, TCA cycle, Electron transfer and ATP generation, Bioenergetics of ATP cycle, glycogenesis, glycogenolysis, gluconeogenesis and Pentose phosphate pathway.

UNIT III:

(15 Hrs)

Proteins – structure, classification and function, Biosynthesis and Oxidation of amino acids.

Nucleic acids: structure, functions and Biosynthesis of nucleotides.

Vitamins- structure and functions.

UNIT IV

(15 Hrs)

Lipids- structure, classification and function, Catabolism of fatty acid – Beta oxidation, significance of beta oxidation, Biosynthesis of triglyceride, biosynthesis of membrane phospholipids, Steroidal hormones-structure and functions, Biosynthesis of prostaglandins.

UNIT V

(15 Hrs)

Enzyme- Enzyme kinetics and properties of enzyme-catalyzed reactions. Substrate concentration, specificity, enzyme concentrations, temperature, pH and inhibitors. Significance of inhibitors. Michaelis-Menten equation. Lineweaver-Burk plot.

Mechanisms of enzyme catalysis- Oligomeric enzymes-isoenzymes, allosteric enzymes and multienzyme complexes. Coenzymes-structure and function of water-soluble coenzymes, minor coenzymes and their functions- Role of enzymes in industrial applications.

TEXT BOOKS:

S.No.	Authors	Title of the Book	Publishers	Year & Edition
1	Harper H. A.	Review of Physiological Chemistry	Lange Publications	1977, (16 th Edition)
2	Lehninger A., Nelson D. L. and Cox M. M.	Principles of Biochemistry	CBC Publishers	2021, (8 th Edition)
3	Rastogi S. C.	Biochemistry	Tata McGraw Hill Publishing Co. Ltd	2019, (4 th Edition)
4	Satyanarayana U.	Biochemistry	Book Syndicate Pvt. Ltd	2021, (6 th Edition)
5	Stryer.	Biochemistry	W H Freeman and Co. Pub.	2015, (8 th Edition)

REFERENCE BOOKS:

S.No.	Authors	Title of the Book	Publishers	Year & Edition
1	Plummer David, T.	An introduction to practical biochemistry	Tata McGraw-Hill, New Delhi	2017, (3 rd Edition)
2	Oser, B. L.	Hawk's Physiological Biochemistry	McGraw Hill Book Co.	1965, (14 th Edition)
3	Jayaraman, J	Laboratory Manual in Biochemistry	Wiley Eastern Ltd.	2011, (2 nd Edition)

Course Designer: Dr.R.Yamuna

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDIT
MZO23CEA	ANIMAL PHYSIOLOGY	THEORY	88	2	-	5

Preamble

This course addresses the students with basic physical and chemical principles that underlie physiological processes, adaptation of animals physiologically to environmental challenges

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Understand the basic structure, and functions of important physiological organs and organ systems	K2
CLO2	Interpret the effects of external stimuli on the physiological functions of the cells	K3
CLO3	Distinguish the physiological processes from biochemical to system level of different organ system	K4
CLO4	Evaluate the functions of physiological systems solely and in coordination with other systems	K5
CLO5	Develop critical thinking skills and apply physiological concepts and principles and devise research questions at the basic and applied levels.	K6

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	S	S	S	S	M
CLO2	S	S	S	S	M
CLO3	S	S	S	S	M
CLO4	S	S	S	M	M
CLO5	S	S	S	M	M

S- Strong; M-Medium

ANIMAL PHYSIOLOGY

MZO23CEA (88 hrs)

UNIT I

(15 Hrs)

Nutrition, digestion and absorption: (a) Nutritive types in animal kingdom. (b) Role of vitamins and minerals in nutrition. Deficiency diseases (c) **Composition, molecular mechanism of secretion & action of all types of digestive juices met within the mammalian digestive pathway; hormonal and nervous regulation of secretion of digestive juices.** (d) Physiological mechanisms involved in the absorption of the end products of digestion

Respiration: (a) Factors modifying oxygen consumption in animals. (b) Acclimatization to low oxygen tension; toxicity of high oxygen tension. (c) Chemistry of respiration, with particular reference to mammals.

UNIT II

(15 Hrs)

Blood and circulation of body fluids: (a) Mechanism of transport of gases of blood: Physiology of erythrocytes, leukocyte function- antibody production, Anti- inflammatory activities, phagocytosis; biochemistry and physiology of blood clotting. (b) Types of heart and transport mechanisms. (c) **General comparative study of cardiac cycle in animals with particular reference to man. (d) Conductile and contractile mechanisms in the heart.**

Excretion: Biophysics, architecture, biochemistry and physiology of various functions performed by the vertebrate nephron; origin and formulation of nitrogenous excretory products; physiological relationship between habitat and excretion mechanisms. Role of kidney in osmoregulation.

UNIT III

(15 Hrs)

Physiology of the nervous system: (a) Nerve impulse: Biophysics, biochemistry and molecular physiology of genesis, conduction and transmission across synaptic junctions. (b) Synapse physiology and integration of information; coding in the neural information processing. Neuro transmitters (c) Reflex action: Various types of central peripheral reflexes in mammalian nervous systems.

Physiology of the receptor system: (a) General mechanism involved in stimulus transduction at receptor sites. (b) Functional architecture and stimulus processing in retina, organ of Corti and olfactory epithelium.

UNIT IV

(14 Hrs)

General Physiology: **Physiology of muscle tissue: (a) Morpho-functional architecture of the contractile apparatus in muscle tissue. (b) A detailed study of the biophysical and biochemical events underlying contraction & relaxation process. (c) Physiological properties of cardiac, skeletal and visceral muscles. (d) Nerve innervation, denervation and muscle function.**

UNIT V

(14 Hrs)

Thermoregulation and cold tolerance: (a) Basic principles of metabolism (b) Heat balance and exchange (c) Endotherms vs Ectotherms (d) Counter-current heat exchangers (e) Torpor, hibernation and aestivation- Adaptations to very cold environments

Stress physiology: (a) Basic concept of environmental stress and strain; concept of elastic and plastic strain; stress resistance, stress avoidance and stress tolerance. (b) Adaptation, acclimation and acclimatization (c) Concept of homeostasis (d) Physiological response to oxygen deficient stress (e) Physiological response to body exercise (f) Meditation, Yoga and their effects.

***Highlighted portions will be covered under Coursera courses. 50% of the course will be covered in the classroom and 50% through Coursera.**

Link for the courses in Coursera

Sensory Science: The Senses- 13h

<https://www.coursera.org/learn/sensory-science-the-senses>

Introductory Human Physiology- 34h

<https://www.coursera.org/learn/physiology#syllabus>

TEXT BOOKS:

S.No.	Authors	Title of the Book	Publishers	Year & Edition
1	Rastogi, S.C.	Essentials of Animal Physiology	New Age International Press	2019, (4 th Edition)
2	Hill R.W	Comparative Physiology of Animals	Sinauer Associates	2016, (4 th Edition)
3	Sembulingam, K., and Prema, S.	Essentials Of Medical Physiology	Jaypee Brothers	2019, (8 th Edition)

REFERENCE BOOKS:

S.No.	Authors	Title of the Book	Publishers	Year & Edition
1	Hall, J. E., & Guyton, A. C.	Guyton and Hall textbook of Medical Physiology.	Philadelphia, P A, Saunders Elsevier.	2020, (14 th edition)
2	Sheerwood, L.	Human Physiology From Cells To Systems	Thomson/Brooks/Cole	2015, (9 th Edition)
3	Chaudhuri S L.,	Concise Medical Physiology	New Central Book Agency (P) Ltd.: Calcutta	2002, (1 st Edition)
4	Cowan, W. M., Südhof, T. C., Stevens, C. F	Synapses	The Johns Hopkins University Press	2003, (1 st Edition))
5	Hille, B.	Ionic channels of Excitable Membranes	Sinauer Associates, Sunderland, Massachussets.	2008, (3 rd Edition)
6	Kandel R, Schwartz J H and Jessell T M.	Principles of Neural Science	Elsevier	2000, (4 th Edition)
7	Randall, Burggren, French, and Eckert	Animal Physiology: Mechanisms and Adaptations by Hill	Wyse and Anderson.	2001, (5 th Edition)

Course Designers:

1. Dr. P. Susheela
2. Dr. Charumathi P

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDIT
MZO2308	ENTOMOLOGY	THEORY	58	2	-	4

Preamble

This course focuses on applied entomology and classification of insects according to their economic importance and their role in various industries.

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Understand the classification of insects, General morphology, feeding and social behavior of Insects.	K2
CLO2	Compare different techniques in collection and preservation of insects, role of biotic and abiotic factors in insect development.	K3
CLO3	Analyze insect collection methods, Salient features of Insect orders and Physiology.	K4
CLO4	Criticize the concept of pest control, Special adaptations of Insects due to environmental changes, synthesis and applications pheromones.	K5
CLO5	Collaborate the process of structural modification, functions of organ systems and Interaction of insects with plants, animals and microbes.	K6

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	S	S	S	S	S
CLO2	S	S	S	S	S
CLO3	S	S	S	M	M
CLO4	S	S	S	M	M
CLO5	S	S	S	M	M

S-Strong M-Medium

ENTOMOLOGY MZO2308 (58 Hrs)

UNIT I

(12 hrs)

Insect Taxonomy

Taxonomic keys – Identification and purpose; Insect classification up to orders with examples; Different techniques of Insect Collection, Preservation, and Mounting

Unit II

(12 hrs)

Morphology and Physiology

Comparative morphology of Insect head, thorax, and abdomen;

Structure and physiology of different systems- digestive, circulatory, respiratory, excretory, nervous, sensory, reproductive, musculature, endocrine and exocrine glands

Unit III

(12 hrs)

Insect ecology

Abiotic factors and their generalized action on insects. Implications for abundance and distribution of organisms - Law of the Minimum, Law of Tolerance, and Biocoenosis.

Population dynamics- Factors affecting abundance- Environmental factors, dispersal and migration, Seasonality in insects Diapause (Quiescence) - aestivation, hibernation

Classes of interactions: Insects with microbes, plants and animal.

Unit IV

(11 hrs)

Insects of Medical Importance

Insect pathology- Infection of insects by bacteria, fungi, viruses, protozoa, rickettsiae, spiroplasma, and nematodes

Insects as pests – Insect pests in human habitation, biology, damage and control of mosquitoes, houseflies, bed bugs, ants, termites, cockroaches, flies, silverfish, head and body lice, carpet beetles, cloth moths, crickets, wasps, house dust mites, insect pests of cattle, poultry, pet animals and their management.

UNIT V

(11 hrs)

Commercial entomology

Culturing of insects-maintenance of adults, rearing and breeding insects.

Beekeeping- Managing colonies for honey production and pollination, Artificial queen rearing, Pests and diseases of honey bees.

Sericulture - Study of different species of silkworms, characteristic features, Moriculture, silk and its uses, pests, and diseases of silkworms, rearing, and management of silkworms.

Lac insect- natural enemies and their management

TEXTBOOKS

S.No	Author	Title	Publishers	Year & Edition
1	Wigglesworth, Vincent B	Insect physiology	Springer Netherlands	1985, (8 th Edition)
2	Eilenberg J	An ecological and social approach to biological control	(Springer).	2005, (1 st Edition)
3	Ananthakrishnan T N and Shivaramakrishnan K G	Ecological entomology: Insect life in odd environment	Scientific Pub: India	2017, (1 st Edition)

REFERENCE BOOKS:

S. No	Author	Title	Publishers	Year & Edition
1	Chapman R F	The Insects: Structure and function	Cambridge University Press: Cambridge	2004, (4th Edition)
2	Cox F E G	Modern Parasitology	Blackwell Scientific Publications: Oxford	1993, (2 nd Edition)
3	Eldridge B	Medical entomology	Springer	2004, (1 st Edition)
4	Fenemore P G and Prakash A	Applied Entomology	New Age Publishers: New Delhi	2009, (2 nd Edition)
5	Pedigo L.P	Entomology and Pest Management	Prentice- Hall Inc.: New Jersey	2004 (4th Edition).
6	Perry A S, Yamamoto I, Ishaaya I and Perry R	Insecticides in Agriculture and Environment	Narosa Pub. House: New Delhi	1998, (1 st Edition)

Course Designer

1. Dr. R. Yamuna
2. Dr. S. Gandhimathy

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDIT
MZO23S1	RESEARCH METHODOLOGY	SPECIAL PAPER	30	2	-	2

SPECIAL PAPER - RESEARCH METHODOLOGY- MZO23S1 (30Hrs)

UNIT I

(7 Hrs)

Definition, basic and applied research, interdisciplinary research, Literature Review - Research reading, discriminative reading, consulting source material, reference cards, primary and secondary literature, Literature citation, components of a research report, use of tables and figures, preparation of photographs and microphotographs, formatting and requirements for manuscript preparation Biological abstract, Review, Monographs, peer reviewed journals, e- resources, digital library, electronic research tools, bibliography software. Internet - Worldwide Web - Search Engines - their functions. Boolean searching - file formats.

UNIT II

(6 Hrs)

Collection and analysis of biological data - mean, median, mode Standard deviation, Standard error, Coefficient of variation, Student 't' test, Skewness, Kurtosis, Chi - square, Correlation, Regression and ANOVA.

UNIT III

(7 Hrs)

Absorption and Emission principles- Principle and application of UV visible, Spectrofluorometer, flame photometer, Atomic, Absorption and emission spectrophotometers, NMR and Mass spectrometer in Biology. Principles and Application of Chromatography: Paper, Thin layer, column, Ion Exchange, Gel filtration, Gas Liquid, HPLC and affinity.

UNIT IV

(5 Hrs)

Research project proposal preparation - funding agencies and thrust areas. Biohazards, risk groups, bio-safety levels, laboratory acquired infections, routes of exposure, safety measures, good laboratory practices, biohazardous wastes, types of hazards.

UNIT V

(5 Hrs)

Research Ethics and Responsible Conduct in Research Brief history and analytical basis of research ethics, responsible conduct in research (Honesty in Science: Integrity, Authorship, Conflicts of Interest, Privacy and Confidentiality, Informed Consent, Risk/Benefit Assessment), The legal regulation of research ethics in India (From UGC, MHRD and other governing agencies), Regulatory requirements relevant to international research.

TEXTBOOKS

S.No	Author	Title	Publishers	Year & Edition
1	Kothari C. R.	Research Methodology: Methods and techniques	New Age International	2023, (5 th Edition)
2	Vijayalakshmi K	Research Methods: Tips and Techniques	Mjp Publishers	2011, (Reprint Edition)
3	Banerjee, P.K.	Introduction to Biostatistics	S Chand & Company	2007, (1 st Edition)

REFERENCE BOOKS:

S. No	Author	Title	Publishers	Year & Edition
1	Daniel, M.	Basic biophysics for biologists.	Agro-Botanical Publishers, India.	2011, (1 st Edition)
2	Kothari C. R.	Research Methodology: Methods and techniques	New Age International	2023, (5 th Edition)
3	John W. Creswell	Research Design,	Sage	2011, (6 th Edition)
4	Wilson and Walker.	Practical biochemistry-principles and techniques	Cambridge University Press.	2000, (5 th Edition)
5	Sandhu G S	Research Techniques In Biological Sciences	Anmol Publishers	2006, (1 st Edition)
6	Gurumani, N.	Research Methodology For Biological Sciences	Mjp Publishers	2011, (1 st Edition)

Course Designer: Dr. R. Yamuna

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDIT
MZO2309	INTRODUCTION TO FORENSIC SCIENCE	ELECTIVE	58	2	-	4

Preamble

This course will serve to identify and examine current and emerging concepts and practices to fulfill the needs of students the field of forensic science

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Understand the knowledge of some of the basic facts, concepts and principles relating to the principles and significance of forensic science	K2
CLO2	Identify the role of the forensic scientist and physical evidence within the criminal justice system and correlate with wildlife crimes.	K3
CLO3	Justify the role of DNA in paternity identification, DNA profiling, wildlife forensics, and forensic entomology.	K4
CLO4	Compare the various aspects of species testing in forensic science and to explain the knowledge of genetic variation at the genus and species level can aid in the reporting of results.	K5
CLO5	Interpret the forensic biological evidences obtained during death investigations and aids in the legal justices to the crime.	K6

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	S	S	S	S	S
CLO2	S	S	S	S	S
CLO3	S	S	S	S	S
CLO4	S	S	S	M	M
CLO5	S	S	S	M	M

S- Strong; M-Medium

INTRODUCTION TO FORENSIC SCIENCE

MZO2309 (58 hrs)

UNIT I (11 Hrs)

History of Development of Forensic Science in India Functions of forensic science, Definitions and concepts in forensic science, Scope of forensic science, Need of forensic science, Basic principles of forensic science, Frye case and Daubert standard. Forensic Science Laboratory – Locard's Exchange Principle

UNIT II (11 Hrs)

Serology Forensics: Importance of Body fluids. Common body fluids, Composition and functions of blood, Distinction between human and non-human blood, Determination of blood groups, Antigens and antibodies, Forensic characterization of bloodstains, Blood enzymes and proteins, Semen. Forensic significance of semen, Composition, functions and morphology of spermatozoa, Collection, evaluation and tests for identification of semen, Composition, functions and forensic significance of saliva, sweat, milk and urine, Tests for their identifications.

UNIT III (12 Hrs)

DNA Forensics: DNA as biological blueprint of life. Extraction of DNA for analysis, Collection of specimens, Polymerase chain reaction – historical perspective, sequence polymorphisms, individualization of evidence, Principles of heredity, Genetics of paternity, DNA testing in disputed paternity, Mendelian laws of parentage testing, Application and Forensic Significance of DNA Profiling

UNIT IV (12 Hrs)

Wildlife Forensics: Fundamentals of wildlife forensic. Significance of wildlife forensic, Protected and endangered species of animals and plants, Illegal trading in wildlife items, such as skin, fur, bone, horn, teeth, flowers and plant, Identification of physical evidence pertaining to wildlife forensics, Identification of pug marks of various animals.

UNIT V (12 Hrs)

Forensic Entomology: Basics of forensic entomology, Insects of forensic importance. Collection of entomological evidences during death investigations. Role of entomology in Forensic Science: Insects associated with the corpses and carrions; Forensic entomological techniques

TEXT BOOKS:

S.No.	Authors	Title of the Book	Publishers	Year & Edition
1	Houck, M. M & Siegel, J. A	Fundamentals of Forensic Science	Academic Press, London,	2015, (3 rd Edition)
2	James, S. H and Nordby, J. J	Forensic Science- An Introduction to Scientific and Investigative Techniques	CRC Press, USA	2015, (4 th Edition)
3	Saferstein	An Introduction of Forensic Science	Prentice Hall Inc, USA,	2010, (2 nd Edition)

REFERENCE BOOKS:

S.No.	Authors	Title of the Book	Publishers	Year & Edition
1	Nanda B. B and Tewari, R. K	Forensic Science in India- A vision for the Twenty First Century	, Select Publisher, New Delhi,	2001, (1 st Edition)
2	Barry, A. J. Fisher	Techniques of Crime Scene Investigation	CRC Press, New York,	2003 (7th Edition)
3	Mordby, J. & Reckoning, D	The Art of Forensic Detection	CRC Press New York,	2003, (1 st Edition)

Course Designer: Dr. Charumathi P

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDIT
MZO2310	BIOANALYTICAL TOOLS AND BIOINFORMATICS	ELECTIVE	58	2	-	4

Preamble

Develop a fundamental understanding of basic concepts and tools in bioinformatics

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Understand the basic utilization of various nucleic acid and protein sequence databases	K2
CLO2	Apply the knowledge of databases in data mining and develop basic understanding of sequence alignments, protein modelling, and phylogenetic analysis.	K3
CLO3	Analyse the challenges in molecular biology computing, secondary structure studies and phylogenetic analysis	K4
CLO4	Ability to apply appropriate bioinformatics software, tools in designing of microarray, molecular modelling and protein prediction	K5
CLO5	Apply the knowledge of bioinformatics tools in drug discovery, crop improvement and other microbial applications	K6

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	S	S	S	S	S
CLO2	S	S	S	S	S
CLO3	S	S	S	S	S
CLO4	S	S	S	S	S
CLO5	S	S	S	M	M

S - Strong; M-Medium

BIOANALYTICAL TOOLS AND BIOINFORMATICS
MZO2310 (58 Hrs)

UNIT I (11 Hrs)

Introduction to bioinformatics, introduction to genomics and proteomics databases, Nucleic acid sequence database: Genbank, UCSC, ENSEMBL, EMBL, DDBJ, protein sequence databases: Swiss- prot, PDB, BLAST, PSI- BLAST (steps involved in use and interpretation of results) and HMMER, BLAST vs FASTA, file formats- FASTA, GCG and Clustal W.

UNIT II (11 Hrs)

Databank search- data mining, data management and interpretation, Information Retrieval from biological databases and SRS. Introduction to computational genomics and proteomics, Multiple sequence alignment, Gene prediction methods and their challenges, ORF, primer designing

UNIT III (12 Hrs)

Introduction to phylogenetic analysis- methods of phylogenetic analysis- PHYLIP, DISTANCES, GROWTREE etc. Protein structure prediction tools- protein secondary structure and folding, molecular modelling, docking, identification and characterization of protein mass fingerprint, LIGPLOT interactions, RNA secondary structures.

UNIT IV (12 Hrs)

Basics of designing a microarray, image analysis and normalization, annotations, Introduction to programming languages - "C". Overview of challenges of molecular biology computing.

UNIT V (12 Hrs)

Structural Bioinformatics in Drug Discovery, Quantitative structure-activity relationship (QSAR) techniques in Drug Design, Microbial genome applications, Crop improvement.

TEXT BOOKS

S.No	Author	Title of the Book	Publisher	Year& Edition
1	Ghosh Z. and Bibekan and M.	Bioinformatics: Principles and Applications.	Oxford University Press.	2008, (1 st Edition)
2.	Marketa Zvelebil, Jeremy O. Baum	Understanding Bioinformatics	Garland Science publishers	2007, (1 st Edition)

REFERENCE BOOKS

S. No	Author	Title of the Book	Publisher	Year& Edition
1	Alam khan, I.	Elementary Bioinformatics	Pharma book Syndicate, Adithya Art Printers, Hyderabad	2005, 1 st Edition).
2	Mani K and Vijayaraj N,	Bioinformatics a practical approach	Aparnaa publication, Coimbatore	2004, (1 st Edition)
3.	Pevsner J.	Bioinformatics and Functional Genomics.	Wiley-Blackwell.	2009, (II Edition)
4.	Dummie, Claverie J. M., Notredame C.,	Bioinformatics	Wiley Publishing, Inc., New York, USA	2007, (2nd Edition)

Course Designers:

Dr. P. B. Harathi

Mrs. S. Gandhimathy

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDIT
MZC22A1	CLINICAL MICROBIOLOGY, BIOCHEMISTRY AND PARASITOLOGY	INTER DISCIPLINARY COURSE	58	2	-	4

INTER DISCIPLINARY COURSE (For M.Sc., Zoology and Chemistry Students)

CLINICAL MICROBIOLOGY, BIOCHEMISTRY AND PARASITOLOGY MZC22A1 (58 Hrs)

Unit I (11 Hrs)

Clinical microbiology: General characteristic of microbes – virus, bacteria, fungi and protozoans. Clinical specimens– Collection methods, Incubation, Catheter; handling, transport. Isolation of microbes from specimens- selective media, differential media, enrichment media, characteristic media. Identification of microbes (virus, bacteria, fungi) through morphological and biochemical characteristics. Prevalent diseases - Chikungunia, Dengue, Nipah, Elephantiasis, Tuberculosis, Cholera, typhoid, Swine flu. Vaccination and types. Routine mycological methods. Laboratory diagnosis of mycotic infection

UNIT II (11 Hrs)

Clinical Chemistry Basics - Different units of measure, cleaning procedures and categorize grades of H₂O; Types of pipets and calibration of pipets; safe practices within the clinical lab. **Principles of clinical biochemical analysis:** Basis of analysis of body fluids for diagnostic prognostic and monitoring purposes. Blood Analysis: Composition of blood, blood grouping & matching, physiological function of Plasma protein, role of blood as oxygen carrier, blood pressure – Hypertension, hypotension, coagulation of blood, Anaemia – causes & control.

UNIT –III (12 Hrs)

Urea determination- the urease method, estimation of bile pigment in serum, estimation of total protein in serum, estimation of total proteins and albumin based on biuret method and BCG method. Diagnostic test for Sugar in Urine. Test for salt in Serum, Test for Chlorides. Detection of Cholesterol in Urine, Detection of Diabetes. Typical reference ranges for biochemical analyst Viz, sodium, potassium, urea, creatinum, AST, ALT, AP and cholesterol and their significance. Biological role of sodium, potassium, calcium, iodine, copper and zinc.

Unit IV (12 Hrs)

Parasites Examination: Collection and preservation, examination of faeces for colour, mucus, consistency, ova, amoeba, parasites, pus cells, RBC. Detection of occult blood in stool- Benzidine test, Guaiac test, ortho toluidine test. Stool concentration method - Sodium chloride and formaldehyde methods for concentration of parasites. Staining of faecal smears and blood films. Techniques for the measurements of the size of parasite eggs. Morphological characters of common parasitic protozoa. Examination of faeces for adult helminth worms. (*Ascaris lumbricoides*, *Enterobius vermicularis*, *Ancylostoma duodenalis*, *Trichuris trichura*).

Unit V (12 Hrs)

Advanced diagnostic tests: Radio immunoassay, Widal test, Blotting techniques, Bilirubin blood test, Interferon – Gamma Release Assays, prenatal diagnosis- Amniocentesis, chorionic villi sampling, post natal diagnosis- chromosomal microarrays, neo natal diagnosis – Apgar score, Blood spot screening, congenital heart diseases, congenital dislocated hip, delayed descent of boys testis. Parkinson's disease, Steven Jones syndrome, Down syndrome.

TEXTBOOKS:

S.No	Author	Title	Publishers	Year& Edition
1.	Asim. K. Das	Bioinorganic chemistry	Books & Allied Pvt Ltd.	2007, (1 st edition).
2.	Jayashree Ghosh	Textbook of Pharmaceutical Chemistry	S. Chand & Co	2003, (3 rd edition)
3	Jayashree Ghosh	Fundamental concepts of Applied Chemistry	S. Chand & Co	2006, (1 st edition)
4	Rana, S.V.S	BioTechniques. Theory and Practice.	Rastogi Publications, Meerut.	2005, (1 st Edition)
5	AmbikaShanmugam	Fundamentals of Biochemistry for Medical Students	Nagaraj and Company Private Limited	2016, (8 th Edition)
6	Mallikarjuna Rao, N	Medical Biochemistry	New Age International (P) Limited, Publishers	2006, (6 th Edition).
7	Dr.K.N. Sachdev	Clinical Pathology and Bacteriology	Jaypee Brothers medical publishers	2000, (9 th Edition)
1. 8	Samuel K M	Notes on Clinical lab techniques	M.K.Gopalan, Chrompet, Chennai	1999, (1 st Edition)
2. 9	Ramnicks Sood	Medical Laboratory Techniques	Jaypee Brothers Medical Publishers (P) Ltd	2015, (2 nd Edition)

REFERENCE BOOKS

S.No	Author	Title	Publishers	Year& Edition
1	Lensing M. Prescott, John P, Harley, Donald A Klein.	Microbiology,	Tata mc Graw Hill, New Delhi	2005, (6 th Edition)
2	Keith Wilson, John Walker.	Principles and Techniques of Biochemistry and Molecular Biology,	Cambridge University Press	2008, (6 th Edition).
3	By Douglas B. Lowrie, Robert G. Whalen	DNA vaccines-methods and protocols	Humana press, Totowa, New Jersey	2000, (1 st Edition)
4	Ananthanarayan and Paniker	Textbook of Microbiology 9 th Edition	Orient Blackswam private limited	2017, (10 th edition)
5	Pelczar	Microbiology	Tata McGraw-Hill publications	2001, (5 th Edition)

Course Designer: Dr.R.Yamuna

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDIT
MZO23P1	CORE PRACTICAL- 1	PRACTICALS	-	-	90	4

Preamble

To enable the students to identify the different invertebrate forms.To analyse the developmental process of various organisms

To apply the knowledge in isolating biomolecules.

Course Outcomes:

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Understand and classify the invertebrate forms, their characteristics and the evolutionary process and behavioural patterns of animals.	K2
CLO2	Analyse the developmental process involved in various organisms.	K3
CLO3	Apply the knowledge of molecular biology in visualizing and quantifying the biomolecules.	K4
CLO4	Compare different ecosystems using various parameters and service for the ecosystem.	K5

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	S	S	S	S	S
CLO2	S	S	S	S	S
CLO3	S	S	S	S	S
CLO4	S	S	S	S	S

S - Strong; M-Medium

CORE PRACTICAL- I- MZO23P1 (90 hrs)

PHYLOGENY OF INVERTEBRATES

1. Museum specimen study of different groups of invertebrates. (9 hrs)
2. Composition assessment of taxonomical diversity or biodiversity of invertebrates in habitat from different ecosystems- Field Study. (5 hrs)
3. Qualitative analysis of fresh water and marine planktons. (6 hrs)

EVOLUTION (Slides/Specimens)

1. Observation of leaf insects and stick insects to study adaptation by cryptic colouration and natural selection.

ANIMAL BEHAVIOUR

1. Field visit to a Zoological park/museum for studying animal behaviour.
2. Field study of nesting behaviour of common available avian fauna of the region.

DEVELOPMENTAL BIOLOGY

1. Identification of the developmental stage of Chick embryo. (9 hrs)
2. Spotters:
 - a. Chick: 36 Hours stage, 48 Hours stage, 72 Hours stage, 96 Hours stage. (3 hrs)
3. Sperm smear and staining. (2 hrs)

MOLECULAR BIOLOGY

1. Squash preparation of giant chromosomes from Chironomous larva or *Drosophila melanogaster*. (4 hrs)
2. Identification of Barr bodies in buccal smear. (2 hrs)
3. Isolation of DNA from animal tissues. (6 hrs)
4. Quantification of DNA by agarose gel electrophoresis- Demonstration (6 hrs)
5. Extraction of DNA by Hot Shot method (6 hrs)
6. Estimation of DNA by Diphenylamine method. (6 hrs)
7. Estimation of RNA by Orcinol method. (6 hrs)

ECOSYSTEM SERVICES AND MANAGEMENT

1. Any one environmental service to be submitted with a report. (12 hrs)
2. Water quality of water samples (Any 3 chemical parameters).
3. Field trip: Eco tour (report to be submitted along with photographs and video) (5 hrs)

REFERENCE BOOKS:

S.No.	Authors	Title of the Book	Publishers	Year & Edition
1	P.S Verma	A Manual of Practical Zoology: Invertebrates	S.Chand & Co	2010, (Reprint edition)
2	M.M.Trigunayat, Krithika Trigunayat	A Manual Of Practical Zoology: Biodiversity, Cell Biology, Genetics & Developmental Biology Part 1	Scientific Publishers India	2009 (Reprint edition)
3.	Eugene P. Odum & Cary W. Barrett	Fundamentals of Ecology	Brooks/ Cole Publishing Compamy	2017, (5 th edition)
4	Sue Carson Heather Miller Melissa Srougi D. Scott Witherow	Molecular Biology Techniques A Classroom Laboratory Manual	Academic Press	2019, (4th Edition)
5	B Hoshang S. Gundevta , Hare Govind Singh	A Textbook of Animal Behaviour	S Chand & Co	2015, (Reprint edition)

Course Designer:

1. Dr. Charumathi Pushparaj

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDIT
MZO23P2	CORE PRACTICAL-II	PRACTICAL	-	-	90	4

Preamble

To enable the students to identify the different vertebrate forms.

To enable students on hands on training of various biochemical analysis

To apply the knowledge in understanding the parameters in defining an ecosystem. To interpret the samples from the site of criminal investigations

Course Outcomes:

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Understand and classify the vertebrate forms and their characteristics	K2
CLO2	Apply the knowledge gained in biochemical analysis of clinical samples.	K3
CLO3	Evaluate the physiological functions of various organ systems	K4
CLO4	Design experiments to investigate the forensic samples.	K5

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	S	S	S	S	S
CLO2	S	S	S	S	S
CLO3	S	S	S	S	S
CLO4	S	S	S	S	S

S - Strong; M-Medium

CORE PRACTICAL- II- MZO23P2 (90 hrs)

PHYLOGENY OF CHORDATES

1. Spotters chordate. (9 hrs)
2. Study of the following skull types with reference to jaw suspensions of some vertebrates (4 hrs)
3. Composition assessment of taxonomical diversity or biodiversity of vertebrates in habitat from different ecosystems – field study.

BIOCHEMISTRY

1. Salivary Amylase in relation to temperature. (4 hrs)
2. Effect of different pH on the activity of salivary amylase. (3 hrs)
3. Qualitative analysis of Carbohydrates. (8 hrs)
4. Estimation of blood glucose by Ortho-toluidine method. (4 hrs)
5. To carry out the separation of amino acids by thin layer chromatography. (4 hrs)
6. Qualitative analysis of urine - protein, glucose, Ketone bodies (6 hrs)

ANIMAL PHYSIOLOGY

1. Rate of oxygen consumption in fishes. (6 hrs)
2. Patterns of osmotic response of earthworms in hetero-osmotic media. (4 hrs)
3. Qualitative analysis of excretory products- ammonia, urea, Uric acid. (3 hrs)
4. Principle and Application of Sphygmomanometer, Kymograph, Haemoglobinometer, ESR. (6 hrs)
5. Estimation of ESR. (3 hrs)
6. Measurement of premenstrual tension through blood pressure measurement (4 hrs)
7. Comparison of ovulatory cycle and basal body temperature. (4 hrs)

FORENSIC SCIENCE

1. To determine blood group from dried blood sample. (3 hrs)
2. To carry out the crystal test on a blood sample (4 hrs)
3. To identify blood samples by chemical tests. (3 hrs)

REFERENCE BOOKS:

S.No.	Authors	Title of the Book	Publishers	Year & Edition
1	Dr. Veena Singh Ghalaut, Dr.S.K Gupta, Dr.Anju Jain	Manual of Practical Biochemistryfor MBBS	Arya Publishing Company	2018, (3 rd Edition)
2	CL. Ghai	A Textbook Of Practical Physiology	Jaypee publications	2013, (8 th Edition)
3	PS VERMA	A Manual of Practical Zoology: Chordates	S.Chand publications	2000, (10th Revised Edition)
4	RK Gorea, TD Dogra, A.D. Aggarwal	Practical Aspects of ForensicMedicine: A Manual For Undergraduates And GeneralPractitioners	Jaypee Brothers Medical Publishers (P) Ltd	2010, (1 st edition)

Course Designer:

1. Dr. Charumathi Pushparaj

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDIT
MZO2311	IMMUNOLOGY	THEORY	73	2	-	4

Preamble

To understand the basic immunological principles, immunotechniques, structural and functional basis of immunoglobulins, the mechanism, mediators, detection and application of antigen-reaction in the immune system.

Course Learning Outcome

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Understand the basic components of immune system at a cellular and molecular level	K2
CLO2	Interpret the mechanisms that regulate immunological response and the basis of immunologic diversity	K3
CLO3	Compare and contrast the key mechanisms and coordination of cellular and biochemical players of innate and adaptive immunity	K4
CLO4	Evaluate the regulatory mechanisms of immune system in health and disease and to comprehend the function of vaccines and Immunotherapy	K5
CLO5	Investigate the molecular mechanisms and design techniques for disease diagnosis and therapeutics	K6

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	S	S	S	M	M
CLO2	S	S	S	M	M
CLO3	S	S	S	S	M
CLO4	S	S	S	S	M
CLO5	S	S	S	S	M

S- Strong; M-Medium

IMMUNOLOGY

MZO2311 (73 Hrs)

UNIT I

14 Hrs

Basic of Immunology: Introduction - Historical perspective. Innate immunity (Non- specific), Adaptive immunity (Specific) - Humoral immunity, Cell Mediated immunity. Cells and organs of immune system: Cells of Immune system - Haematopoiesis, Stem cells, Lymphoid cells, Mononuclear cells, Granulocytes, Mast cells, Dendritic cells. Organs of immune system- Primary lymphoid organs and Secondary lymphoid organs.

UNIT II

14 Hrs

Antigens: Immunogenicity vs Antigenicity, Haptens. Factors influencing Immunogenicity. Epitopes - B cell epitope and T cell epitope. Antibodies: Immunoglobulin - structure, isotypes and biological function. Immune response & theories. Antigenic determinant on immunoglobulin- isotype, allotype and idiotype. B-cell receptor, immunoglobulin superfamily. Antigen - Antibody interaction and immunodiagnostics.

UNIT III

Mediators of Immune System

15 Hrs

Monoclonal antibody, Polyclonal antibody, Organization and expression of immunoglobulin genes. Synthesis of immunoglobulin and disorders of immunoglobulin synthesis. MHC - Restriction, Organization and inheritance of MHC, Antigen processing and presentation. T cell receptor, cytokine, adhesion molecules, Complement.

UNIT IV

15 Hrs

Clinical immunology: Immunity to infection: bacteria, viral, fungal and parasitic infections, Hypersensitive reaction, Transplantation immunology. Tumour Immunology: General features, Tumour microenvironment, Tumour antigens, and Immune responses to Tumours. Vaccines: Principles and types of Vaccines - DNA Recombinant Vaccine, Serum therapy. Recent advances in vaccines- covid vaccines. Autoimmunity- Autoimmune diseases and therapeutics

UNIT V

15 Hrs

Immunotechniques: Cell separation techniques – magnetic sorting, FACS; Agglutination tests, Immunoprecipitation techniques, Elispot assay, Immunofluorescence, Epitope mapping, Antibody engineering in *E. coli*, Radioimmunoassay, Western blotting, Immunoelectrophoresis, Immunochromatography, Immuno-PCR, Gene expression analysis of immune system cells.

TEXTBOOK

S.No	Author	Title	Publishers	Year & Edition
1.	Kuby Richard, Thomas, Barbara, Janis	Immunology	Freeman and company, New York, USA.	2018, 7 th Edn.

REFERENCE BOOKS

S.No	Author	Title	Publishers	Year & Edition
1.	Roitt, I.M.	Essential Immunology.	Blackwell Scientific, Oxford	2017, 1st Edn.
2.	Thao Doan , Fabio Lievano, Susan M. Viselli, Michelle Swanson- Mungerson	Lippincott's Illustrated Reviews: Immunology	Wolters Kluwer	2021, 1st Edn.
3	Janeway, C.A. and P. Travers.	Immunobiology.	Current Biology Ltd.London.	2017, 1st Edn.
4	Paul, W.E.	Fundamentals of Immunology.	Raven Press. New York	2003, 1st Edn.
5	Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai	Cellular and Molecular Immunology	Elsevier	2021, 1st Edn.

Course Designers

1. Dr.Charumathi Pushparaj
2. Dr. P. B. Harathi

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDIT
MZO2312	ENTOMOLOGY	THEORY	58	2	-	4

Preamble

This course focuses on applied entomology and the classification of insects according to their economic importance and their role in various industries.

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Understand the classification of insects, General morphology, feeding and social behavior of Insects.	K2
CLO2	Compare different techniques in collection and preservation of insects, role of biotic and abiotic factors in insect development.	K3
CLO3	Analyze insect collection methods, Salient features of Insect orders and Physiology.	K4
CLO4	Criticize the concept of pest control, Special adaptations of Insects due to environmental changes, synthesis and applications pheromones.	K5
CLO5	Collaborate the process of structural modification, functions of organ systems and Interaction of insects with plants, animals and microbes.	K6

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	S	S	S	S	S
CLO2	S	S	S	S	S
CLO3	S	S	S	M	M
CLO4	S	S	S	M	M
CLO5	S	S	S	M	M

S-Strong; M-Medium

ENTOMOLOGY MZO2312 (58 Hrs)

UNIT I

12 hrs

Insect Taxonomy

Taxonomic keys – Identification and purpose; Insect classification up to orders with examples; Different techniques of Insect Collection, Preservation, and Mounting

Unit II

12 hrs

Morphology and Physiology

Comparative morphology of Insect head, thorax, and abdomen;
Structure and physiology of different systems- digestive, circulatory, respiratory, excretory, nervous, sensory, reproductive, musculature, endocrine and exocrine glands

Unit III

12 hrs

Insect ecology

Abiotic factors and their generalized action on insects. Implications for abundance and distribution of organisms - Law of the Minimum, Law of Tolerance, and Biocoenosis.
Population dynamics- Factors affecting abundance- Environmental factors, dispersal and migration, Seasonality in insects Diapause (Quiescence) - aestivation, hibernation
Classes of interactions: Insects with microbes, plants and animal.

Unit IV

11 hrs

Insects of Medical Importance

Insect pathology- Infection of insects by bacteria, fungi, viruses, protozoa, rickettsiae, spiroplasma, and nematodes
Insects as pests – Insect pests in human habitation, biology, damage and control of mosquitoes, houseflies, bed bugs, ants, termites, cockroaches, flies, silverfish, head and body lice, carpet beetles, cloth moths, crickets, wasps, house dust mites, insect pests of cattle, poultry, pet animals and their management.

UNIT V

11 hrs

Commercial entomology

Culturing of insects-maintenance of adults, rearing and breeding insects.
Beekeeping- Managing colonies for honey production and pollination, Artificial queen rearing, Pests and diseases of honey bees.
Sericulture - Study of different species of silkworms, characteristic features, Moriculture, silk and its uses, pests, and diseases of silkworms, rearing, and management of silkworms.
Lac insect- natural enemies and their management

TEXTBOOKS

S.No	Author	Title	Publishers	Year & Edition
1	Wigglesworth, Vincent B	Insect physiology	Springer Netherlands	1985, 1 st Edn.
2	Eilenberg J	An ecological and social approach to biological control	(Springer).	2005, 1 st Edn.
3	Ananthakrishnan T N and Shivaramakrishnan K G	Ecological entomology: Insect life in odd environment	Scientific Pub: India	2017, 1 st Edn.

REFERENCE BOOKS:

S. No	Author	Title	Publishers	Year & Edition
1	Chapman R F	The Insects: Structure and function	Cambridge University Press: Cambridge	2004, 4 th Edn.
2	Cox F E G	Modern Parasitology	Blackwell Scientific Publications: Oxford	1993, 1 st Edn.
3	Eldridge B	Medical entomology	Springer	2004, 1 st Edn.
4	Fenemore P G and Prakash A	Applied Entomology	New Age Publishers: New Delhi	2009, 1 st Edn.
5	Pedigo L.P	Entomology and Pest Management	Prentice- Hall Inc.: New Jersey	2004, 4 th Edn.
6	Perry A S, Yamamoto I, Ishaaya I and Perry R	Insecticides in Agriculture and Environment	Narosa Pub. House: New Delhi	1998, 1 st Edn.

Course Designer

1. Dr. R. Yamuna

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDIT
MZO2313	MOLECULAR ENDOCRINOLOGY AND REPRODUCTIVE PHYSIOLOGY	THEORY	73	2	-	4

Preamble

Upon successful completion of this course the student should recognize the foundations of the molecular endocrinology and sexual differentiation; they can understand the concepts of regulation of glands, their dysfunction and mechanisms of hormone action. This course describes the use of hormonal and immuno-contraception.

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Understand the structure and function of various endocrine glands and hormones and their role in male and female reproductive system and neuroendocrine regulation, ablation and replacement therapy.	K2
CLO2	Apply the concepts involved in the classification of hormones, synthesis and storage of different hormones, mechanism of hormone receptors and Pathophysiology of endocrine glands, physiology of reproductive system and the hormonal and immune contraception works.	K3
CLO3	Analyze the significance of development of endocrine glands, various endocrine methodologies, different classes of hormones and the functions of male and female reproductive systems in terms of infertility permissive and termination action of hormone, Pathophysiology of endocrine glands and causes. Analyze the techniques involved in Artificial insemination, in vitro fertilization and embryo transfer	K4
CLO4	Describe the role of Neuroendocrine regulation of immune system, synthesis and control of synthesis, storage, metabolism and functions. Endocrine glands in relation to the normal reproductive physiology like in pregnancy, parturition, lactation and menopause.	K5
CLO5	Judge the ability of hormones to develop the immunity against the Pathophysiology caused in terms of various organ systems and about the role of hormones as contraceptives	K6

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	S	S	S	S	S
CLO2	S	S	S	S	S
CLO3	S	S	S	S	S
CLO4	S	S	S	M	M
CLO5	S	S	S	S	S

S- Strong; M-Medium

MOLECULAR ENDOCRINOLOGY AND REPRODUCTIVE PHYSIOLOGY

MZO2313 (73 Hrs)

UNIT I

14 Hrs

Definition and scope of molecular endocrinology- Introduction: A brief history of discovery of hormones. General classes of hormones: peptide, steroid, neuro-transmitters, neuropeptides, chalcones, peptide-growth stimulating factors, eicosanoids and pheromones. Endocrine methodologies: Ablation and replacement, bioassays, immunoassays, Immunocytochemistry, autoradiography, electrophysiological and pharmacological methods, hormone-receptor interactions, cloning techniques.

UNIT II

14 Hrs

Developmental biology of mammalian endocrine system. Structural features and hormones of endocrine glands- hypothalamus, pituitary, pineal, thyroid, parathyroids, GI tract, pancreatic islets, adrenals and gonads. Hormones of endocrine glands: synthesis and control of synthesis (Feedback mechanism) storage, metabolism and functions. Neuroendocrine regulation: Neuroendocrine regulation of immune system.

UNIT III

15 Hrs

Mechanisms of hormone action: Receptors and types- membrane receptors, nuclear receptors; receptor regulation and signal transduction, second messengers, permissive actions of hormones and termination of hormone action, mechanism of peptide and steroid hormone action. Techniques for quantitation of hormones. Pathophysiology of hypothalamic, pituitary, pineal, thyroid, parathyroid, GI tract, pancreatic islets, adrenal and gonadal hormones.

UNIT IV

15 Hrs

Structure of male reproductive system, Testicular events and Cholesterol as a precursor and biosynthesis of steroid hormones, Structure of sperm, Biochemistry of semen, Capacitation of spermatozoa, Structure of female reproductive system, Follicular development and selection- Oocyte maturation and its regulation - Ovulation: factors involved in follicular rupture - Luteinization and luteolysis - Follicular atresia - Regulation of reproductive cycle in female, Endocrinology of pregnancy, parturition and lactation, Menopause.

UNIT V

15 Hrs

Male sterility: azoospermia, oligozoospermia, asthenozoospermia, varicocele its causes and control, Artificial insemination, in vitro fertilization and embryo transfer. Fertility control, Female reproductive disorder: amenorrhea, polycystic ovary. Fertilization: Activation of egg - Contraception leading to prevention of polyspermy: surgical, hormonal and immunocontraception. Contraception: Natural and chemical methods, Oral contraception, Contraceptives of future.

TEXT BOOK

S.No	Author	Title	Publishers	Year & Edition
1	Samuel S. C. Yen, Robert B. Jaffe, Robert L. Barbieri,	Reproductive Endocrinology: Physiology, Pathophysiology, and Clinical Management	Saunders publisher. USA.	2013, 7

REFERENCE BOOKS

S.No	Author	Title	Publishers	Year & Edition
1	Henry M. Kronenberg, Shlomo Melmed, Kenneth S. Polonsky, P. Reed Larsen. Williams.	Textbook of Endocrinology	Saunders Elsevier	2008, 11 th Edn.
2	Bolander, F. F	Molecular Endocrinology	Academic Press	2004, 3 th Edn.
3	Ernst Knobil and Jimmy D. Neil,	The Physiology of Reproduction	Raven Press	2002, 1 st Edn.
4	Samuel S. C. Yen, Robert B. Jaffe, Robert L. Barbieri	Reproductive Endocrinology: Physiology, Pathophysiology, and Clinical Management	Saunders publisher. USA.	2009, 1 st Edn.
5	Freedman L. P.,	Molecular Biology of Steroid and Nuclear Hormone receptors	Birkhauser, Boston, USA.	1998, 1 st Edn.
6	Litwack, G.,	Biochemical actions of hormones	Academic press, New York, USA	1985, 1 st Edn.

Course Designer

1. Dr. P. Susheela

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDIT
MZO2314	AGRICULTURAL AND INDUSTRIAL ZOOLOGY	ELECTIVE	58	2	-	4

Preamble

To analyze the life cycle and the mechanisms in all the animals to adapt to their habitat, and interpret them to apply in industries.

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Understand agriculturally important organisms and their economic importance in small scale industries and crop pest management	K2
CLO2	Apply the economically important insects in small scale industries and integrated pest management principles	K3
CLO3	Analyze the knowledge on economic zoology about lifecycle of microbes and their management effectively in agriculture practices	K4
CLO4	Integrate and apply knowledge on apiculture, pisciculture, sericulture, lac culture, integrated pest management principles in controlling the pests of economic importance.	K5
CLO5	Interpret the knowledge on agri based small scale industries and the innovative approach of learning from nature in terms of Biomimicry and its application in industry	K6

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	M	M	S	S	S
CLO2	S	S	S	S	S
CLO3	S	S	S	S	S
CLO4	S	S	S	S	S
CLO5	S	S	S	S	S

S - Strong; M-Medium

AGRICULTURAL AND INDUSTRIAL ZOOLOGY

MZO2314 (58 Hrs)

Unit I

11 hrs

Apiculture: Species of honey bees – Social organization of honey bee – selection of bees and location for apiary – Newton's bee hive – products of bee keeping – enemies and diseases of honey bees.

Sericulture: Species of silkworm – life history of mulberry silkworm – Rearing of silkworm – pests and diseases of silkworm.

Lac Culture: Introduction – Life history – Host plants – cultivation of Lac – Enemies of lac cultivation – Economic importance of Lac.

Entrepreneurial aspects of Apiculture, Sericulture and Lac culture.

Unit II

11 hrs

Pests - categories, causes for outbreak, economic damage - Biology and control of insect pests of agricultural importance: codling moth, mango mealy bug, Cotton white fly - Organochlorine, Insecticides, Organophorous insecticides, Carbamates, Acaricides, Nematicides, Rodenticides, Molluscicides, and Botanical pesticides - Pheromonal and Hormonal control - Pest monitoring - Integrated pest management (IPM)-Definition, concepts, goals, and strategies of IPM, IPM program development and models.

Unit III

12 hrs

Aquaculture: Freshwater aquaculture: Carp culture – types of ponds – preparation – maintenance – harvesting and management. Integrated and composite culture. Prawn culture. Marine Aquaculture: Edible – pearl oyster culture. Ornamental fish culture. Aquaponics-Overview, Maintenance and Troubleshooting.

Biomimicry: Definition, Applications & Scope of Biomimicry in Industries - Processes and systems in nature - Collaboration with nature to devise and apply practical solutions to current challenges - Insect mimicry: Entomophagous insects.

Unit IV

12 hrs

Poultry Farming: General introduction to poultry farming - Principles of poultry housing, Management of chicks - growers and layers, Feed formulation and Methods of poultry feeding, Poultry diseases-viral, bacterial, and parasitic (two each) – Symptoms, Control and management, Selection, care and handling of hatching eggs - Egg testing - Faecal management in poultry.

Unit V

12 hrs

Dairy Farming: Dairy farming – advantages of dairying – classification of breeds of cattle – Indigenous and exotic breeds – Selection of dairy cattle. Breeding – artificial insemination – Dairy cattle management – housing – water supply – cattle nutrition feeding standards – Common contagious diseases. Dairying as a source of additional income and employment.

TEXT BOOKS

S.No	Author	Title	Publishers	Year & Edition
1	S.S. Khanna, HR Singh	A Textbook of Fish and Fisheries	Narendra Publishing House.	2014, 3 rd Edn.
2	Aruga, H.	Principles of Sericulture	. Oxford & IBH Publishing Co. New Delhi.	1998, 1 st Edn.
3	Atwal, A.S.	Essentials of beekeeping and pollination.	Kalyani Publ. New Delhi.	2000, 1 st Edn.

REFERENCE BOOKS

S.No	Author	Title	Publishers	Year & Edition
1	Kenny Ausubel and J.P. Harpignies	Nature's Operating Instructions edited by Keys to virtuous exploitation of nature	Kenny Ausubel and JP Harpignies	2011, 1 st Edn.
2	Donell Meadows	Connected Wisdom: Living Stories about Living Systems by Linda Booth-Sweeney Thinking in Systems	Linda Booth Sweeney	2009, 1 st Edn.
3	Lagler, K.F. Bardach, J.E. Miller, R.R. and Pasina D.R.M.	Inothology.	John Wiley and Sons, New York	1987, 1 st Edn.
4	Verman, L.R.	Beekeeping in integrated mountain development.	Oxford & IBH Publ.Co., New Delhi.	1990, 1 st Edn.
5	Stine, K.E and Brown, T.M.	Principles of Toxicology.	Lewis Publishers London.	1996, 1 st Edn.
6	Atwal, A. S. and Dhaliwal G.S.	Agriculture pests of South Asia and their management.	Kalyani Publishers New Delhi.	1997, 1 st Edn.
7	Janine Benyus Harper Collins,	Biomimicry: Innovation Inspired by Nature	Mariner Books	2009, 1 st Edn.

Course Designers

1. Dr. Charumathi Pushparaj
2. Dr. R. Yamuna

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDIT
MZO2315	GENOMICS, METAGENOMICS AND EPIGENETICS	ELECTIVE	58	2	-	4

Preamble

This paper gives a current knowledge about gene, genomics, metagenomics and epigenetics.

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Understand recent techniques in genomics and sequencing	K2
CLO2	Apply the techniques used in functional genomics such as microarrays, mRNA expression and miRNA expression	K3
CLO3	Analyse the growth of genomics into metagenomics, application of next generation sequencing technologies and evaluate the challenges in this field.	K4
CLO4	Criticize the application of metagenomics in the environment, health, agriculture and industry.	K5
CLO5	Interprete the connections between the epigenetic factors and phenotypic variations, analyze their implications in regulation of gene expression	K6

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	M	M	S	S	S
CLO2	S	S	S	S	S
CLO3	S	S	S	S	S
CLO4	S	S	S	S	M
CLO5	S	S	S	M	M

S - Strong; M-Medium

GENOMICS, METAGENOMICS AND EPIGENETICS

MZO2315 (58 Hrs)

UNIT I

11 Hrs

GENOMICS

Organization and structure of genomes - size, complexity, gene-complexity, architecture of mitochondrial genome, organization and nature of nuclear DNA in eukaryotes; transposable elements, pseudogenes, segmental duplications. Mapping genomes - physical maps, EST, SNPs as physical markers, radiation hybrids, FISH, optical mapping, gene maps, integration of physical and genetic maps; sequencing genomes: recognition of coding and non-coding regions and annotation of genes, quality of genome-sequence data, base calling and sequence accuracy.

UNIT II

11 Hrs

APPROACHES TO EXPLORE GENE EXPRESSION

Genomics, gene expression - Gene expression analysis using quantitative PCR methods – Gene expression analysis- Microarrays - Microarray applications. Modifying Gene Expression and Cellular Function, Gene silencing - Forward genetics & reverse genetics.

UNIT III

12 Hrs

METAGENOMICS

Introduction - from genomics to metagenomics, 16S rRNA analysis and culturing, culture independent insight, global impact of metagenomics; next generation of DNA sequencing technologies and potential challenges, the developments and impact of 454 and Solexa sequencing. Pioneering projects in metagenomics - acid mine drainage project.

UNIT IV

12 Hrs

METAGENOMICS AND ENVIRONMENT

Ecological inference from metagenomics- symbiosis, competition and communication; metagenomics of soil and soil health; microbial community - genomics in ocean; application of metagenomics– technical advancement in the field, application and expected benefits from large scale metagenomics data, application in human health, agriculture, industry and environment remediation.

UNIT V

12 Hrs

EPIGENETICS

Epigenetics - from phenomenon to field, a brief history of epigenetics - overview and concepts; chromatin modifications and their mechanism of action, heterochromatin formation; RNAi and heterochromatin assembly, role of noncoding RNAs. Epigenetics: DNA methylation in mammals, germ line and pluripotent stem cells, epigenetic control of lymphopoiesis, nuclear transplantation and the reprogramming of the genome; epigenetics and human disease, epigenetic determinants of cancer.

TEXT BOOKS

S.No	Author	Title	Publishers	Year & Edition
1.	David C. Allis and Thomas Jenuwein.	Epigenetics.	Cold Spring Harbor Laboratory Press, New York, USA.	2007
2.	Primrose, S. B. and Twyman R. M.	Principle of Genome Analysis and Genomics,	Blackwell Publishing Company, Malden, USA.	2006
3	Arthur M. Lesk	Introduction to genomics	oxford university	2017, 3 rd Edn.
4	Daniel L. Hartl, Elizabeth W. Jones	Essential Genetics: A Genomics Perspective	Jones & Bartlett Publishers	2005, 4 th Edn.
5	Jonathan Pevsner	Bioinformatics and Functional Genomics	Wiley-Liss publishers	2015 4 th Edn.

REFERENCE BOOKS

S. No	Author	Title	Publishers	Year & Edition
1	Nature Publishing Group,	Next generation DNA sequencing.	Cold Spring Harbor Laboratory Press, New York, USA	2010
2	Brown, T. A.,	Genomes 3	Garland Science Publishing, London, UK	2005
3	Mount, D. W.,	Bioinformatics: Sequence and Genome Analysis, The New Science of Metagenomics: Revealing the secrets of our microbial planet	Cold Spring Harbor Laboratory Press, New York, USA. Academic press, Washington DC, USA	2013
4	Watson, J.D	Molecular Biology of Gene	Pearson Education, Delhi, India.	2004

Course Designers

1. Dr. S. Gandhimathy
2. Dr. P.B. Harathi

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDIT
MZO23S1	RESEARCH METHODOLOGY	SPECIAL PAPER	30	2	-	2

SPECIAL PAPER - RESEARCH METHODOLOGY- MZO23S1 (30Hrs)

UNIT I

7 Hrs

Research methods vs. Methodology. Types of research – Descriptive vs. Analytical, applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, criteria of good research. Defining and formulating the research problem, literature review and secondary sources, citations, patents, and research databases. Web as a source, identifying research gap, development of working hypothesis, biological abstract, components of a research report, peer-reviewed journals. Research project proposal preparation and SOP writing - funding agencies and thrust areas.

UNIT II

6 Hrs

Collection and analysis of biological data - mean, median, mode Standard deviation, Standard error, Coefficient of variation, Student 't' test, Skewness, Kurtosis, Chi-square, Correlation, Regression, and ANOVA. Data presentation -Use of tables and figures, preparation of photographs.

UNIT III

7 Hrs

Absorption and Emission principles- Principle and application of UV visible, FTIR, XRD, Spectrofluorometer, flame photometer, Atomic, Absorption and emission spectrophotometers, NMR and Mass spectrometer in Biology. Principles and Application of Chromatography: Paper, Thin layer, column, Ion Exchange, Gel filtration, Gas Liquid, HPLC and affinity.

UNIT IV

5 Hrs

Biohazards, risk groups, bio-safety levels, laboratory-acquired infections, routes of exposure, safety measures, good laboratory practices, biohazardous wastes, types of hazards.

Clinical Trials- Introduction, procedures & records, Informed consent, responsibility & rules applicable to investigators and sponsors, Clinical Trial Guidelines.

UNIT V

5 Hrs

Research Ethics and Responsible Conduct in Research - Brief history and analytical basis of research ethics (Honesty in Science: Integrity, Authorship, Conflicts of Interest, Privacy and Confidentiality, Informed Consent, Risk/Benefit Assessment), The legal regulation of research ethics in India (From UGC, MHRD and other governing agencies), animal ethical committee, UGC guideline for discontinuation of dissection. Regulatory requirements relevant to international research. Plagiarism and Self-Plagiarism.

TEXTBOOKS

S.No	Author	Title	Publishers	Year & Edition
1	Anderson,Durstun and Polle.	Thesis and Assignment writing.	Wiley Eastern Ltd., NewDelhi	1970, 1 st Edn.
2	Kothari C. R.	Research Methodology: Methods and techniques	New Age International	2009, 1 st Edn.

REFERENCE BOOKS

S. No	Author	Title	Publishers	Year & Edition
1	Comir and Peter Wood Ford.	Writing scientific papers in English.	Pitman Medical Publishing Co. London.	1979,1 st Edn.
2	Ewing, G.W.	Instrumental methods of chemical analysis	McGraw Hill Book Company.	1988, 1 st Edn.
3	Daniel, M.	Basic biophysics for biologists.	Agro-Botanical Publishers, India.	1989, 1 st Edn.
4	Palanichamy, S. and M. Shanmugavelu.	Research methods Min biological sciences.	Palani Paramount Publications, Tamil Nadu,India.	1997, 1 st Edn.
5	Wilson and Walker.	Practical biochemistry-principles and techniques	Cambridge University Press.	2000, 1 st Edn.
6	Milton, J.S.	Statistical methods in Biological and Health Sciences.	McGraw Hill Inc., NewYork.	1992, 1 st Edn.
7	John W. Creswell	Research Design,	Sage	2011, 1 st Edn.
8	Kothari C. R.	Research Methodology: Methods and techniques	New Age International	2009, 1 st Edn.

Course Designer

1. Dr. R. Yamuna

COURSE CODE	COURSE TITLE	Category	L	T	P	Credits
MNM22CS2	CYBER SECURITY II	-	30	-	-	2

Preamble

This course provides the classification of cyber security and cyber crime and its laws and data privacy and security in social media

Prerequisite

Basics of Internet

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Understand the basic concepts of Cybersecurity and Cybersecurity threat landscape.	K2
CLO2	Apply the methods to identify the cyber- attacks and crimes.	K3
CLO3	Analyze the legal framework that exists in India for cybercrime and legal frame work followed by other countries.	K4
CLO4	Estimate the data privacy and security issues related to personal data privacy and security.	K5
CLO5	CLO5 Create a privacy setting on social media platform and register complaints on a social media platform.	K6

CYBER SECURITY II (MNM22CS2)

UNIT I

6 hrs

Overview of cyber security: Cyber security terminologies- Cyberspace- Cyber attack- Cyber threats - Cyber terrorism – Cyberwarfare.

UNIT II

8 hrs

Cyber crimes: Cyber Crimes targeting computer system and mobiles- Online scam frauds: emails Scams- Phishing- Vishing- Smishing- Online job fraud- online sextortion- Debit and credit card fraud online payment fraud- cyberbullying. Social Media Scam & Frauda: Impersonation- Identify theft – Job scams- Misinformation- Fake newcyber crime against persons -Cyber grooming -Child pornography - cyber stalking-Cyber police station -Crime reporting produce.

UNIT III

4 hrs

Cyber law: Cyber laws and legal and ethical aspects related to new technologies: AI/ML- uIoTBlockchain- Darknet and social media- Cyber law of other countries.

UNIT IV

5 hrs

Data privacy and Data security: Defining data- Metro-Big data- Non personal data- Data protectionGeneral Data Protection Regulations (GDPR)- 2016 Personal Information Protection and the Electronic document Act(PIPEDA)- Social media Data privacy and Security issues.

UNIT V

7 hrs

Social Media Platforms and Cyber Security : Case Study on Platform for reporting Cyber Crimes, Checklist for reporting cyber crimes online, Setting privacy settings on social media platforms, Registering complaints on social media platforms, Do's and Don'ts for posting content on social media platforms, prepare password policy for computer and mobile device, security controls for computer and mobile phones , digital Forensics, Cyber Bulling, Phishing, Facebook Attack, Cyber Security audit and Compliance and National Security Policies.

Reference Books:

1. Anand Shinde (2021), Introduction to Cyber Security – Guide to the world of Cyber Security, Notion Press Sumit Belapure, Nina Godbole (2011), Cyber security understanding cyber crimes, computer forensics and legal Perspectives, Wiley India Pvt Ltd.
2. Dorothy F. Denning (1998), Information warfare and security, Addison Wesley.
3. Henry A. Oliver, (2014), Security in the digital age: social media security threats and vulnerabilities, Social Wise Media Group Nataraj Venkataramanan, Ashwin Shriram (2016), Data privacy principle and practice. CRC Press
4. W. KragBrothy (2006), Information security governance guidelines for information security manager, Wiley Publication.
5. Martin Weiss, Michael G. Solomon (2015), Auditing IT Infrastructure for compliance, 2/e, Jones Bartlett Learning.

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDIT
MZO23P3	CORE PRACTICAL- III	PRACTICALS	-	-	60	4

Preamble

To equip the students to perform immunotechniques.

Enable the students to understand the importance of entomology

To develop analytical skills in molecular endocrinology and animal physiology

Course Learning Outcomes:

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Understand and develop entrepreneur skill in immunotechniques and mounting techniques.	K5
CLO2	Analyse and interpret the pest, vectors and parasites in day today life.	K5
CLO3	Analyse the major role of endocrine hormones in the physiology of the organisms.	K6
CLO4	Integrate the concept of protein estimation in insect hemolymph sample.	K6

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	S	S	S	S	S
CLO2	S	S	S	S	S
CLO3	S	S	S	S	S
CLO4	S	S	S	M	S

S- Strong; M-Medium

CORE PRACTICAL-III- MZO23P3 (60 Hrs)

IMMUNOLOGY AND IMMUNOTECHNIQUES

1. Immunodiffusion assay 4 hrs
2. Precipitin test 4 hrs
3. Differential staining and identification of leucocytes 2 hrs
4. Elisa Technique(Demonstration) 3 hrs
5. Western Blotting(Demonstration) 3 hrs
6. Spotters- Lymphoid organs- Thymus, Spleen, Bone marrow, Lymph node. 4 hrs

ENTOMOLOGY

1. Mounting: 1 hr
- a. Wings and their venation. Different types of antennae and legs of insects. 2 hrs
- b. Sting apparatus of an insect. 1 hrs
2. Enumerate haemocytes in haemolymph of *Spodoptera litura* or cockroach 4 hrs
3. Identification of pigments present in the *Drosophila* eye by chromatographic method. 4 hrs
4. Estimation of protein in haemolymph of silkworm 4 hrs
5. Pests of stored products: creation of household pest album- digitize 1 hrs
6. Vectors: *Anopheles*, *Culex*, and *Aedes* adult mosquitoes. 4 hrs

Parasites: *Leishmania* sp., *Plasmodium* sp. and *Wuchereria* sp

7. Field visit: Identification and listing (at least 10 species each) of harmful and beneficial insects. (Preparation of an album) 4 hrs

MOLECULAR ENDOCRINOLOGY AND REPRODUCTIVE PHYSIOLOGY

1. Effect of thyroxine on the respiratory metabolism of fish. 4 hrs
2. Identification of menstrual phase using human saliva. 4 hrs
3. Effect of ACTH hormone on blood glucose of fish- Group Experiment. 4 hrs
4. Spotters: Pituitary, Thyroid, Adrenal, Pancreas, Testis and Ovary. 2 hrs

REFERENCE BOOKS

S.No	Author	Title	Publishers	Year & Edition
1	Karthik Kaliaperumal und Senbagam Duraisamy Senthilkumar Balakrishnan	Practical Immunology A Laboratory Manual	LAP LAMBERT Academic Publishing;	2017, 1 st Edn.
2	Ambika Shanmugam	Fundamentals of Biochemistry for Medical Students	Nagaraj and Company Private Limited	2005, 1 st Edn.
3	Jayashree Ghosh	Textbook of Pharmaceutical Chemistry	S. Chand & Co	2003, 3 rd Edn.
4	Mallikarjuna Rao, N	Medical Biochemistry 6 edn.	New Age International (P) Limited, Publishers	2006, 1 st Edn.
5	Litwack, G.,	Biochemical actions of hormones	Academic press	1985, 1 st Edn.
6	Wigglesworth, Vincent B	Insect physiology	Springer Netherlands	1985, 1 st Edn.

7.	<u>Sathe Tukaram Vithairan</u>	Basic Entomology 2005: A Practical Manual	Daya Publishing House	2005
8.	H. L. Devasahayam	Practical Manual of Entomology (Insects and Non-Insects Pests)	New India Publishing Agency	2011

Course Designer:

1. **Dr. S. Gandhimathy**

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDIT
MZO23P4	CORE PRACTICAL- IV	PRACTICALS	-	-	60	4

Preamble

Understand the economic importance of organisms in relation to agriculture.

To educate the students in applied microbiology.

Develop bio products by applying the knowledge of biotechnology.

Course Outcomes:

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Understand the relationship between living organisms and abiotic factors to enrich agricultural field	K4
CLO2	Apply the knowledge of microbiology in visualizing and quantifying the microbes.	K5
CLO3	Create bioproducts by using the process of bioprocessing in the field of biotechnology.	K6
CLO4	Integrate the concept of antibiotics in antimicrobial activity.	K6

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	S	S	S	S	S
CLO2	S	S	S	S	S
CLO3	S	S	S	M	S
CLO4	S	S	S	S	S

S- Strong; M-Medium;

CORE PRACTICAL-IV MZO23P4 (60 Hrs)

AGRICULTURAL AND INDUSTRIAL ZOOLOGY

1. Field visit report to be submitted on Monoculture and polyculture land / Sericulture / Apiculture / Pisciculture farms
2. Industrial visit report to be submitted on visiting a research Institute to observe and learn the rearing and culturing of different insects, fungi, and other microbes for Biocontrol application (CMFRI, KMFRI, TNAU etc.).
3. Spotters – identification and significance of instars of *Bombyx mori*, Edible and ornamental Fishes **4 hrs**
4. Dissection – Silk gland in *Bombyx mori* and Reproductive system in earthworm. **8hrs**

APPLIED MICROBIOLOGY

1. Preparation and use of glassware cleaning solutions (Acid Cleaning Solution) **4hrs**
2. Microbial analysis of food products - bacterial and fungi **8hrs**
3. Preparation of bacterial smear and Gram Staining. **8hrs**
4. Biochemical tests for microorganisms
4. Study of bacterial growth curve by turbidimetry **4hrs**
5. Determination of the susceptibility of bacteria against different antibiotic agents. **3hrs**

BIOTECHNOLOGY, BIOPRODUCTS AND BIOPROCESSING

1. Identification of mitochondria in the human cells using Janus green staining method **4hrs**
2. Estimation of citric acid in citrus fruits. **4hrs**
3. .Wine Production by yeast fermentation process and estimation of alcohol at different time intervals. **8hrs**

REFERENCE BOOKS

S. No	Author	Title	Publishers	Year & Edition
1	Atwal, A.S	Essentials of Beekeeping and pollination	Kalyani Pub	2000, 1 st Edn.
2	Aruga, H.	Principles of Sericulture	Oxford & IBH Publishing Co.	1998, 1 st Edn.
3	S.S. Khanna, HR Singh	A Textbook of Fish and Fisheries	Narendra Publishing House	2014, 3 rd Edn.
4	Ghosh Z. and Bibekanand M	Bioinformatics: Principles and Applications	Oxford University Press	2008, 1 st Edn.
5	Dubey, R. C.	Text book of Biotechnology,	S. Chand Co.,	2014, 5 th Edn.
6	Gupta, P.K.	Elements of Biotechnology	Rastogi Publications	2006, 1 st Edn.

Course Designer

1. Dr. R. Yamuna