PSGR
Krishnammal College for Women

DEPARTMENT OF ZOOLOGY

CHOICE BASED CREDIT SYSTEM & LEARNING OUTCOME BASED CURRICULAR FRAMEWORK

MASTER OF ZOOLOGY
2023 – 2025 BATCH
(I, II, III & IV 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 organizations

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.

PSGR Krishnammal College for Women

DEPARTMENT OF ZOOLOGY

CHOICE BASED CREDIT SYSTEM & LEARNING OUTCOME BASED CURRICULAR FRAMEWORK & SCHEME OF EXAMINATION MASTER OF ZOOLOGY – 2023-2025 BATCH

SEM	Subject Code	Title of the Paper	Instruction hours/week	Contact hours	Tutorial	Duration of Examination	Examination Marks			Credits
							CA	ESE	TOTAL	
I	MZO2301	Paper I- Phylogeny, Systematics and Functional Organization of Invertebrates	5	73	2	3	25	75	100	4
	MZO2302	Paper II – Evolution and Animal Behaviour	5	73	2	3	25	75	100	4
	MZO2303	Paper III - Developmental Biology	5	73	2	3	25	75	100	4
	MZO2304	Paper IV – Molecular Cell Biology	5	73	2	3	25	75	100	4
	MZO2305	Paper V- Ecosystem Services and Sustainable Environmental management	4	58	2	3	25	75	100	4

	MZO23P1	Practical-I	3	45	…	…	…	…	…	…
	MZO23P2	Practical –II	3	45	…	…	.....	…	…	…
II	MZO2306	Paper VI – Phylogeny, Systematics and Functional organization of Chordates	5	73	2	3	25	75	100	4
	MZO2307	Paper VII-Biochemistry	5	73	2	3	25	75	100	4
	MZO2308 / **Or**	Paper VIII-Animal Physiology + Coursera course	3+3	88	2	3	25	75	100	5 (2+3)
	MZO2312 **+**	Paper XI-Entomology	4	58	2	3	25	75	100	4
	MZO22S1	Special Course-Research Methodology	2	30	2	3	-	-	100	2
	MZO2309 MZO2310	Elective – I 1. Introduction to Forensic Science 2.Bioanalytical tools and Bioinformatics	4	58	2	3	25	75	100	4
	MZC22A1	Inter-Disciplinary Course-Clinical Microbiology, Biochemistry and Parasitology	4	58	2	3	25	75	100	4
	MZO23P1	Practical-I	3	45	….	3	25	75	100	4
	MZO23P2	Practical –II	3	45	….	3	25	75	100	4

III	MZO2311	Paper X Immunology	5	73	2	3	25	75	100	4
II / III	MZO23CEA /	PaperVIII– Animal Physiology **(OR)**	3 + 3	41+45	4	-	100	-	100	5
	MZO2312 + MZO23S1	Paper XI- Entomology + Special Course - Research Methodology	4 2	58 30	2 -	3 3	25** -	75 100	100 100	4 2
III	MZO2313	Paper X I1- Molecular Endocrinology and Reproductive Physiology	5	73	2	3	25	75	100	4
	MZO2314 MZO2315	Paper - XII Elective II 1. Agricultural and Industrial Zoology (Or) 2.Genomics Metagenomics and Epigenetics	4	58	2	3	25	75	100	4
	MNM22CS2	Cyber Security - II	2	30	-	-	-	100	100	Grade
		Comprehensive Exam	-			2	-	-		Grade
	MZO23P3	Core Practical-III	4	60	..	4	25	75	100	4
	MZO21P4	Practical –IV	4	60	..	4	25	75	100	4
I - III	17MONL1	Online Course #	-	-	-	-	-	-		1*
IV	MZO2316	Applied Microbiology	5	73	2	3	25	75	100	5
	MZO2317	Biotechnology, Bioproducts and Bioprocessing	5	73	2	3	25	75	100	5

	MZO18AC1/ MZO18AC2	Advanced Learners Course* Solid Waste Management / Wildlife Biology and Ornithology	-	-	..	3	25	75	100	5
	MZO23PROJ	Project and Viva voce	20			Viva - Voce	25	75	100	5
I - IV	**Grand Total**								**2200 +100**	**90 + 5**

** : Open book test – Entomology (CIA Examination)

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

: Self study

QUESTION PAPER PATTERN

CA Question from each unit comprising of

One question with a weightage of 2 Marks :2 x 3 = 6
One question with a weightage of 5 Marks (Internal Choice at the same CLO level) :5 x 3 =15
One question with a weightage of 8 Marks (Internal Choice at the same CLO level) :8 x 3 =24

Total :45 Marks

ALC

Section A (Paragraph answer) (4 out of 6) 4 x 4 : 16 Marks
Section B (Essay type) 1 out of 2 : 9 Marks

Total : 25 Marks

End Semester Examination

ESE Question Paper Pattern: 5 x 15 = 75 Marks
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

End Semester for - Advance Learner Courses

Section A 5 questions out of 8 - open choice 5x5 :25 marks
Section B 5 questions out of 8-open choice 5x10 :50 marks

Total :75 marks

PG-IDC and Special Course:

Section A 5 questions (Internal choice) :25 marks
Section B 5 questions (Internal choice) :75 marks

Total :100 marks

Continuous Internal Assessment Pattern

Theory

CIA Test : 5 marks (conducted for 45 marks after 50 days)

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

Total : 25 Marks

Practical

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

Total : 25 marks

ESE Practical Pattern

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

Project:

I Review - Selection of the field of study, Topic &literature collection	: 5 Marks
II Review - Research Design & Data Collection	: 10 Marks
III Review – Analysis &Conclusion preparation of rough draft	: 10 Marks
	Total : 25 Marks

End semester examination:

Evaluation of the project : 25 Marks

Viva Voce : 50 Marks

Total : 75 Marks

Cyber Security II

Quiz : 60 Marks
Case Study : 20 Marks
Poster : 20 Marks

RUBRICS

Assignment/ Seminar/Quiz

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 – MZO2301					
CLO1		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 – MZO2302					
CLO1	S	S	M	M	S
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	M	M	S
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 – MZO2304					
CLO1	S	S	M	M	S
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 – 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 – MZO2308					
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 – 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				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 –MZ02311					
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	S	S
COURSE- MZO23P4					
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 - MZO2316					
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 - MZO2317					
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

COURSE NO	COURSE NAME	CATEGORY	L	T	P	CREDIT
MZO2301	PHYLOGENY, SYSTEMATICS AND FUNCTIONAL ORGANIZATION OF INVERTEBRATES	CORE	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	K_2
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	K_3
CLO3	Analyze the speciation, Origin of Invertebrates and Phylogenetic interrelationships between Invertebrate phyla, Affinities and Systematic Position of Minor Phyla.	K_4
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.	K_5
CLO5	Collaborate on the Principles of taxonomy, structure and functions, phylogenetic relationship, Affinities and Systematic Position of Minor Phyla.	K_6

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

MZO2301 (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 **(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 flight 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 trachea in Arthropoda.

UNIT III **(15 Hrs)**

Origin of Invertebrates and Phylogenetic interrelationships between Invertebrate phyla. Origin of Protists. Prokaryotes and Eukaryotes. Multi-cellularity -Edicaran and Burgess Shale fauna.Cambrain 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 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, Onychopohra, 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 of Publication
1	Barnes, R. D	Invertebrate Zoology	Toppan International Co., NY	1982 (6th Edn).
2	Barrington, E. J. W.	Invertebrate Structure and Functions	English Language Book Society.	1969 (2nd 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 of Publication
1	Anderson, T. A.	Invertebrate Zoology	Oxford University Press, New Delhi.	2001 (2nd Edn).
2	Hyman, L. H.	The Invertebrates (Vol I-VI)	McGraw-Hill Companies Inc. NY	2017 (8th Edn).
3	Kapoor, V. C.	Theory and Practice of Animal Taxonomy	Oxford and IBH Publishing Co., Pvt. Ltd. New Delhi.	2008 (2nd Edn).
4.	Mayr, E.	Principles of Systematic Zoology	McGraw Hill Book Company, Inc., NY	1996 (1st Edn).
5.	Narendran, T. C.	An introduction to Taxonomy	Zoological Survey of India	2015 (7th 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 (2nd Edn).

COURSE NO.	COURSE NAME	CATEGORY	L	T	P	CREDIT
MZO2302	EVOLUTION AND ANIMAL BEHAVIOUR	CORE	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	K_2
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	K_3
CLO3	Associate the fundamental of evolution including diversity in genes that unify the biological sciences and group foraging.	K_4
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.	K_5
CLO5	Interpret the evolutionary process associate with theories, and molecular tools to assess animal behaviour like communication, aggression, cooperation while interacting with the environment.	K_6

Mapping with Programme Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	S	S	M	M	L
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; L-Low

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 of Publication
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 (5th ed.)
3	Jha, A. P.	Genes and Evolution	John Publication, New Delhi.	1992.

Reference Books:

S.No.	Authors	Title of the Book	Publishers	Year of Publication
1	Avise, J. C.	Molecular Markers, Natural History and Evolution	Chapman and Hall, New York.	1993 (1st 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 NO.	COURSE NAME	CATEGORY	L	T	P	CREDIT
MZO2303	DEVELOPMENTAL BIOLOGY	CORE	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	K_2
CLO2.	Interpret the concepts involved in the determination, differentiation, and development of different tissues and organs	K_3
CLO3.	Compare and contrast the involvement of various signals, environmental cues and cells from birth to death of an organism.	K_4
CLO4.	Criticize the molecular bases and gene regulation in producing differential signals signals and the feedback mechanisms in various tissues	K_5
CLO5.	Investigate the ability of homogenous zygote to develop into a complete organism.	K_6

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; L-Low

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**. 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 of Publication
1	Gilbert, S. F.	Developmental Biology	Publisher-Sinauer Associates Inc, Massachusetts, USA.	2006(8th Edn)
2	Balinsky, B. I.	An Introduction to Embryology	Publisher – Thomas Asia Pvt. Ltd.	2004(5th Edn)

REFERENCE BOOKS

S.No.	Authors	Title of the Book	Publishers	Year of Publication
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 NO.	COURSENAME	Category	L	T	P	Credit

MZO2304	MOLECULAR CELL BIOLOGY	CORE	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 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; L-Low

MOLECULAR CELL BIOLOGY- MZO2304 (71hrs)

UNIT I **(14 Hrs)**

Cell structure permeability and transport

Prokaryotes, **Development of multicellular organisms**, Cell wall structure of bacteria and eukaryotes, **Plasma membrane structure and models, cell organelles**; cell permeability– concentration gradient and partition coefficient, **transport of small molecules– active transport, passive transport, ion channels, 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; Cell signaling: Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, **regulation of signaling pathways, bacterial chemotaxis**. Cellular communication: **General principles of cell communication**, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, neurotransmission, and its regulation.

UNIT III **(15 Hrs)**

Molecular structures of genes and chromosomes

Structure of DNA – DNA melting and reannealing, base composition and sequence, size, shape, super twisting; molecular events of prokaryotic and eukaryotic chromosome organization, exon; intron– DNA mutation and repair mechanism, **Organization of genes and chromosomes:** Operon, interrupted genes, gene families, **structure of chromatin and chromosomes**, unique and repetitive DNA, heterochromatin, euchromatin, transposons.

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, introns and exons.

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.** Regulation of gene expression – lac operon, trp operon, ara operon. Regulation of gene expression by cyclic AMP, Protein Kinase C, **Growth factors and cytokines.**

TEXT BOOKS:

S.No.	Authors	Title of the Book	Publishers	Year of Publication
1	Benjamin Lewin	Gene IX	Oxford University Press, 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., Roberts, K., and Walter, P	Molecular Biology of the Cell	Garland Science, New York	2002

4	Cooper, G. M.	The Cell – A Molecular Biological Approaches	ASM Press, Washington	2013

REFERENCE BOOKS

S.No.	Authors	Title of the Book	Publishers	Year of Publication
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.	Molecular Biology	Narosa Publishing House	2000.

COURSE NO.	COURSE NAME	CATEGORY	L	T	P	CREDIT
MZO2305	ECOSYSTEM SERVICES AND SUSTAINABLE ENVIRONMENTAL MANAGEMENT	CORE	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 of Publication
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 of Publication
1	Mark Everard	Ecosystem Services – Key issues:	Earth scan from Routledge.	(2015)

COURSE NO.	COURSE NAME	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.	K_2
CLO2.	Analyse the developmental process involved in various organisms.	K_3
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.	K_5

Mapping with Programme 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; L-Low

CORE PRACTICAL- I- MZO23P1 (90 hrs) PHYLOGENY OF

INVERTEBRATES

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

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.
2. Spotters:

a. Chick: 36 Hours stage, 48 Hours stage, 72 Hours stage, 96 Hours stage.

3. Sperm smear and staining.

MOLECULAR BIOLOGY

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

ECOSYSTEM SERVICES AND MANAGEMENT

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

REFERENCE BOOKS:

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

Course Designers:

1. **Dr. Charumathi Pushparaj**
2. **Dr. K. Krishnapriya**

COURSE NO.	COURSE NAME	CATEGORY	L	T	P	CREDIT
MZO23P2	CORE PRACTICAL- II	PRACTICALS	-	-	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	K_2
CLO2.	Apply the knowledge gained in biochemical analysis of clinical samples.	K_3
CLO3.	Evaluate the physiological functions of various organ systems	K_4
CLO4.	Design experiments to investigate the forensic samples.	K_5

Mapping with Programme 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; L-Low

CORE PRACTICAL- II- MZO23P2 (90 hrs)

PHYLOGENY OF CHORDATES

1. Spotter chordate.
2. Study of the following skull types with reference to jaw suspensions of some vertebrates
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.
2. Effect of different pH on the activity of salivary amylase.
3. Qualitative analysis of Carbohydrates.
4. Estimation of blood glucose by colorimetric method.
5. To carry out the separation of amino acids by thin layer chromatography.
6. Qualitative analysis of urine - protein, glucose, Ketone bodies

ANIMAL PHYSIOLOGY

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

FORENSIC SCIENCE

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

BIOANALYTICAL TOOLS AND BIOINFORMATICS

1. Multiple sequence alignment of the gene of interest and its interpretation.
2. Construction of phylogenetic tree using bioinformatics tools.
3. Establish a docking mechanism of a protein with a ligand using bioinformatics tools.

REFERENCE BOOKS:

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

Course Designer:

1. **Dr. N. Aarthi**
2. **Dr. Charumathi Pushparaj**

COURSE NO.	COURSENAME	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	K_2
CLO2.	Determine the tendencies in elasmobranch evolution, extinction of reptiles,evolution of paired fins and limbs, Jaw kinetics in relation to feeding.	K_3
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.	K_4
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	K_5
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.	K_6

Mapping with Programme 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; L-Low

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- Rhynocephalia- 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, Sphenodon 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 of Publication
1	Waterman. A. J.	Chordate Structure and Function.	Mc Millan Co. London.	1971.
2	Jolie, M.	Chordate Morphology.	East West Press. Pvt, Ltd,	1968.
3	Hyman L. H.	Comparative Vertebrate Anatomy.	The University of Chicago Press, Chicago.	1966.

REFERENCE BOOKS:

S.No.	Authors	Title of the Book	Publishers	Year of Publication

1	Romer, A. S. and Parson, T. S.	Vertebrate Body.	W. B. Saunders Co. Philadelphia.	1978.
2	Young, J.	Life of Vertebrates.	Clarendon Press, Oxford.	1969.
3	Colbert, E. H.	Evolution of Vertebrates.	John Wiley and Sons Inc, New York.	1969.
4	Holstead.	The Pattern of Vertebrate Evolution.	Freeman and Co. San Francisco. U.S.A.	1969.
5	Hobart M. Smith,	Evolution of Chordate Structure,	Holt, Rinehart & Winston Inc. New York	1960.

Course Designer:

1. **Dr. P. Susheela**
2. **Dr. N. Aarthi**

COURSE NO.	COURSE NAME	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.	K_2
CLO2.	Apply the concepts of the biomolecules Metabolic pathways in energy production at cellular and molecular levels, regulation and disorders associated.	K_3
CLO3.	Analyse how Charbohydrates, proteins, nucleic acids and vitamins influence the biological processes and their architecture;	K_4
CLO4.	Describe the Chemistry of Biomolecules their synthesis and breakdown with clinical references.	K_5
CLO5.	Integrate the knowledge of enzymes in various industries and interpret the mechanism of action of various drugs and their catalytic properties.	K_6

Mapping with Programme 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; L-Low

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 of Publication
1	Harper H. A.	Review of Physiological Chemistry	Lange Publications	1993
2	Lehninger A., Nelson D. L. and Cox M. M.	Principles of Biochemistry	CBC Publishers	1993
3	Rastogi S. C.	Biochemistry	Tata McGraw Hill Publishing Co. Ltd	2003
4	Satyanarayana U.	Biochemistry	Book Syndicate Pvt. Ltd	2006
5	Stryer.	Biochemistry	W H Freeman and Co. Pub.	2008.

REFERENCE BOOKS:

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

Course Designer: Dr.R.Yamuna

Preamble

COURSE NO.	COURSE NAME	CATEGORY	L	T	P	CREDIT
MZO2308	ANIMAL PHYSIOLOGY	THEORY	88 (43+45)	2	-	5 (2+3)

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	K_2
CLO2.	Interpret the effects of external stimuli on the physiological functions of the cells	K_3
CLO3.	Distinguish the physiological processes from biochemical to system level of different organ system	K_4
CLO4.	Evaluate the functions of physiological systems solely and in coordination with other systems	K_5
CLO5.	Develop critical thinking skills and apply physiological concepts and principles and devise research questions at the basic and applied levels.	K_6

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; L-Low

ANIMAL PHYSIOLOGY
MZO2308 (88 hrs= 43 hrs + 45 hrs)

UNIT I **(6 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 **(12 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) Conductible 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 **(2 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 **(6 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 **(17 Hrs)**

Thermoregulation and cold tolerance: (a) Basic principles of metabolism (b) Heat balance and exchange (c) Endotherms vs Ectotherms (d) Counter-current heat exchangers € 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 € 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 of Publication
1	Guyton and Hall	Text Book of Medical Physiology	W. B. Saunders	2001 (10th Ed.).
2	Hill R.W	Comparative Physiology of Animals	Sinauer Associates	2016 (4th Edn)
3	Randall, Burggren, French, and Eckert	Animal Physiology: Mechanisms and Adaptations by Hill	Wyse and Anderson.	2001 (5th Edn)

REFERENCE BOOKS:

S.No.	Authors	Title of the Book	Publishers	Year of Publication
1	Hyman L. H.	The Invertebrata, Vol I to VI.	McGraw Hill Book Co., New York.	1951
2	Hoar, W.S.	General and comparative Animal Physiology	Prentice Hall of Indian	
3	Hall, J. E., & Guyton, A. C.	Guyton and Hall textbook of Medical Physiology.	Philadelphia, P A, Saunders Elsevier.	2011.
4	Chaudhuri S L.,	Concise Medical Physiology	New Central Book Agency (P) Ltd.: Calcutta	2002
5	Cowan, W. M., Südhof, T. C., Stevens, C. F	Synapses	The Johns Hopkins University Press	2003 (I Edn)
6	Hille, B.	Ionic channels of Excitable Membranes	Sinauer Associates, Sunderland, Massachussets.	2008.
7	Kandel R, Schwartz J H and Jessell T M.	Principles of Neural Science	(Elsevier)	2000 (4^{th} Edn)
8	Murray, R. K, Granner, D. K. Maynes, P. A and Rodweli, V. W.	Harper's Biochemistry.	McGraw Hill, New York.	1998 (25th Edn)

Course Designers:

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

COURSE NO.	COURSE NAME	CATEGORY	L	T	P	CREDIT
MZO2212	ENTOMOLOGY	CORE	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 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 MZO2212 (58 Hrs)

UNIT I **11 hrs**

Insect classification and preservation

Methods of taxonomical identification of insects. Insect classification up to orders with examples, Insect Morphology: Comparative morphology of head thorax, abdomen and their appendages; Collection of insects-different techniques of insect collection, Preservation of and mounting techniques of insect samples, culturing of insects-maintenance of adults, rearing and breeding insects.

Unit II **11 hrs**

Anatomy & Physiology

Integument, Sensory systems, Nervous System, muscle and locomotion, Mouth parts & Digestive system-food uptake and utilization, Respiratory System- gas exchange, circulatory system, Excretory System, Mechanism of sound production- Stridulatory organs.

Unit III **12hrs**

Reproduction & insect communication

Reproduction, egg development, post embryonic development, endocrine system, Insect pheromones, chemical characteristics, pheromone olfaction mechanisms, biosynthesis of pheromones, pheromone application in pest management-traps and lures, Influence of bacterial semio-chemicals in insect survival and management. Bioluminescence- mechanism of light production.

Unit IV **12hrs**

Insect Ecology and Behaviour

Abiotic factors: Influence of temperature, light, wind and weather on insect development, circadian rythms, diapausing, migration, and emergence: Insect population dynamics. Biotic factors: Community ecology: Classes of interactions: Insects with microbes, plants and animal interaction.

UNIT V **12hrs**

Medical entomology and parasitic diseases: Insects as vectors, insects of medical importance - Morphology of mosquitoes (*Anopheles stephensi, Aedes aegypti, Culex quinquefasciatus*), house flies, human lice and rat fleas with role in disease transmission and control. Household pests-House fly, cockroaches, bed bugs, and ants –biology, economic importance and management.

TEXTBOOKS

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

REFERENCE BOOKS:

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

Course Designer

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

COURSE NO.	COURSE NAME	CATEGORY	L	T	P	CREDIT
MZO22S1	RESEARCH METHODOLOGY	SPECIAL PAPER	30	2	-	2

SPECIAL PAPER - RESEARCH METHODOLOGY- MZO22S1 (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 of publication
1	Anderson,Durston and Polle.	Thesis and Assignment writing.	Wiley Eastern Ltd., NewDelhi	1970
2	Kothari C. R.	Research Methodology: Methods and techniques	New Age International	2009

REFERENCE BOOKS:

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

Course Designer: Dr. R. Yamuna

COURSE NO.	COURSE NAME	CATEGORY	L	T	P	CREDIT
MZO2309	ELECTIVE I- 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	K_2
CLO2.	Identify the role of the forensic scientist and physical evidence within the criminal justice system and correlate with wildlife crimes.	K_3
CLO3.	Justify the role of DNA in paternity identification, DNA profiling, wildlife forensics, and forensic entomology.	K_4
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.	K_5
CLO5.	Interpret the forensic biological evidences obtained during death investigations and aids in the legal justices to the crime.	K_6

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 of Publication
1	Houck, M. M & Siegel, J. A	Fundamentals of Forensic Science	Acadamic Press, London,	2006.
2	James, S. H and Nordby, J. J	Forensic Science- An Introduction to Scientific and Investigative Techniques	CRC Press, USA	2003
3	Saferstein	An Introduction of Forensic Science	Prentice HallInc, USA,	2007.

REFERENCE BOOKS:

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

Course Designer: Dr. K. Krishnapriya

COURSE NO.	COURSE NAME	CATEGORY	L	T	P	CREDIT
MZO2310	ELECTIVE I- 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	K_2
CLO2.	Apply the knowledge of databases in data mining and develop basic understanding of sequence alignments, protein modelling, and phylogenetic analysis.	K_3
CLO3.	Analyse the challenges in molecular biology computing, secondary structure studies and phylogenetic analysis	K_4
CLO4.	Ability to apply appropriate bioinformatics software, tools in designing of microarray, molecular modelling and protein prediction	K_5
CLO5.	Apply the knowledge of bioinformatics tools in drug discovery, crop improvement and other microbial applications	K_6

Mapping with Programme 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 of Publish
1	Ghosh Z. and Bibekan and M.	Bioinformatics: Principles and Applications.	Oxford University Press.	2008
2.	Marketa Zvelebil, Jeremy O. Baum	Understanding Bioinformatics	Garland Science publishers	2007

REFERENCE BOOKS

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

Course Designers:
Dr. P. B. Harathi
Mrs. S. Gandhimathy

COURSE NO.	COURSE NAME	CATEGORY	L	T	P	CREDIT
MZC18A1	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
MZC18A1 (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 toludine 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 lumbriocoides. 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. Pakinson's disease, Steven Jones syndrome, Down syndrome.

TEXTBOOKS:

S.No	Author	Title	Publishers	Year of publication
1.	Asim. K. Das	Bioinorganic chemistry	Books & Allied Pvt Ltd.	2007(1st edn).
2.	Jayashree Ghosh	Textbook of Pharmaceutical Chemistry	S. Chand & Co	2003 (3rd edn)
3	Jayashree Ghosh	Fundamental concepts of Applied Chemistry	S. Chand & Co	2006 (1st edn)
4	Rana, S.V.S	BioTechniques. Theory and Practice.	Rastogi Publications, Meerut.	2005
5	AmbikaShanmugam	Fundamentals of Biochemistry for Medical Students	Nagaraj and Company Private Limited	2005
6	MallikarjunaRao, N	Medical Biochemistry	New Age International (P) Limited,Publishers	2006 (6th Edn).
7	Dr.K.N. Sachdev	Clinical Pathology and Bacteriology	Jaypee Brothers medical publishers	1990
8	Samuel K M	Notes on Clinical lab techniques	M.K.Gopalan, Chrompet, Chennai	1999
9	Ramnick Sood	Medical Laboratory Techniques	Jaypee Brothers Medical Publishers (P) Ltd	2009

REFERENCE BOOKS

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

Course Designer: Dr. K. Krishnapriya and Dr.R.Yamuna

COURSENO.	COURSE NAME	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.	K_2
CLO2.	Analyse the developmental process involved in various organisms.	K_3
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.	K_5

Mapping with Programme 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; L-Low

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 ofinvertebrates 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. (3 hrs)

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: (3 hrs)
    a. Chick: 36 Hours stage, 48 Hours stage, 72 Hours stage, 96 Hours stage.
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.
2. Water quality of water samples (Any 3 chemical parameters). (12 hrs)
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 of Publication
1	P.S Verma	A Manual of Practical Zoology: Invertebrates	S.Chand & Co	2010 Revised edition
2	M.M.Trigunayat, Krithika Trigunayat	A Manual Of Practical Zoology: Biodiversity, Cell Biology, Genetics & Developmental Biology Part 1	Scientific Publishers India	2009 Revised edition
3.	Eugene P. Odum & Cary W. Barrett	Fundamentals of Ecology	Brooks/ Cole Publishing Compamy	5th edition
4	Sue Carson Heather Miller Melissa Srougi D. Scott Witherow	Molecular Biology Techniques A Classroom Laboratory Manual	Academic Press	4th Edition, 2019
5	B Hoshang S. Gundevta , Hare Govind Singh	A Textbook of Animal Behaviour	S Chand & Co	Revised edition 2015

Course Designers:

1. **Dr. Charumathi Pushparaj**
2. **Dr. K. Krishnapriya**

COURSE NO.	COURSE NAME	CATEGORY	L	T	P	CREDIT
MZO23P2	CORE PRACTICAL- II	PRACTICALS	-	-	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	K_2
CLO2.	Apply the knowledge gained in biochemical analysis of clinical samples.	K_3
CLO3.	Evaluate the physiological functions of various organ systems	K_4
CLO4.	Design experiments to investigate the forensic samples.	K_5

Mapping with Programme 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; L-Low

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)

OR

BIOANALYTICAL TOOLS AND BIOINFORMATICS

1. Multiple sequence alignment of the gene of interest and its interpretation. (3 hrs)
2. Construction of phylogenetic tree using bioinformatics tools. (3 hrs)
3. Establish a docking mechanism of a protein with a ligand using bioinformatics tools. (4 hrs)

REFERENCE BOOKS:

S.No.	Authors	Title of the Book	Publishers	Year of Publication
1	Dr. Veena Singh Ghalaut, Dr.S.K Gupta, Dr.Anju Jain	Manual of Practical Biochemistryfor MBBS	Arya Publishing Company	3rd Edition,2018
2	CL. Ghai	A Textbook Of Practical Physiology	Jaypee publications	8th Edition
3	PS VERMA	A Manual of Practical Zoology: Chordates	S.Chand publications	10th Revised edition,2000
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 First edition

Course Designer:

1. **Dr. N. Aarthi**
2. **Dr. Charumathi Pushparaj**

COURSE NO.	COURSE NAME	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 of Publication & Edition
1.	Kuby Richard, Thomas, Barbara, Janis	Immunology	W. H. Freeman and company, New York, USA.	7th Ed., 2018

REFERENCE BOOKS

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

Course Designer

1. Dr.Charumathi Pushparaj

2. Dr. P. B. Harathi

COURSE NO.	COURSE NAME	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; Collection of different techniques of insect collection, Preservation, and mounting techniques of insect samples

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

Basic principles of abiotic factors and their generalized action on insects. Implications for abundance and distribution of organisms including insects Law of the Minimum, Law of Tolerance, and biocoenosis, Systems approach to ecology
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 interaction.

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 and habitats, 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 of publication
1	Wigglesworth, Vincent B	Insect physiology	Springer Netherlands	1985
2	Eilenberg J	An ecological and social approach to biological control	(Springer).	2005
3	Ananthakrishnan T N and Shivaramakrishnan K G	Ecological entomology: Insect life in odd environment	Scientific Pub: India	2017

REFERENCE BOOKS:

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

Course Designer

1. Dr. R. Yamuna

COURSE NO.	COURSE NAME	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, chalones, 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 of publication & Edition
1	Samuel S. C. Yen, Robert B. Jaffe, Robert L. Barbieri,	Reproductive Endocrinology: Physiology, Pathophysiology, and Clinical Management	Saunders publisher. USA.	2013 (7^{th} edn).

REFERENCE BOOKS

S.No	Author	Title	Publishers	Year of publication & 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 (3rd edn)
3	Ernst Knobil and Jimmy D. Neil,	The Physiology of Reproduction	Raven Press	2002.
4	Samuel S. C. Yen, Robert B. Jaffe, Robert L. Barbieri	Reproductive Endocrinology: Physiology, Pathophysiology, and Clinical Management	Saunders publisher. USA.	2009.
5	Freedman L. P.,	Molecular Biology of Steroid and Nuclear Hormone receptors	Birkhauser, Boston, USA.	1998.
6	Litwack, G.,	Biochemical actions of hormones	Academic press, New York, USA	1985

Course Designer

1. Dr. P. Susheela

COURSE NO.	COURSE NAME	CATEGORY	L	T	P	CREDIT
MZO2314	Elective II: 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

Elective II: 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 of publication & Edition
1	S.S. Khanna, HR Singh	A Textbook of Fish and Fisheries	Narendra Publishing House.	2014(3rd Edn).
2	Aruga, H.	Principles of Sericulture	. Oxford & IBH Publishing Co. New Delhi.	1998.
3	Atwal, A.S.	Essentials of beekeeping and pollination.	Kalyani Publ. New Delhi.	2000

REFERENCE BOOKS

S.No	Author	Title	Publishers	Year of publication
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
2	Donell Meadows	Connected Wisdom: Living Stories about Living Systems by Linda Booth-Sweeney Thinking in Systems	Linda Booth Sweeney	2009
3	Lagler, K.F. Bardach, J.E. Miller, R.R. and Pasina D.R.M.	Inothology.	John Wiley and Sons, New York	1987
4	Verman, L.R.	Beekeeping in integrated mountain development.	Oxford &IBH Publ.Co., New Delhi.	1990
5	Stine, K.E and Brown, T.M.	Principles of Toxicology.	Lewis Publishers London.	1996
6	Atwal, A. S. and Dhaliwal G.S.	Agriculture pests of South Asia and their management.	Kalyani Publishers New Delhi.	1997
7	Janine Benyus Harper Collins,	Biomimicry: Innovation Inspired by Nature		2009

Course Designer

Dr. Charumathi Pushparaj and Dr. R. Yamuna

COURSE NO.	COURSE NAME	CATEGORY	L	T	P	CREDIT
MZO2315	ELECTIVE II- 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

ELECTIVE II- 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 of publication & 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, (3rd Edn)
4	Daniel L. Hartl, Elizabeth W. Jones	Essential Genetics: A Genomics Perspective	Jones & Bartlett Publishers	2005 (4 Edn)
5	Jonathan Pevsner	Bioinformatics and Functional Genomics	Wiley-Liss publishers	2015 (4 edn)

REFERENCE BOOKS

S. No	Author	Title	Publishers	Year of publication
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 Designer

1. Dr. S. Gandhimathy

2. Dr. P.B. Harathi

COURSE NO.	COURSE NAME	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 of publication
1	Anderson,Durston and Polle.	Thesis and Assignment writing.	Wiley Eastern Ltd., NewDelhi	1970
2	Kothari C. R.	Research Methodology: Methods and techniques	New Age International	2009

REFERENCE BOOKS

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

Course Designer: Dr. R. Yamuna

COURSE NO.	COURSE NAME	Category	L	T	P	Credits
MNM22CS2	CYBER SECURITY (PG)	-	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 (PG) - 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- IoTBlockchain- 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 Forenics, 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 NO.	COURSE NAME	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	S	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 of publication & Edition
1	Karthik Kaliaperumal und Senbagam Duraisamy Senthilkumar Balakrishnan	Practical Immunology A Laboratory Manual	LAP LAMBERT Academic Publishing;	2017 (1 edn)
2	Ambika Shanmugam	Fundamentals of Biochemistry for Medical Students	Nagaraj and Company Private Limited	2005
3	Jayashree Ghosh	Textbook of Pharmaceutical Chemistry	S. Chand & Co	2003 (3 edn)
4	Mallikarjuna Rao, N	Medical Biochemistry 6 edn.	New Age International (P) Limited, Publishers	2006
5	Litwack, G.,	Biochemical actions of hormones	Academic press	1985
6	Wigglesworth, Vincent B	Insect physiology	Springer Netherlands	1985

7.	Sathe Tukaram Vithairan	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 NO.	COURSE NAME	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 byusing 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	S	S
CLO4	S	S	S	S	S

S- Strong; M-Medium; L-Low

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 of publication & Edition
1	Atwal, A.S	Essentials of Beekeeping and pollination	Kalyani Pub	2000
2	Aruga, H.	Principles of Sericulture	Oxford & IBH Publishing Co.	1998
3	S.S. Khanna, HR Singh	A Textbook of Fish and Fisheries	Narendra Publishing House	2014 (3rd Edn)
4	Ghosh Z. and Bibekanand M	Bioinformatics: Principles and Applications	Oxford University Press	2008
5	Dubey, R. C.	Text book of Biotechnology,	S. Chand Co.,	2014 (5thEdn).
6	Gupta, P.K.	Elements of Biotechnology	Rastogi Publications	2006

Course Designer:

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDIT
MZO2316	APPLIED MICROBIOLOGY	THEORY	73	2	–	5

Preamble

To enable the student to understand and apply the techniques used in the different phases of industrial microbiology, Food, health–care, environmental protection, agriculture and research.

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 microorganisms in various sectors (medical, food, environment)	K2
CLO2	Relate the techniques involved in transforming microbes to antibiotics and in production of beverages.	K3
CLO3	To comprehend the techniques and the underlying principles in downstream processing and appreciate how microbiology is applied in the manufacture of industrially significant products.	K4
CLO4	Evaluate explicitly the microbes in the environment, growth of microorganisms and impact of environment on their growth.	K5
CLO5	Develop critical thinking on interrelationships between microbes, soil and plants.	K5, 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

APPLIED MICROBIOLOGY MZO2316 (73 Hrs)

UNIT I **(14 Hrs)**

INDUSTRIAL MICROBIOLOGY

Industrially important organisms– Isolation, preservation and strain improvement. Development of inoculum – Scale up (Pilot study) – Upstream and downstream processing. Microbial production of alcoholic beverages, organic acids (Citric acid, Acetic acid, Lactic acid and Itaconic acid), Amino acids (L – Glutamic acid and L – Lysine), enzymes (Amylases, Proteases and Pectinases), Microbial transformations – steroids, sterols, antibiotics and pesticides. Use of microbial processes in Ayurvedic preparations

UNIT II **(14 Hrs)**

PHARMACEUTICAL MICROBIOLOGY

Production of vaccines, toxoid, antisera and their standardization. Antiseptics, disinfectants and their standardization.

Sub culturing and culture suspension. Microbial assay of antibiotics (Penicillin, Semi synthetic penicillins, Streptomycin, Tetracyclines and Griseofulvin) and vitamins (B12, B2 and C), Sterility testing. Bacterial Endotoxin Test (BET).

Historical context of smallpox inoculation in India and its relevance to modern vaccine development.

UNIT III **(15 Hrs)**

FOOD AND DAIRY MICROBIOLOGY

Microorganisms important in food microbiology. Factors influencing microbial growth in food. Extrinsic and Intrinsic factors. Sources of food contamination. Contamination, and spoilage of fruits, vegetables, meat, poultry, eggs, fish and other sea foods**.** Canning – Methods – Types – Spoilage of canned foods. Principles of food preservation**.** Food borne diseases, food intoxication and their control measures. Food sanitation. Food control agencies and their regulations. Dairy Microbiology: Micro flora of milk. Sources of milk contamination. Preservation and spoilage of milk and milk products.

UNIT IV **(15 Hrs)**

ENVIRONMENTAL MICROBIOLOGY

Microbiology of air– composition of air, number and types of organisms in air. Distribution and sources of air borne organisms. Enumeration of bacteria in air– Air sampling devices. Air sanitation. Air borne diseases and their control. Microbiology of water– Indicator organisms. Assessment of water quality. Water sanitation. Water borne diseases. ISI and BIS Regulations for packaged drinking water. Waste treatment– Types of wastes– Characterization of solid and liquid wastes. Effluent treatment– Primary, secondsary (aerobic and anaerobic) and tertiary Methods– Disinfection– SCP and Biogas production.

UNIT V **(15 Hrs)**

AGRICULTURAL MICROBIOLOGY

Interrelationships between soil, microbes and plants, Rhizosphere concept, R: S ratio, rhizoplane; spermosphere; phyllosphere, Mycorrhizae–types, Rumen flora, Insects microbial interactions. Indigenous techniques for improving soil health, like Panchagavya, Jeevamrutha, and Beejamrutha.

Phytopathology – Classification of plant diseases, signs, and related terminology. Bacterial disease – Citrus canker, Blight of paddy, Fungal Disease– Red rot of sugarcane, Black stem rust of wheat, Tikka leaf spot, Wilt of cotton, Viral Disease – TMV, Vein clearing disease. Principles and methods of plant disease management, integrated plant disease management.

TEXT BOOKS

S.No	Author	Title	Publishers	Year of publication
1	Michael J. Pelczar, Chan. E.C.S and Noel R. Krieg	Microbiology	McGraw Hill Education	2001, (5thEdn).
2	Ananthanarayanan and Panicker	A Textbook of Microbiology	Universities press.	2024, (13th Edn)

REFERENCE BOOKS:

S.No	Author	Title	Publishers	Year of publication
1	Agarwal AK & Pradeep Parihar	Industrial Microbiology.	Student Edn, Behind Nasrani Cinema, Chopasani Road, Jodhpur	2006
2	Patel A H	Industrial Microbiology.	Laxmi Publications, New Delhi	2005 (2^{nd} Edn)
3	James M Jay	Modern Food Microbiology, CBS.	Publishers & Distributors; New Delhi	2004, (4^{th} Edn)
4	Adams MR & MO Moss	Food Microbiology	New Age International (P) Limited. Publishers; New Delhi.	2005, (1st Edn)
5	Purohit SS, AK Saluja, HN Kakrani	Pharmaceutical Biotechnology	Agrobios (India)	2004, (Ist Edn)

Course Designer:

1. **Dr. R.Yamuna**

COURSE NO.	COURSE NAME	CATEGORY	L	T	P	CREDIT
MZO2317	BIOTECHNOLOGY, BIOPRODUCTS AND BIOPROCESSING	Theory	73	2	-	5

Preamble

Upon successful completion of this course the student should recognize the foundations of modern biotechnology and the application of recombinant DNA technology to human, animals, plants and microbial organisms.

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 principles of biotechnology, bioproducts development and bioprocessing	K_2
CLO2	Relate the tools and techniques used in genetic engineering, bioprocessing and also bioproducts development	K_3
CLO3	Interpret the strategies for developing vaccines, chemotherapeutic drugs, ART, biodiversity conservation and sustainable bioproducts using biotechnology and bioprocessing techniques	K_4
CLO4	Compare the scientific aspects and current themes of the biotechnology industry and apply appropriate methodologies	K_5
CLO5	Develop critical thinking for applications of biotechnology in various fields like genetic engineering, medicine, agriculture, conservation and bioprocessing	K_6

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

BIOTECHNOLOGY, BIOPRODUCTS AND BIOPROCESSING MZO2217 (73 Hrs)

UNIT I **(14 Hrs)**

Tools and Techniques of Genetic Engineering:

Basic Principles of Genetic Engineering; Restriction enzymes, Linkers/Adaptors; Cloning Vectors - Salient Features and Types - Plasmids, Phages, Cosmids, Shuttle and Expression Vectors; Techniques - Strategies of rDNA Technology, Insertion of a Foreign DNA into a Vector, Transfer of rDNA into a Bacterial Cell, Selection & Screening of Recombinants- Marker techniques-, RFLP, RAPD.

UNIT II **(14 Hrs)**

Basic Techniques of mammalian cell culture

Culture media and its composition, Disaggregation of animal tissue. Primary culture & secondary culture. Evolution of cell line & continuous cell line, characterization of cell lines. Monolayer, suspension culture, Organ Culture. Measurement of viability and cytotoxicity, Apoptosis: Measurement of cell death; Cell cloning

UNIT III **(15 Hrs)**

Medical Biotechnology

Gene Therapy – Germ Line Gene Therapy and Somatic cell Line Gene Therapy, Tissue Engineering: Skin, Liver, Pancreas. Recombinant vaccines, Cell adhesion based therapy: Integrins, Inflammation. Chemotherapeutic drugs – Protein Synthesis Inhibitors, Anti- Inflammatory, Antibacterial, Antifungal, Antiviral, Antihelminthic, Anticancer Drugs. Assisted reproductive technology- Artificial insemination, embryo transfer, invitro fertilization, embryo cloning.

UNIT IV **(15 Hrs)**

Eco-Friendly Bioproducts from Renewable Sources and Biodiversity:

Fundamentals of composting process: composting technologies, composting systems and compost quality, scientific aspects and prospects of biofuel production: methanogenic, acetogenic, and fermentative bacteria, anaerobic and aerobic digestion processes and conditions, bioethanol, biohydrogen and biodiesel; biofertilizers and biopesticides, In-situ and Ex-situ conservation, germplasm conservation

UNIT V **(15 Hrs)**

Bioprocess Principles

Role of bioprocess engineer in the biotechnology industry, concept of Bioprocess, outline of an integrated bioprocess and generalized process flow sheets. General requirements of fermentation processes, types of fermentations, Basic design and construction of fermentor. An overview of aerobic and anaerobic fermentation processes and its applications. Designing of media for fermentation processes, Types of media.

TEXT BOOKS

S. No	Author	Title of the Book	Publisher	Year of Publish
1	Singh D.P. and Dwivedi S.K.	Environmental Microbiology & Biotechnology	New Age International Publishers	2004
2	Dubey, R. C.	A text book of Biotechnology	S. Chand Co., New Delhi	2014, 5thEdn

REFERENCE BOOKS:

S.No	Author	Title of the Book	Publisher	Year of Publish
1.	Bhattacharya & Ritu Banerjee	Environmental Biotechnology	Oxford Press	2007
2.	Michael B.C., Shuler L. and FikretKargi	Bioprocess Engineering Basic concepts	Prentice Hall	1992.
3.	Ignacimuthu S.	Introduction to Genetic Engineering	Blackwell Science Publications	2005.
4.	Peters P.,	Biotechnology, A guide to genetic engineering,	WMC brown publisher, UK.	2009.
5.	Singh, B.D.,	Biotechnology	Kalyani Publications, Chennai	2003.
6.	Gupta, P.K.,	Elements of Biotechnology	Rastogi Publications, Meerut	2006.

Course Designer
Dr. Charumathi Pushparaj

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDIT
MZO18AC1	SOLID WASTE MANAGEMAENT	ALC	--		-	5

SOLID WASTE MANAGEMENT - ADVANCED LEARNERS COURSE MZO18AC1 UNIT I

Introduction to Solid Waste Management

Municipal solid waste: Definition - Sources and types of solid waste- composition and its determinants of Solid waste-factors influencing generation-quantity assessment of solid wastes-methods of sampling and characterization.

UNIT II

Collection and Transfer

Methods of Residential and commercial waste collection – Collection vehicles – Manpower– Collection routes – Analysis of collection systems; Transfer stations – Selection of location, operation & maintenance; options under Indian conditions – Field problems- solving.

UNIT III

Processing Techniques and Recovery of Energy

Processing techniques – purposes mechanical volume reduction – necessary equipments – chemical volume reduction – incinerators– mechanical size reduction selection of equipments – components separation – methods – drying and dewatering. Recovery of Resources, conversion products and energy recovery – recoverable materials – processing and recovery systems – incineration with heat recovery.

UNIT IV

Disposal of Solid Wastes

Refuse disposal – various methods – incinerations – principle features of an incinerator – site selection and plant layout of an incinerator - sanitary landfill- methods of operation – advantages and disadvantages of sanitary land fill - site selection – reactions occuring in completed landfills – gas and leachate movement and control – equipments necessary.

UNIT V

Hazardous Waste Management

Sources of hazardous wastes- Nuclear and e-wastes, Biomedical and chemical wastes.– Effects on community– Storage and collection of hazardous wastes – Problems in developing countries – Protection of public health and the environment.

Management of hazardous wastes

Quantities of hazardous waste generated – Components of a hazardous waste management plan – Hazardous waste minimization – Disposal practices in Indian Industries – Future challenges.

TEXT BOOK

S.No	Author	Title of the Book	Publisher	Year of Publish
1	M.S. Bhatt and AsherefIlliyan	, Solid Waste Management: An Indian Perspective	Synergy Books India	2012
2	Techobanoglous Thiesen Ellasen;	Solid Waste Engineering Principles and Management	McGraw - Hill	1997
3.	CPHEEO	Manual on Municipal 1 Solid waste Management	Ministry of Urban Development, Govt. Of. India, New Delhi	2000

REFERENCE BOOKS:

S.No	Author	Title of the Book	Publisher	Year of Publish
1.	George Techobanoglo us	Integrated Solid Waste Management"	McGraw - Hill	1993
2.	R.E.Landrefh and P.A.Rebers,"	Municipal Solid Wastes-Problems &Solutions" ,	Lewis,	1997.
3.	Claude Fourie, Christian Ferra, Paul Medori, TeanDevaux	Ecology Science and Practice;,	Oxford and IBH Publishing Co (Pvt) LTD,	Special Indian Edn.
4.	P.S.Verma, V.K.Agarwal	Principles of Ecology.	S.Chand& Company (Pvt) LTD.	1989
5.	A. D.Bhide and B.B.Sundaresa n	Solid Waste Management – Collection, Processing and disposal	Mudrashilpa Offset Printers, Nagpur	2001.
6.	H.N. Tiwari,	Environmental Law Allahabad Law. Agency		1997.
7.	A., Divan and Noble M.	Environmental, Environmental Law and Policy in India	Materials and Statutes) Tripathi Bombay.	1991
8.	JA. D. Bhide and B.B. Sundaresan,	"Solid Waste Management – Collection, Processing and disposal"	Mudrashilpa Offset Printers, Nagpur,	2001

Course Designer: Dr. N. Ezhili

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDIT
MZO18AC2	WILDLIFE BIOLOGY AND ORNITHOLOGY	ALC	-		-	5

WILDLIFE BIOLOGYAND ORNITHOLOGY- ADVANCED LEARNERS COURSE-MZO18AC2

UNIT I

Wildlife Biology: Values of Wildlife - conservation values and ethics - Wildlife Habitat; Causes of depletion of Wildlife resources - habitat loss, construction of dams, hunting, poisoning, poaching and other developmental activities - Man and Wildlife conflict (with special emphasis to Indian Hotspots). Biodiversity extinction and conservation approaches: ecologically sensitive area; regional and national approaches for biodiversity conservation.

UNIT II

Theory and analysis of Conservation of populations: stochastic perturbations; Population viability analysis; minimum viable populations and recovery strategies for threatened species, National and International efforts for conservation: CITES, IUCN, CBD; Ramsar Convention on wetlands, Conservation of natural resources: resources types and degradations; human impact on Terrestrial and Aquatic resources; Conservation of Forest and Grassland resources.

UNIT III

Control and management - Wildlife Protection Act (1972) with its latest amendments - Indian Forest act (Brief Account only). Red data book on animals - IUCN criteria and definition regarding extinct (EX), extinct in the wild (EW), critically endangered (CD), low risk (LR), data deficient (DD) and not evaluated animals (NE) - Endangered and Endemic faunal species (primate, aves, amphibians and reptiles) of north eastern region (Brief account with threat to their survival) - Wildlife trade and CITES - Concept of Bioethics.

UNIT IV

Bird Behaviour and Ecology: Study of anatomy of birds with special emphasis of adaptations to terrestrial, aquatic and arboreal habitat. : Breeding biology-Mating systems-monogamy, polygamy and polyandry, courtship, nest building, clutch, incubation, growth of nestlings, parental care, fledging period, brood parasitism. Foraging behaviour: Food, feeding, predator avoidance and defense, territoriality. Social systems: Solitary, communal, flocks - mixed species, single species.

UNIT V

Conservation of Birds: Endangered bird species - Threatened birds in India. Red Data Book. IUCN criteria. Artificial breeding and release of endangered birds. Recent conservation issues, decline of vultures. Role of NGO’s in conservation of birds. Legal protective measures. Bird sanctuaries. Indicator species: Grassland, desert, wetland, forest, Himalayan. Bird biodiversity hotspots in India.

TEXT BOOKS

S.No	Author	Title of the Book	Publisher	Year of Publish
1	Salim Ali.	The Book of Indian Birds	Oxford	2011, (2nd Edn)
2	Gautam Kumar Saha and Subhendu Mazumdar	Wildlife Biology: An Indian Perspective. Prentice hall of India.		2017

REFERENCE BOOKS

S.No	Author	Title of the Book	Publisher	Year of Publish
1	Krys Kazmierczak and van Perlo B. A	Field Guide to the Birds of the Indian Subcontinent, ISBN: 0300079214	Yale University Press	2000.
2	Asad Rahmani and Zafar Islam	Important Bird Areas in India Priority sites for conservation,	ISBN: 9780195673333.	2004.
3.	Ashish Kothari and Orient Longman	Birds in Our Lives,	ISBN9788173715860.	2007.
	Manakadan, R., Ranjit, J.C., Daniels, Nikhil Bhopale	Birds of Indian Subcontinent: A Field Guide,	Bombay Natural History Society and OUP	2011.

Course Designer: Dr. G. Sasikala

Course Code	Course Title	Category	L	T	P	Credit
MZO23PROJ	PROJECT	Project	-		300	5

PROJECT

Project and Viva Voce

Execution procedure for the allotment of students for the project

Project students are assigned through the system. Staff members are allotted to choose the project students by lot system. Projects were all based on the students' interest.

Execution of research

- ✓ The research work can be carried out in the department or any other organization approved by the staff co-ordinator and the Head of the Department
- ✓ One review meeting will be conducted in between to monitor the progress of the research.
- ✓ Viva voce examination will be conducted by external examiner and the staff co-ordinator guiding the project.

Area of work

Genetic Engineering, Biotechnology, Microbiology Enzyme technology, Bioremediation, Solid waste management, Organic farming, Apiculture, Environmental Monitoring and Management, Aquaculture, Toxicology, Entomology and areas relevant to Zoology.

Methodology

Each project should contain the following details Brief

introduction to the topic

Review of literature

Materials and Methods

Experimental Results and Discussion- evidences in the form of figures, tables, graphs and photographs can he enclosed.

Summary References

The above content should not exceed 100 pages.