College of Excellence, nirf 2021-6th Rank
Autonomous and Affiliated to Bharathiar University
Reaccredited with A++ grade by NAAC, An ISO 9001: 2015 Certified Institution
Peelamedu, Coimbatore-641004

DEPARTMENT OF ZOOLOGY

CHOICE BASED CREDIT SYSTEM &
OUTCOME BASED EDUCATION SYLLABUS

MASTER OF ZOOLOGY
2021 – 2023 BATCH

PROGRAMME OUTCOMES

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

PO1: Acquire sound knowledge in Zoology for critical thinking, learning and research

PO2: Develop professional skills and soft skills through technical training, communication and presentation

PO3: Identify, formulate, and solve biological problems and also contribute to the community through academic, governmental and non-governmental organizations

PO4: Integrate the courses such as taxonomy, cell biology, evolution, biochemistry, physiology, developmental biology, molecular biology, genomics, microbiology and immunology for a successful career

PO5: 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.

DEPARTMENT OF ZOOLOGY

CHOICE BASED CREDIT SYSTEM & OUTCOME BASED EDUCATION
SYLLABUS & SCHEME OF EXAMINATION
MASTER OF ZOOLOGY – 2021-2023 BATCH

SEM	Subject Code	Title of the Paper	Instruction hours/week	Contact hours	Tutorial	Duration of Examination	Examination Marks			Credits
							CA	ESE	TOTAL	
I	MZO2101	Paper I- Phylogeny, Systematics and Functional organization of Invertebrates	5	71	4	3	50	50	100	4
	MZO2102	Paper II – Evolution and Animal Behaviour	5	71	4	3	50	50	100	4
	MZO2103	Paper III - Developmental Biology	5	71	4	3	50	50	100	4
	MZO2104	Paper IV – Molecular Cell Biology	5	71	4	3	50	50	100	4
	MZO2105	Paper V- Ecosystem Services and Sustainable Environmental management	4	56	4	3	50	50	100	4
	MZO20P1	Practical-I	3	45	…	.....	…..	…..	……	….
	MZO21P2	Practical –II	3	45		.....	……	…..	…..	…..

II	MZO2106	Paper VI – Phylogeny, Systematics and Functional organization of Chordates	5	71	4	3	50	50	100	4
	MZO2107	Paper VII- Biochemistry	5	71	4	3	50	50	100	4
	MZO2108	Paper VIII- Animal Physiology	6	86	4	3	50	50	100	5
	MZO2109 MZO2110	Elective – I 1. Introduction to Forensic Science 2.Bioanalytical tools and Bioinformatics	4	56	4	3	50	50	100	4
	MZC18A1	Inter Disciplinary Course- Clinical Microbiology, Biochemistry and Parasitology	4	56	4	3	-	100	100	4
	MZO21P1	Practical-I	3	45	..	3	50	50	100	4
	MZO21P2	Practical –II	3	45	..	3	50	50	100	4
III	MZO1910	Paper IX- Immunology	5	71	4	3	40	60	100	4
	MZO2011	Paper X- Entomology	4	56	4	3	40	60	100	4
	MZO1912	Paper XI - Molecular Endocrinology and Reproductive Physiology	5	71	4	3	40	60	100	4
	MZO1913 MZO1914	Elective II 1.Agricultural and Industrial Zoology 2. Genomics, Metagenomics and Epigenetics	4	56	4	3	40	60	100	4
	MZO19S1	Special Course- Research Methodology	2	30	4	3	-	-	100	2
	MNM15CS	Cyber Security	2-	26	4	-	-	-	Grade	
		Comprehensive Exam	-			2	-	-	Grade	

	MZO20P3	Practical-III	4	45	..	4	40	60	100	4
	MZO20P4	Practical –IV	4	45	…	4	40	60	100	4
IV	MMONL1	Open Course - Self Study Online Courses	-	-	-	-	-	-	-	1*
	MZO2012	Paper XII – Applied Microbiology	5	71	4	3	40	60	100	5
	MZO1917	Paper XIII – Biotechnology, Bioproducts and Bioprocessing.	5	71	4	3	40	60	100	5
	MZO18AC1 MZO18AC2	Advanced Learners Course* 1.Solid Waste Management	-	Self-Study	..	3	-	-	100*	5*
	MZO18PROJ	Project	20			Viva - Voce	20	80	100	5
		Grand Total							**2200 +100**	**90 +5**

QUESTION PAPER PATTERN

QUESTION PAPER PATTERN

CORE & ELECTIVE PAPERS

Continuous Internal Assessment: 50 Marks

SECTION	MARKS	TOTAL
A – 5 X 2 Marks	10	50
B – 4 X 5 Marks	20	
C - 2/3 X 10 Marks	20	

End Semester Examination: 100 Marks

SECTION	WORD LIMIT	MARKS	TOTAL
A-11/13 X 2 Marks	One or two sentences	22	100
B - 5/7 X 6 Marks	300	30	
C- 4/6 X 12 Marks	600-800	48	

The last question will be compulsory and the question can be taken from any unit.

Knowledge Levels

Section A& B- K2 & K3 (52 marks)

Section C - K4, K5, K6 (48 marks)

ADVANCED LEARNERS COURSE (ALC)

Continuous Internal Assessment: 25 Marks

SECTION	MARKS	TOTAL
A – 4 / 6 X 4 Marks	16	25
B – 1 / 2 X 9 Marks	9	

End Semester Examination: 75 Marks

SECTION	MARKS	TOTAL
A - 5 / 8 X 5 Marks	25	75
B – 5 / 8 X 10 Marks	50	

CYBER SECURITY

Continuous Internal Assessment: 40 Marks

SECTION	MARKS	TOTAL
A – 5 / 8 X 2 Marks	10	40
B – 6 / 8 X 5 Marks	30	

INTERDISCIPLINARY COURSE AND SPECIAL COURSE

End Semester Examination: 100 Marks

SECTION	MARKS	TOTAL
A - 5 X 5 Marks (Internal Choice)	25	100
B – 5 X 15 Marks (Internal Choice)	75	

PROJECT

Group 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.

Internal Assessment: 20 Marks

Review	Mode of Evaluation	Marks	Total
I	Selection of the field of study, Topic & Literature collection	5	**20**
II	Research design & data collection	10	
III	Analysis & Conclusion, Preparation of rough draft	5	

Evaluation of the project: 100 Marks

Mode of Evaluation	Marks	Total
Project Report		
Relevance of the topic to academic / society	10	**80**
Objectives	10	
Experimental Design	30	
Expression of Results and Discussion	30	
Viva Voce		
Presentation	10	**20**
Discussion	10	

WEIGHTAGE ASSIGNED TO VARIOUS COMPONENTS OF CONTINUOUS INTERNAL ASSESSMENT

Theory

	CIA I	CIA II	Model Exam	Assignment/ Class Notes	Seminar	Quiz	Class Participation	Application Oriented/Innovation/ Creativity	Attendance	Max. Marks
Core / Elective	7	7	10	4	5	4	5	5	3	50
ALC		10	15	-	-	-	-	-	-	25
Information Security	40	40		10		10				100

Practical

	Model Exam	**Lab Performance**	**Regularity in Record Submission**	**Attendance**	**Maximum Marks**
Core	12	20	5	3	40

RUBRICS

Assignment/ Seminar

Maximum - 20 Marks (converted to 4 marks)

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

CLASS PARTICIPATION

Maximum - 20 Marks (converted to 5 marks)

Criteria	5 Marks	4 Marks	3 Marks	2 Marks	1 Mark	Points scored
Level of Engagement in Class	Student proactively contributes to class by offering ideas and asks questions more than once per class.	Student proactively contributes to class by offering ideas and asks questions once per class	Student contributes to class and asks questions occasionally	Student rarely contributes to class by offering ideas and asking no questions	Student never contributes to class by offering ideas	
Listening Skills	Student listens when others talk, both in groups and in class. Student incorporates or builds off of the ideas of others.	Student listens when others talk, both in groups and in class.	Student listens when others talk in groups and in class occasionally	Student does not listen when others talk, both in groups and in class.	Student does not listen when others talk, both in groups and in class. Student often interrupts when others speak.	
Behavior	Student almost never displays disruptive behavior during class	Student rarely displays disruptive behavior 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 POs WITH COs

COURSE	PROGRAMME OUTCOMES				
	PO1	PO2	PO3	PO4	PO5
COURSE – MZO2101					
CO1	H	H	H	**H**	H
CO2	H	H	H	**H**	H
CO3	H	H	H	H	**H**
CO4	H	H	H	M	M
CO5	H	H	H	M	M
COURSE – MZO2102					
CO1	H	H	M	M	H
CO2	H	H	M	M	M
CO3	H	H	H	H	M
CO4	H	H	H	H	M
CO5	H	H	H	M	M
COURSE – MZO2103					
CO1	H	H	M	M	H
CO2	H	H	M	M	M
CO3	H	H	H	H	M
CO4	H	H	H	H	M
CO5	H	H	H	M	M
COURSE – MZO2104					
CO1	H	H	M	M	H
CO2	H	H	M	M	M
CO3	H	H	H	H	M
CO4	H	H	H	H	M
CO5	H	H	H	M	M
COURSE – MZO2105					
CO1	M	H	H	H	H
CO2	H	H	H	H	H
CO3	M	H	H	H	H
CO4	H	H	H	H	H
CO5	H	H	H	H	H
CO5	H	H	H	M	M

COURSE – MZO2106					
CO1	M	M	H	H	H
CO2	H	H	H	H	H
CO3	H	H	H	H	H
CO4	H	H	H	H	H
CO5	H	H	H	H	H
COURSE – MZO2107					
CO1	H	H	H	H	H
CO2	H	H	H	H	H
CO3	H	H	H	H	H
CO4	H	H	H	M	M
CO5	H	H	H	M	M
COURSE – MZO2108					
CO1	H	H	H	H	H
CO2	H	H	H	H	H
CO3	H	H	H	H	H
CO4	H	H	H	M	M
CO5	H	H	H	M	M
COURSE – MZO2109					
CO1	H	H	H	H	H
CO2	H	H	H	H	H
CO3	H	H	H	H	H
CO4	H	H	H	M	M
CO5	H	H	H	M	M
COURSE – MZO2110					
CO1	H	H	H	H	H
CO2	H	H	H	H	H
CO3	H	H	H	H	H
CO4	H	H	H	H	H
CO5	H	H	H	M	M
COURSE – MZO21P1					
CO1	H	H	H	H	H
CO2	H	H	H	H	H
CO3	H	H	H	H	H
CO4	H	H	H	H	H
COURSE – MZO21P2					
CO1	H	H	H	H	H
CO2	H	H	H	H	H
CO3	H	H	H	H	H
CO4	H	H	H	H	H

COURSE	PROGRAMME OUTCOMES				
	PO1	PO2	PO3	PO4	PO5

COURSE – MZO1910					
CO1	H	H	H	H	H
CO2	H	H	H	H	H
CO3	H	H	H	H	H
CO4	H	H	H	H	H
CO5	H	H	H	M	M
COURSE – MZO2011					
CO1	H	H	H	H	H
CO2	H	H	H	H	H
CO3	H	H	H	M	M
CO4	H	H	H	M	M
CO5	H	H	H	M	M
COURSE - MZO1912					
CO1	M	M	H	H	H
CO2	H	H	H	H	H
CO3	H	H	H	H	H
CO4	H	H	H	M	M
CO5	H	H	H	H	H
COURSE - MZO1913					
CO1	M	M	H	H	H
CO2	H	H	H	H	H
CO3	H	H	H	H	H
CO4	H	H	H	H	H
CO5	H	H	H	H	H
COURSE - MZO1914					
CO1	M	M	H	H	H
CO2	H	H	H	H	H
CO3	H	H	H	H	H
CO4	H	H	H	H	M
CO5	H	H	H	M	M
COURSE - MZO19P3					
CO1	H	H	H	H	H
CO2	H	H	H	H	H
CO3	H	H	H	H	H
CO4	H	H	H	H	H
COURSE - MZO19P4					
CO1	H	H	H	H	H
CO2	H	H	H	H	H
CO3	H	H	H	H	H
CO4	H	H	H	H	H
COURSE - MZO2012					
CO1	M	M	H	H	H
CO2	H	H	H	H	H
CO3	H	H	H	H	H
CO4	H	H	H	H	H
CO5	H	H	H	H	H

COURSE - MZO1917					
CO1	M	M	H	H	H
CO2	H	H	H	H	H
CO3	H	H	H	H	H
CO4	H	H	H	H	H
CO5	H	H	H	M	H

H- High; M-Medium; L-Low

COURSE NO	COURSE NAME	CATEGORY	L	T	P	CREDIT
MZO2101	PHYLOGENY, SYSTEMATICS AND FUNCTIONAL ORGANIZATION OF INVERTEBRATES	THEORY	71	4	-	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 Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1.	Understand the meaning and use of biological nomenclature and hierarchical levels of classification of invertebrates	K_2, K_3
CO2.	Narrate the structure and function of invertebrates in relation to locomotion, digestion and respiration.	K_2, K_3
CO3.	Interpret the Origin of Invertebrates and Phylogenetic interrelationships between Invertebrate phyla	K_3, K_4
CO4.	Compare and contrast the structural organization of invertebrates and their larval forms and to analyse the importance of hormones in developmental events of insects and crustaceans	K_4, K_5
CO5.	Elaborate on the Affinities and Systematic Position of Minor Phyla	K_5, K_6

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5
CO1	H	H	H	H	H
CO2	H	H	H	H	H
CO3	H	H	H	H	H
CO4	H	H	H	M	M
CO5	H	H	H	M	M

H- High; M-Medium; L-Low

PHYLOGENY, SYSTEMATICS AND FUNCTIONAL ORGANIZATION OF INVERTEBRATES
MZO2101 (71 Hrs)

UNIT I **(13 Hrs)**

Principles of Taxonomy

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

UNIT II **(15 Hrs)**

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 **(14 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 **(14 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 Designers:

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

COURSE NO.	COURSE NAME	CATEGORY	L	T	P	CREDIT
MZO2102	EVOLUTION AND ANIMAL BEHAVIOUR	CORE	71	4	-	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 Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1.	Understand concepts and theories of Organic Evolution, the diversity of life on Earth, including diversity in genes.	K_2, K_3
CO2.	Interpret how natural selection underpins all biological processes and how evolution has generated biological diversity	K_2 , K_3
CO3.	Associate the fundamental of population ecology and Hardy Weinberg equilibrium that unify the biological sciences and form the foundation for efforts in the conservation and protection of the earth's biodiversity.	K_3, K_4
CO4.	Understand the behavioural patterns in animals and the influence of genes, environment and levels of selection on behavioural patterns.	K_4, K_5
CO5.	Interpret the behavioural patterns of animals with respect to food search, predators, communication and aggressiveness.	K_5, K_6

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	H	H	M	M	H
CO2	H	H	M	M	M
CO3	H	H	H	H	M
CO4	H	H	H	H	M
CO5	H	H	H	M	M

H- High; M-Medium; L-Low

EVOLUTION AND ANIMAL BEHAVIOUR
MZO2102 (71 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, 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 **(14 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 **(14 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 Designers:

1. **Dr. G. Sasikala**
2. **Dr. K. Krishnapriya**

COURSE NO.	COURSE NAME	CATEGORY	L	T	P	CREDIT
MZO2103	DEVELOPMENTAL BIOLOGY	CORE	71	4	-	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 Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1.	Learn key concepts, including mechanisms by which differential gene activity controls development and mechanisms that determine cell fate	K_2, K_3
CO2.	Provide in-depth knowledge in formation of gametes and the process of fertilization	K_3, K_4
CO3.	Explain the processes of growth and development organs	K_3, K_4
CO4.	Analyse the role of temperature, hormones and gene expression in the sex determination of various animal phyla.	K_4,K_5
CO5.	Interpret the mechanisms by which animals age and the process of senescence.	K_5, K_6

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	H	H	M	M	H
CO2	H	H	M	M	M
CO3	H	H	H	H	M
CO4	H	H	H	H	M
CO5	H	H	H	M	M

H- High; M-Medium; L-Low

DEVELOPMENTAL BIOLOGY
MZO2103 (71hrs)

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 **(14 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 **(14 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 Designer: Dr. Charumathi Pushparaj

COURSE NO.	COURSENAME	Category	L	T	P	Credit
MZO2104	MOLECULAR CELL BIOLOGY	Theory	71	4	-	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 Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the cell structure of prokaryotes and eukaryotes and mechanism of movement of substances across cell membranes	K_2, K_3
CO2	Describe the DNA structure, chromosomal organization, the DNA mutations and repair mechanisms	K_2, K_3
CO3	Analyse the most important methods by which cells communicate and how cells send signals and interpret the signals they receive.	K_4, K_5
CO4	Compare the process DNA replication and transcription in prokaryotes and Eukaryotes	K_5, K_6
CO5	Analyse and interpret gist of gene regulation and expression in prokaryotes and eukaryotes	K_5, K_6

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	H	H	M	M	H
CO2	H	H	M	M	M
CO3	H	H	H	H	M
CO4	H	H	H	H	M
CO5	H	H	H	M	M

H- High; M-Medium; L-Low

MOLECULAR CELL BIOLOGY
MZO2104 (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 **(15 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 signalling: Hormones and their receptors, cell surface receptor, signalling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signalling 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 **(14 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 **(14 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 **(14 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 cyclicAMP, 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 Designer: Dr. M. Sheeba

COURSE NO.	COURSE NAME	CATEGORY	L	T	P	CREDIT
MZO2105	ECOSYSTEM SERVICES AND SUSTAINABLE ENVIRONMENTAL MANAGEMENT	ELECTIVE	56	4	-	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 Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Describe the distinguishing characteristics of the different ecosystems and components with their energy levels	K_2, K_3
CO2	Explain the Services rendered by various ecosystems and their significance	K_2, K_3
CO3	Analyse the Ecosystem Services by Assessment and by creation of databases interpretation and Decision Making – Case Studies	K_4, K_5
CO4	Explain Interpretation and Decision Making by Case Studies, by learning through interpretation of Environmental Protection Acts, Policies and Programs	K_5, K_6
CO5	Apply the Recent Trends in Environmentally Sustainable Management by ways of Community Participation in resource management	K_5, K_6

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	M	H	H	H	H
CO2	H	H	H	H	H
CO3	M	H	H	H	H
CO4	H	H	H	H	H
CO5	H	H	H	H	H

H- High; M-Medium; L-Low

ECOSYSTEM SERVICES AND SUSTAINABLE ENVIRONMENTAL MANAGEMENT
MZO2105 (56 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 **(12 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. 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.

UNIT III **(11 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 – Ecological foot prints. Community Participation in Water Resource Management, Forest Resource Management, Energy Resource Management.

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. Challenges in SD: Poverty, Decentralization - Ethical Consumerism, Social Awareness- Role of GIS and Remote Sensing in Environmental Management.

UNIT V **(10 hrs)**

Introduction to Industry 4.0- Need – Reasons for Adopting Industry 4.0 - Definition – Goals and Design Principles - Technologies of Industry 4.0- Skills required for Industry 4.0- Advancements in Industry 4.0- – Impact of Industry 4.0 on Society, Business, Government and People - Introduction to 5.0.

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 Designers:
Dr.N. Ezhili
Dr. K. Krishnapriya

COURSE NO.	COURSENAME	Category	L	T	P	Credit
MZO2106	PHYLOGENY, SYSTEMATICS AND FUNCTIONAL ORGANIZATION OF CHORDATES	Theory	71	4	-	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 Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1.	Understand and identify the evolution of chordates from Protochordates. Origin of jaws in Pisces.	K_2, K_3
CO2.	Understand and analyse how the fishes originated and amphibians evolved from Pisces	K_2, K_3
CO3.	Interpret the phylogenetic relationships of each vertebrate phylum and to narrate on the conquest of land by reptiles and to Substantiate birds as a glorified reptiles	K_4, K_5
CO4.	Compare the anatomy of vertebrates in perception to phylogenetic evolution	K_5, K_6
CO5.	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_5, K_6

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	M	M	H	H	H
CO2	H	H	H	H	H
CO3	H	H	H	H	H
CO4	H	H	H	H	H
CO5	H	H	H	H	H

H- High; M-Medium; L-Low

PHYLOGENY, SYSTEMATICS AND FUNCTIONAL ORGANIZATION OF CHORDATES
MZO2106 (71 hrs)

UNIT I **(11 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 **(10 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 **(18 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 **(18 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 **(14 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
MZO2107	BIOCHEMISTRY	Theory	71	4	-	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 Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1.	Understand basic principles of biochemistry, structure of chemical bonds and their significance in biological system.	K_2, K_3
CO2.	Understand the structure and function of carbohydrates, their metabolism and regulatory mechanisms.	K_2, K_3
CO3.	Analyse how proteins, nucleic acids and vitamins influence the biological processes and their architecture.	K_4, K_5
CO4.	Discuss the role of lipids and fatty acids in various regulatory mechanisms and their metabolism and regulation.	K_5, K_6
CO5.	Integrate the knowledge of enzymes in various industries and interpret the mechanism of action of various drugs and their catalytic properties.	K_5, K_6

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	H	H	H	H	H
CO2	H	H	H	H	H
CO3	H	H	H	H	H
CO4	H	H	H	M	M
CO5	H	H	H	M	M

H- High; M-Medium; L-Low

BIOCHEMISTRY- MZO2107 (71 hrs)

UNIT I **(15 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: **(14 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 **(14 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 **(14 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: Mrs. P. Susheela

COURSE NO.	COURSE NAME	CATEGORY	L	T	P	CREDIT
MZO2108	ANIMAL PHYSIOLOGY	THEORY	86	4	-	5

Preamble

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

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1.	Understand how animals meet their energy demands, digest food, and respire	K_2, K_3
CO2.	Gain insight on how animals circulate body fluids, excrete and osmoregulate and achieve homeostasis. And also understand the functions of heart across the animal kingdom.	K_2, K_3
CO3.	Interpret the functions of nervous system and analyse how animals process information and respond to various stimuli.	K_3, K_4
CO4.	Analyse the contraction and relaxation process of muscles and its functions.	K_5, K_6
CO5.	Integrate the knowledge of thermoregulation in animals and their adaptation to extreme environmental conditions and also gain insight in to the physiology of stress and adaptation to stress.	K_5, K_6

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	H	H	H	H	H
CO2	H	H	H	H	H
CO3	H	H	H	H	H
CO4	H	H	H	M	M
CO5	H	H	H	M	M

H- High; M-Medium; L-Low

ANIMAL PHYSIOLOGY
MZO2108 (86 hrs)

UNIT I **(18 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 **(17 Hrs)**

Blood and circulation of body fluids: (a) Mechanism of transport of gases of blood: Physiology of 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 **(17 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 **(17 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 (e) Torpor, hibernation and aestivation- Adaptations to very cold environments

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

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 Designer:

1. **Mrs. P. Susheela**

COURSE NO.	COURSE NAME	CATEGORY	L	T	P	CREDIT
MZO2109	ELECTIVE I- INTRODUCTION TO FORENSIC SCIENCE	ELECTIVE	56	4	-	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 Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1.	Demonstrate knowledge and understanding of some of the basic facts, language, concepts and principles relating to the principles and significance of forensic science	K_2, K_3
CO2.	Identify the role of the forensic scientist and physical evidence within the criminal justice system.	K_2, K_3
CO3.	Justify the role of DNA in paternity identification and DNA profiling.	K_3, K_4
CO4.	Compare the various aspects of species testing in wildlife 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, K_6
CO5.	Interpret the entomological evidences obtained during death investigations.	K_5, K_6

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	H	H	H	H	H
CO2	H	H	H	H	H
CO3	H	H	H	H	H
CO4	H	H	H	M	M
CO5	H	H	H	M	M

H- High; M-Medium; L-Low

INTRODUCTION TO FORENSIC SCIENCE
MZO2109 (56 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 **(12 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 **(11 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 **(11 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 **(11 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
MZO2110	ELECTIVE I- BIOANALYTICAL TOOLS AND BIOINFORMATICS	ELECTIVE	56	4	-	4

Preamble

Develop a fundamental understanding of basic concepts and tools in bioinformatics

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the basic utilization of various nucleic acid and protein sequence databases	K_2,K_3
CO2.	To apply the knowledge of databases in data mining, retrieval, and sequence alignment techniques.	K_3,K_4
CO3.	Able to understand gene prediction methods, construct a phylogenetic tree, explore RNA secondary structure, and microarray technique.	K_3,K_4
CO4.	Able to understand protein structures prediction tools and explore molecular modeling techniques.	K_4,K_5
CO5.	Apply the knowledge of bioinformatics tools in drug discovery, crop improvement, and understand the challenges and future of bioinformatics	K_5,K_6

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	H	H	H	H	H
CO2	H	H	H	H	H
CO3	H	H	H	H	H
CO4	H	H	H	H	H
CO5	H	H	H	M	M

H - High; M-Medium

BIOANALYTICAL TOOLS AND BIOINFORMATICS
MZO2110 (56 Hrs)

UNIT I **(14 Hrs)**

Introduction to bioinformatics, Sequence and molecular file formats, Nucleic acid sequence database: Genbank, UCSC, ENSEMBL, EMBL, DDBJ, protein sequence databases: Swiss-prot, PDB, and HMMER, GCG, Gene structure, Protein structure and Gene expression data bases.

UNIT II **(14 Hrs)**

Data retrieval & sequence alignment: Data search, mining, management and interpretation, Information Retrieval from biological databases, SRS. Sequence Alignment- Pair wise alignment, Multiple alignments BLAST vs FASTA, Clustal W, Alignment scores, introduction to Bioalgorithms-alignment algorithms.

UNIT III **(15Hrs)**

Introduction to computational genomics, Gene sequences, Gene annotation, Gene prediction methods and their challenges, molecular phylogenetic methods, softwares for gene prediction and molecular phylogenetic analysis, ORF finder, primer designing, RNA secondary structures and analysis tools, Microarray technicque and its applications.

UNIT IV **(14Hrs)**

Introduction to computational proteomics, protein mass finger printing method, protein secondary structure and folding, protein structure prediction tools, introduction to protein modelling, LIGPLOT interactions.

UNIT V **(14 Hrs)**

Structural Bioinformatics in Drug Discovery, Quantitative structure-activity relationship (QSAR) techniques in Drug Design, Molecular docking methods, Microbial genome applications; Crop improvement. Overview of the challenges in molecular biology computing and future of bioinformatics.

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.

Course Designers:

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

COURSE NO.	COURSE NAME	CATEGORY	L	T	P	CREDIT
MZC18A1	CLINICAL MICROBIOLOGY, BIOCHEMISTRY AND PARASITOLOGY	INTER DISCIPLINARY COURSE	56	4	-	4

INTER DISCIPLINARY COURSE (For M.Sc., Zoology and Chemistry Students)
CLINICAL MICROBIOLOGY, BIOCHEMISTRY AND PARASITOLOGY
MZC18A1 (56 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)**

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 .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.

Unit III **(11 Hrs)**

Clinical Chemistry: Determination of Glucose in Serum by Folin & Wu's method, Determination of Serum Cholesterol – Sackett's method for total cholesterol. 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 **(11 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: PCR, ELIZA, Radio immunoassay, Widal test, Immunoassays, Blotting techniques, prenatal diagnosis, post natal diagnosis- 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	2006 (6th Edn).
7	Dr.K.N. Sachdev	Clinical Pathology and Bacteriology	Jaypee Brothers medical publishers	1990
	Samuel K M	Notes on Clinical lab techniques	M.K.Gopalan, Chrompet, Chennai	1999

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 Techniquesof 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	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. M. Sheeba

COURSE NO.	COURSE NAME	CATEGORY	L	T	P	CREDIT
MZO21P1	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

CO Number	CO Statement	Knowledge Level
CO1.	Understand and classify the invertebrate forms and their characteristics	K_2, K_3
CO2.	Understand the evolutionary process and behavioural patterns of animals.	K_2, K_3
CO3.	Analyse the developmental process involved in various organisms.	K4, K_5
CO4.	Apply the knowledge of molecular biology in visualizing and quantifying the biomolecules.	K_5, K_6
CO5	Compare different ecosystems using various parameters and service for the ecosystem.	K_5, K_6

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	H	H	H	H	H
CO2	H	H	H	H	H
CO3	H	H	H	H	H
CO4	H	H	H	H	H
CO5	H	H	H	H	H

H- High; M-Medium; L-Low

CORE PRACTICAL- I- MZO21P1 (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. Construction of taxonomic tree from the character in invertebrate animal groups.
4. 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. Estimation of DNA by Diphenylamine method.
6. 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
MZO21P2	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 of 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

CO Number	CO Statement	Knowledge Level
CO1.	Understand and classify the vertebrate forms and their characteristics	K_2, K_3
CO2.	Apply the knowledge gained in biochemical analysis of clinical samples.	K_4, K_5
CO3.	Evaluate the physiological functions of various organ systems	K_5, K_6
CO4.	Design experiments to investigate the forensic samples.	K_5, K_6

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	H	H	H	H	H
CO2	H	H	H	H	H
CO3	H	H	H	H	H
CO4	H	H	H	H	H

H- High; M-Medium; L-Low

CORE PRACTICAL- II- MZO21P2 (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.	COURSE NAME	CATEGORY	L	T	P	CREDIT
MZO1910	IMMUNOLOGY	THEORY	71	4	-	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 Outcome

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

CO Number	CO Statement	Knowledge Level
CO1.	The mechanisms and differences between primary and secondary responses and their relevance to immunizations	K_2,K_3
CO2.	Comprehensive and practical understanding of basic immunological principles	K_2,K_3
CO3.	Identify the role of antigen presenting cells, lymphocytes, and phagocytic cells in immune responses	K_3, K_4
CO4.	Role of immunology in protection against disease and autoimmune Disorders	K_4,K_5
CO5.	Advanced knowledge of the underlying principles of immunology and its application in biological systems.	K_5, K_6

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	H	H	H	H	H
CO2	H	H	H	H	H
CO3	H	H	H	H	H
CO4	H	H	H	H	H
CO5	H	H	H	M	M

H - High; M-Medium

IMMUNOLOGY
MZO1910 (71 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 **(15 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 **(14 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 **(14 Hrs)**

Clinical immunology: Immunity to infection: bacteria, viral, fungal and parasitic infections Hypersensitive reaction, Transplantation immunology. Vaccines: Principles and types of Vaccines - DNA Recombinant Vaccine, Serum therapy. Autoimmunity- Autoimmune diseases and therapeutics

UNIT V **(14 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, Immunochromatography, Immuno-PCR, Gene expression analysis of immune system cells.

TEXT BOOK

S.No	Author	Title	Publishers	Year of publication
1.	Kuby Richard, Thomas, Barbara, Janis	Immunology	W. H. Freeman and company, New York, USA.	6th Ed., 2017

REFERENCE BOOKS

S.No	Author	Title	Publishers	Year of publication
1.	Roitt, I.M.	Essential Immunology.	Blackwell Scientific, Oxform	1994.
2.	D.P. Stites, A.I. TerrandT.G. Parsloio	Medical Immunology.	Prentice Hall, New Jersey.	1997.
3	Janeway, C.A. and P. Travers.	Immunobiology.	Current Biology Ltd.London.	1997.
4	Paul, W.E.	Fundamentals of Immunology.	Raver Press. NewYork	1989.
5	Srivastava, R., Ram, B.P. and Tyle, P.	Molecular mechanism of immune regulation.	VCH Publishers, NewYork.	1991.

Course Designer:

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

COURSE NO.	COURSE NAME	CATEGORY	L	T	P	CREDIT
MZO2011	ENTOMOLOGY	THEORY	56	4	-	4

Preamble

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

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1.	Understand the classification of insects and state their roles in applied entomology and insect insect preservation techniques	K_2, K_3
CO2.	Understand the anatomy and physiology of insects	K_2, K_3
CO3.	Analyse the reproductive system and embryogenesis and explore the endocrine system functions and investigate the pheromones and semiochemicals in insect communication.	K_3, K_4
CO4.	Analyze the role of biotic and abiotic factors in insect in determining the insect ecology and behaviour.	K_4, K_5
CO5.	Address the entomological evidences for the medically important arthropods and their management.	K_5, K_6

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	H	H	H	H	H
CO2	H	H	H	H	H
CO3	H	H	H	M	M
CO4	H	H	H	M	M
CO5	H	H	H	M	M

H-Strong M-Medium

ENTOMOLOGY
MZO2011 (56 Hrs)

UNIT I **12 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

Anatomy & Physiology **12 hrs**

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

Reproduction & insect communication **11hrs**

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

Insect Ecology and Behaviour **10hrs**

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.

UNITV **11hrs**

Medical entomology and parasitic diseases: Insects as vectors, insects of medical importance - Morphology of mosquitoes, 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.

TEXT BOOKS

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. **Mrs. S. Gandhimathy**
2. **Dr. N. Aarthi**

COURSE NO.	COURSENAME	CATEGORY	L	T	P	CREDIT
MZO1912	MOLECULAR ENDOCRINOLOGY AND REPRODUCTIVE PHYSIOLOGY	THEORY	71	4	-	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 Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the structure and function of various endocrine glands and hormones.	K_2, K_3
CO2	Analyse the importance of different endocrine methodologies, synthesis and storage of different hormones	K_3, K_4
CO3	Narrate the mechanism, permissive and termination action of hormone. Estimate the Pathophysiology of endocrine glands and causes.	K_4, K_6
CO4	Compare and contrast the structure and functions of the male and female reproductive system. Significance of hormones in pregnancy, parturition, lactation and menopause.	K_5,K_6
CO5	Analyse the reasons for male and female infertility and narrate about the contraceptives	K_5, K_6

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	M	M	H	H	H
CO2	H	H	H	H	H
CO3	H	H	H	H	H
CO4	H	H	H	M	M
CO5	H	H	H	H	H

H- High; M-Medium

MOLECULAR ENDOCRINOLOGY AND REPRODUCTIVE PHYSIOLOGY
MZO1912 (71 Hrs)

UNIT I **(15 Hrs)**

Definition and scope of molecular endocrinology- Introduction: A brief history of discovery of hormones. 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. Neuroendocrine regulation: Neuroendocrine regulation of immune system.

UNIT II **(14 Hrs)**

Endocrine methodologies: Ablation and replacement, bioassays, immunoassays, Immunocytochemistry, autoradiography, electrophysiological and pharmacological methods, hormone-receptor interactions, cloning techniques: General classes of hormones: peptide, steroid, neuro-transmitters, neuropeptides, chalones, peptide-growth stimulating factors, eicosanoids and pheromones. Hormones of endocrine glands: synthesis and control of synthesis, storage, metabolism and functions.

UNIT III **(14 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. Techniques for quantitation of hormones. Pathophysiology of hypothalamic, pituitary, pineal, thyroid, parathyroid, GI tract, pancreatic islets, adrenal and gonadal hormones.

UNIT IV **(14 Hrs)**

Structure of male reproductive system, Testicular events and biosynthesis of testosterone, 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 **(14 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
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
1	Henry M. Kronenberg, Shlomo Melmed, Kenneth S. Polonsky, P. Reed Larsen. Williams.	Textbook of Endocrinology	Saunders Elsevier	2008 (11th 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. M. Sheeba**
2. **Dr. N. Aarthi**

COURSE NO.	COURSE NAME	CATEGORY	L	T	P	CREDIT
MZO1913	AGRICULTURAL AND INDUSTRIAL ZOOLOGY	ELECTIVE	56	4	-	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 Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Understand agriculturally important organisms and their economic importance.	K_2, K_3
CO2	Learn about the economically important insects in industries and apply the knowledge in development of small scale industries	K3, K4
CO3	Use biocontrol effectively in agricultural industry and learn the lifecycle of microbes that affect the crops	K4, K_5
CO4	Effective apply integrated pest management principles in controlling the pests of economic importance.	K_5, K_6
CO5	Know the innovative approach of learning from nature in terms of Biomimicry and to interpret the important applications of Biomimicry in industry	K_5, K_6

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	M	M	H	H	H
CO2	H	H	H	H	H
CO3	H	H	H	H	H
CO4	H	H	H	H	H
CO5	H	H	H	H	H

H - High; M-Medium

AGRICULTURAL AND INDUSTRIAL ZOOLOGY - ELECTIVE PAPER II
MZO1913 (56 Hrs)

UNIT I **(12 Hrs)**

Agricultural Zoology

Apiculture: The Honey bees: Apiculture practices: Hive products, Bee products, Bee pasturage, Apiculture and cross pollination: Beekeeping and pesticides: Enemies and diseases of honey bees. Bee keeping industry in India and its future.

Pisciculture: Monoculture and composite culture Fresh water & marine fisheries, induced breeding & its technique in pisciculture; Haps & ponds for fish culture and their management; Fish enemies and their control; fish diseases and their control; Importance of fish culture and fishing gears.

UNIT II **(11 Hrs)**

Industrial Zoology

Sericulture: Sericulture and its strains, rearing of silkworms. Sericulture and its components, Silk reeling. Pests and diseases of silk moth. Byproducts of sericulture, Non-mulberry sericulture-Tassar, Muga and Ericulture: Sericulture industry in India. Innovations in silk in India.

Lac culture: Lac insect- Taxonomy, distribution and life history, Host plants and lac insects, Strains of lac insect and their propagation. Commercial Production of Lac.

UNIT III **(11 Hrs)**

Crop Pests and their Management

Biology and control of following insect pests of agricultural importance: Termites, Rice weevils, Castor hairy caterpillar, codling moth, mango mealy bug, Cotton white fly, citrus psylla and cabbage Caterpillar. Biology and control of some important Phytoparastic nematodes; Anguina, Xiphinema sp & Heterodera sp.

UNIT IV **(11 Hrs)**

Principles of pest management

Pests -Definition, categories, causes for outbreak, economic damage.

Pest monitoring- pest surveillance, forecasting, survey and sampling techniques, crop loss estimation, Integrated pest management (IPM)-Definition, concepts, goals and strategies of IPM, key components of IPM, IPM program development and models. Organochlorine, Insecticides, Organophorous insecticides, Carbamates, Acaricides, Nematicides, Rodenticides, Molluscicides and Botanical pesticides. Pheromonal and Hormonal control. Chemosterilants and genetic control.

UNIT V **(11 Hrs)**

Biomimicry

Definition. Applications & Scope of Biomimicry in Industries. Importance of learning about Biomimicry. Processes and systems in nature- Collaboration with nature to devise and apply practical solutions to current challenges.

Insect mimicry: Entomophagous insects; Insect resistance- History of resistance, cross and

multiple resistance, resistance development, resistance mechanisms and management.

TEXT BOOKS

S.No	Author	Title	Publishers	Year of publication
1	S.S. Khanna, HR Singh	A Textbook of Fish and Fisheries	Narendra Publishing House.	2014(3rdEdn).
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:

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

COURSE NO.	COURSE NAME	CATEGORY	L	T	P	CREDIT
MZO1914	ELECTIVE II- GENOMICS, METAGENOMICS AND EPIGENETICS	ELECTIVE	56	4	-	4

Preamble

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

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1.	Understand recent techniques in genomics and sequencing	K_2,K_3
CO2.	Connect and contrast the techniques used in functional genomics such as microarrays, mRNA expression and miRNA expression	K_2,K_3
CO3.	Recognise the growth of genomics into metagenomics, application of next generation sequencing technologies and evaluate the challenges in this field.	K_3, K_4
CO4.	Criticize the application of metagenomics in the environment, health, agriculture and industry.	K_4,K_5
CO5.	Identify connections between the epigenetic factors and phenotypic variations, analyse their implications in regulation of gene expression	K_5,K_6

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	M	M	H	H	H
CO2	H	H	H	H	H
CO3	H	H	H	H	H
CO4	H	H	H	H	M
CO5	H	H	H	M	M

H - High; M-Medium

GENOMICS, METAGENOMICS AND EPIGENETICS- ELECTIVE
MZO1914 (56 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 EXPLOREGENEEXPRESSION

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 **(11 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)**

METAGENOMICSANDENVIRONMENT

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 **(11 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
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^{th}Edn)
5	Jonathan Pevsner,	Bioinformatics and Functional Genomics	Wiley-Liss publishers	2015, (4^{th}edn)

SUGGESTED 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.
4	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
5	Watson, J.D	Molecular Biology of Gene	Pearson Education, Delhi, India.	2004.

Course Designer: Dr. P. B. Harathi

COURSE NO.	COURSE NAME	CATEGORY	L	T	P	CREDIT
MZO19S1	RESEARCH METHODOLOGY	SPECIAL PAPER	30	4	-	2

SPECIAL PAPER - RESEARCH METHODOLOGY-
MZO19S1 (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 UVvisible, 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.

UNITIV **(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.

TEXT BOOKS

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. N. Ezhili
Dr. K. Krishnapriya

COURSE NO.	COURSE NAME	CATEGORY	L	T	P	CREDIT
MNM15CS	CYBER SECURITY	SPECIAL PAPER	26	4	-	-

Preamble

This course presents the principles of Cyber Security and its attack. It covers all aspects of cyberspace, botnet, cybercrime and its case studies.

UNIT I **(5Hrs)**

Cyberspace: Introduction- Web Threats for Organizations - Security and Privacy Implications from Cloud Computing - Social Media Marketing - Social Computing and the Associated Challenges for Organizations - Protecting People's Privacy in the Organization- Organizational Guidelines for Internet Usage- Safe Computing Guidelines and Computer Usage Policy.

Unit II **(5 Hrs)**

Security Threats: Malicious Software, Types of Attacks, Threats to E-commerce, e-cash, Credit/Debit Cards.

Unit III **(5 Hrs)**

Cyber Security: Introduction -An Essential Component of Cyber security - Forensics Best Practices for Organizations - Media and Asset Protection - Importance of Endpoint Security in Organizations

Unit IV **(5 Hrs)**

Cyber Attacks: Introduction - How Criminals Plan the Attacks - Social Engineering - Cyberstalking -Cybercafe and Cybercrimes - Botnets: The Fuel for Cybercrime - Attack Vector - Cloud Computing

Unit V **(6 Hrs)**

Case Study on Cyber Crime & Security: lntroduction on Cyber Crime - Trends in Mobility - Credit Card Frauds in Mobile and Wireless Computing Era. Illustrations, Examples and Mini-Cases - Introduction - Real-Life Examples - Mini-Cases Illustrations of Financial Frauds in Cyber Domain - Digital Signature-Related Crime Scenarios - Digital Forensics Case Illustrations - Online Scams.

Text Book

S.No	Author	Title of the Book	Publisher	Year of Publish
1	Faculty of Computer Science – PG	Essentials of Cyber Security	Kalai Kathir Achachagam	2016

Reference Book

S.No	Author	Title of the Book	Publisher	Year of Publish
1	Nina Godbole and Sunit Belpure	Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives	Publication Wiley	2011
2.	William Stallings	Network Security Essentials –Applications and Standards	Pearson Education	2011

COURSE NO.	COURSE NAME	CATEGORY	L	T	P	CREDIT
MZO20P3	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 Outcomes:

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

CO Number	CO Statement	Knowledge Level
CO1.	Understand and develop entrepreneur skill in immunotechniques.	K_4, K_5
CO2.	Analyse and interpret the pest, vectors and parasites in day today life.	K_4 K_5
CO3.	Analyse the major role of endocrine hormones in the physiology of the organisms.	K_5, K_6

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	H	H	H	H	H
CO2	H	H	H	H	H
CO3	H	H	H	H	H

H- High; M-Medium; L-Low

CORE PRACTICAL-III- MZO20P3 (60 Hrs)

IMMUNOLOGY AND IMMUNOTECHNIQUES

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

ENTOMOLOGY

1. Mounting:

a. Wings and their venation. Different types of antennae and legs of insects.

b. Sting apparatus of an insect.

2. Enumerate haemocytes in haemolymph of *Spodoptera litura* or cockroach.
3. Identification of pigments present in the Drosophila eye by chromatographic method.
4. Estimation of protein in haemolymph of silkworm
5. Pests of stored products: creation of household pest album- digitize
6. Vectors: *Anopheles, Culex,* and *Aedes* adult mosquitoes.

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)

MOLECULAR ENDOCRINOLOGY AND REPRODUCTIVE PHYSIOLOGY

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

REFERENCE BOOKS

S.No	Author	Title	Publishers	Yearof publication
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(3rdedn)
4.	Mallikarjuna Rao, N	Medical Biochemistry 6thedn.	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. K. Krishnapriya**
2. **Mrs. S. Gandhimathy**

COURSE NO.	COURSE NAME	CATEGORY	L	T	P	CREDIT
MZO20P4	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 bioproducts by applying the knowledge of biotechnology.

Course Outcomes:

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

CO Number	CO Statement	Knowledge Level
CO1.	Understand the relationship between living organisms and abiotic factors to enrich agricultural field	K_4, K_5
CO2.	Apply the knowledge of microbiology in visualizing and quantifying the microbes.	K_4, K_5
CO3.	Create bioproducts by using the process of bioprocessing in the field of biotechnology.	K_5, K_6

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	H	H	H	H	H
CO2	H	H	H	H	H
CO3	H	H	H	H	H

H- High; M-Medium; L-Low

CORE PRACTICAL-IV MZO20P4 (60 Hrs)

AGRICULTURAL AND INDUSTRIAL ZOOLOGY

1. Collection and identification of ticks, mites, bugs, aphids, beetle, moth and butterfly in two different monoculture lands and one polyculture land. Report to be submitted with photographs.
2. Counting of Termatoria in two Monoculture lands and in one polycuture land as a report.
3. Visit 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.)-report
4. Visit to an Apicuture farm, Pisciculture Farm, Sericulture Farm.
5. Preparation of Album of different types of silk and Cocoon
6. Dissection of Silk gland in Bombyx mori
7. spotters – identification and significance of instars of Bombyx mori, Edible and ornamental fishes

APPLIED MICROBIOLOGY

8. Quantification of Microbes: Sampling and Serial Dilution; Bacterial count in Soil.
9. Biochemical test for microorganisms
10. Staining and identification fungi and spores
11. Examination of bacterial hydrolysis of starch by iodine test
12. Antibiotic sensitivity test
13. Microbiological (Bacteria and Fungi) examination of spoiled foods-
    - Vegetables
    - Fruits
    - Dairy products

BIOTECHNOLOGY, BIOPRODUCTS AND BIOPROCESSING

1. Identification of mitochondria in the human cells using Janus green staining method
2. Estimation of citric acid in citrus fruits
3. Preparation of wine- Group experiment
4. Visit to distilleries.

REFERENCE BOOKS

S. No	Author	Title	Publishers	Year of publication
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(5th Edn).
6.	Gupta, P.K.	Elements of Biotechnology	Rastogi Publications	2006

Course Designer:

1. **Mrs. S. Gandhimathy**
2. **Dr. K. Krishnapriya**

COURSE NO.	COURSENAME	CATEGORY	L	T	P	CREDIT
MZO2012	APPLIED MICROBIOLOGY	THEORY	71	4	–	4

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 Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Understanding of the role of microorganisms in the medical, food industries, environment and industrial applications.	K_2, K_3
CO2	Application of microbes in industries, pharmaceutics, environment and agriculture.	K_3, K_4
CO3	Analyze role of beneficial microorganisms in food processing and dairy, compare them with food spoilage microorganisms.	K_4, K_5
CO4	Evaluate explicitly the microbes in the environment, growth of microorganisms and impact of environment on their growth.	K_5, K_6
CO5	Create microbial transformations in agriculture, pharmaceutics and Environment.	K_5, K_6

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	M	M	H	H	H
CO2	H	H	H	H	H
CO3	H	H	H	H	H
CO4	H	H	H	H	H
CO5	H	H	H	H	H

H- High; M–Medium

APPLIED MICROBIOLOGY
MZO2012 (71 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.

UNIT II **(14 Hrs)**

PHARMACEUTICAL MICROBIOLOGY

Production of vaccines, toxoid, antisera and their standardization. Antiseptics, disinfectants and their standardization. Types of water (DM/Purified water/) used in pharmaceutical industry. Environmental monitoring. 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). Microbial limit test.

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 **(14 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, secondary (aerobic and anaerobic) and tertiary Methods– Disinfection– SCP and Biogas production.

UNIT V **(14 Hrs)**

AGRICULTURAL MICROBIOLOGY

Interrelationships between soil, microbes and plants, Rhizosphere concept, R: S ratio, rhizoplane; spermosphere; phyllosphere, Mycorrhizae–types, Rumen flora, Insects microbial interactions. 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.	2017, (10th Edn).

REFERENCE BOOKS:

S.No	Author	Title	Publishers	Year of publication
1	Stanbury, P.F., Whittaker, A and Hall, S.J.	Principles of fermentation technology	Elsevier	1995 (3rd Edn)
2	Crueger and Crueger, A.	Biotechnology: A text book of Industrial Microbiology	Sinavos association, Ino Sundeland	1991 (2nd Edn).
3	Agarwal AK & Pradeep Parihar	Industrial Microbiology.	Student Edn, Behind Nasrani Cinema, Chopasani Road, Jodhpur	2006
4	Patel A H	Industrial Microbiology.	Laxmi Publications, New Delhi	2005 (2nd Edn)
5	James M Jay	Modern Food Microbiology, CBS.	Publishers & Distributors; New Delhi	2004, (4th Edn)
6	Adams MR & MO Moss	Food Microbiology	New Age International (P) Limited. Publishers; New Delhi.	2005, (1st Edn)
7	Purohit SS, AK Saluja, HN Kakrani	Pharmaceutical Biotechnology	Agrobios (India)	2004, (Ist Edn)

Course Designer:

1. **Dr. M. Sheeba**
2. **Dr. K. Krishnapriya**

COURSE NO.	COURSE NAME	CATEGORY	L	T	P	CREDIT
MZO1917	BIOTECHNOLOGY, BIOPRODUCTS AND BIOPROCESSING	Theory	71	4	-	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 Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Identify the methods of tools and techniques of Genetic Engineering, strategies of r DNA technology and marker techniques	K_1, K_2
CO2	Describe and discuss the mammalian cell culture, the kinetics and mechanism of cell growth	K_3, K_4
CO3	Apply the deep understanding of vaccine and other chemotherapeutic agents, develop germ line gene therapy, somatic cell line gene therapy and cell adhesion based therapy	K_3, K_4
CO4	Develop eco-friendly bioproducts especially biofuels from renewable resources	K_5, K_6
CO5	Analyse the bio process technology in biotechnology industry Compare and discuss the general principles of sterilization.	K_5, K_6

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	M	M	H	H	H
CO2	H	H	H	H	H
CO3	H	H	H	H	H
CO4	H	H	H	H	H
CO5	H	H	H	H	H

H- High; M-Medium

BIOTECHNOLOGY, BIOPRODUCTS AND BIOPROCESSING
MZO1917 (71 Hrs)

UNIT I **(15 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

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

UNIT I **(14 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 **(14 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 **(14 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, design and usage of various commercial media for industrial fermentations, thermal death kinetics of microorganisms, batch and continuous heat sterilization of liquid media, filter sterilization of liquid media, air, design of sterilization equipment.

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:

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

COURSE NO.	COURSE NAME	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 Techobanoglous	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.Sundaresan	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.		Environmental Policy. Forest Policy. Bare Acts –	Government Gazette Notification.	
9.	JA. D. Bhide and B.B. Sundaresan,	"Solid Waste Management – Collection, Processing and disposal"	Mudrashilpa Offset Printers, Nagpur,	2001

Course Designer: Dr. N. Ezhili

COURSENO.	COURSE NAME	CATEGORY	L	T	P	CREDIT
MAS18AC2	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