PSGR
Krishnammal College for Women

CELEBRATING WOMEN SINCE 1963

DEPARTMENT OF ZOOLOGY

CHOICE-BASED CREDIT SYSTEM (CBCS)

LEARNING OUTCOMES - BASED CURRICULUM FRAMEWORK (LOCF)

MASTER OF SCIENCE IN ZOOLOGY

2025– 2027 BATCH

(I SEMESTER)

PROGRAMME LEARNING OUTCOMES (PLOs)

PLO1: Demonstrate comprehensive knowledge of structural, functional, and evolutionary aspects of animals, integrating concepts from invertebrates, vertebrates and animal physiology.

PLO2: Develop scientific inquiry, critical thinking, and research methodologies, applying statistical and experimental approaches to biological sciences.

PLO3: Utilize advanced biological techniques, including molecular, microbiological, biochemical, and forensic methodologies, to conduct independent and collaborative research.

PLO4: Understand and apply principles of sustainable ecosystem management, conservation biology, and animal welfare, while adhering to ethical considerations in biological sciences.

PLO5: Effectively communicate scientific concepts through writing, presentations, and discussions, fostering continuous learning and interdisciplinary engagement.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO1: Classify and analyze animal diversity, phylogeny, and evolutionary patterns to understand biological relationships and ecological adaptations.

PSO2: Comprehend and apply principles of biochemistry, endocrinology, and molecular biology to explain metabolic processes and physiological functions in animals.

PSO3: Employ knowledge of forensic science, entomology, and biotechnology for practical applications in environmental monitoring, healthcare, and crime investigations.

PSO4: Conduct independent research projects using advanced methodologies in genetics, microbiology, and immunology, contributing to scientific advancements.

PSO5: Integrate principles of natural resource management, aquaculture, and animal husbandry for sustainable utilization and conservation of biological resources.

PSGR Krishnammal College for Women

MASTER OF SCIENCE IN ZOOLOGY
CHOICE-BASED CREDIT SYSTEM (CBCS)
LEARNING OUTCOMES- BASED CURRICULUM FRAMEWORK (LOCF)
SYLLABUS & SCHEME OF EXAMINATION
2025-2027 BATCH
Semester I

SEM	Course Code	Title of the Course	Course Type	Instruction Hours/week	Contact hours	Tutorial	Duration of examination	Examination marks			Credits
								CA	ESE	TOTAL	
I	MZO2501	Structural and functional organization of invertebrates and vertebrates	CC	5	73	2	3	25	75	100	4
	MZO2502	Animal Phylogeny and Evolution	CC	5	73	2	3	25	75	100	4
	MZO2503	Developmental Biology	CC	5	73	2	3	25	75	100	4
	MZO2504	Microbiology	CC	4	58	2	3	25	75	100	4
	MZO2505	Natural resource management and Sustainable ecosystem	CC	5	73	2	3	25	75	100	4
	MZO25P1	Zoology Lab Course I	CC	3	45	-	-	-	-	-	-
	MZO25P2	Zoology Lab Course II	CC	3	45	-	-	-	-	-	-
I-III	17MONLI	Online course*	ACC	-	-	-	-	-	-	-	

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

EXAMINATION SYSTEM

Pattern:

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

Continuous Internal Assessment CA – Theory

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

Core

CIA Test	5 Marks (conducted for 45 marks after 50 days – 3 units)
Model Exam	7 Marks (Conducted for 75 marks after 85 days (Each Unit 15 Marks)
Seminar/Assignment/Quiz	5 Marks
Class Participation	5 Marks
Attendance	3 Marks (Attendance 75% - 80% - 1 Mark, 81% - 90% - 2 Marks, 91% - 100% - 3 Marks
	Total :25 Marks

Practical

Lab Performance	7 marks
Regularity	5 marks
Model Exam	10 marks
Attendance	3 marks
	Total: 25 Marks

End semester Examination- Theory **5 x 15 = 75 Marks**

Core

Question from each unit comprising of

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

ESE Practical Pattern

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

MAPPING OF PLOs WITH CLOs

COURSE	PROGRAMME OUTCOMES				
	PLO1	PLO2	PLO3	PLO4	PLO5
COURSE – MZO2501					
CLO1	S	S	**S**	M	M
CLO2	S	S	**S**	**S**	M
CLO3	S	S	S	S	M
CLO4	S	S	S	S	M
CLO5	S	S	S	S	M
COURSE – MZO2502					
CLO1	S	S	M	M	M
CLO2	S	S	M	M	M
CLO3	S	S	S	S	M
CLO4	S	S	S	S	M
CLO5	S	S	S	M	M
COURSE –MZO2503					
CLO1	S	S	S	M	M
CLO2	S	S	S	S	S
CLO3	S	M	S	S	M
CLO4	M	M	S	S	M
CLO5	M	M	S	M	S
COURSE –MZO2504					
CLO1	S	S	M	S	M
CLO2	M	S	S	S	M
CLO3	M	S	S	S	S
CLO4	M	S	S	M	S
CLO5	M	S	S	M	S
COURSE – MZO2505					
CLO1	S	S	M	S	M
CLO2	M	S	S	S	M
CLO3	M	S	S	S	S
CLO4	M	S	S	M	S
CLO5	M	S	S	M	S
COURSE – MZO25P1					
CLO1	M	M	S	S	S
CLO2	S	S	S	S	S
CLO3	S	S	S	S	S
CLO4	S	S	S	S	S
CLO5	S	S	S	S	S
COURSE – MZO25P2					
CLO1	S	S	S	S	S
CLO2	S	S	S	S	S
CLO3	S	S	S	S	S
CLO4	S	S	S	M	M
CLO5	S	S	S	M	M

S- Strong; M-Medium

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDIT
MZO2501	STRUCTURAL AND FUNCTIONAL ORGANIZATION OF INVERTEBRATES AND VERTEBRATES	CORE	73	2	-	4

Preamble

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

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Develop a comprehensive understanding of the structural and functional organization of non-chordates and chordates by exploring their classification, anatomical features, and physiological adaptations.	K_2
CLO2	Analyze evolutionary trends and adaptive features in different animal groups by examining key morphological and physiological modifications that have enabled survival and diversification across various habitats	K_3
CLO3	Compare the anatomical features and functional morphology across the animal kingdom, emphasizing the interrelationships between form and function in evolutionary contexts	K_4
CLO4	Evaluate the comparative anatomy their physiological mechanisms in different phyla, including comparative aspects of digestion, circulation, respiration, excretion, neural coordination, and reproduction.	K_5
CLO5	Develop critical thinking and research skills by interpreting comparative anatomical and physiological data for evolutionary and functional analyses, fostering a scientific approach to problem-solving in zoology.	K_6

Mapping with Programme Learning Outcomes

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

S- Strong; M-Medium

STRUCTURAL AND FUNCTIONAL ORGANIZATION OF INVERTEBRATES AND VERTEBRATES

MZO2501 (73 hrs)

UNIT I

Organisation and Classification of Invertebrates 12 Hrs

General principles of classification- Taxonomic hierarchy, Nomenclature rules and taxonomic tools – Identification keys, molecular markers, DNA barcoding. Developmental patterns of invertebrates -Protostomes and Deutrostomes, Body cavity and coelom, symmetry, and Metamerism, Outline of the Classification of invertebrates up to order level.

UNIT II

Structural and Functional Adaptations in Invertebrates 17 Hrs

Locomotion in invertebrates – Protozoa, Annelids, and Echinodermata. Arthropoda -insect flight mechanism. Feeding and digestion in lower metazoans –cnidaria, arthropoda and mollusca. Respiration – gills, tracheae, book lungs, and respiratory pigments. Mechanisms of excretion in Platyhelminthes, Annelida, and Arthropoda. Open and closed circulation in invertebrates. Trends in neural evolution of invertebrates. Larval forms of crustaceans and echinoderms. Photoreception and photosensitivity in non-chordate forms. Interrelationship of Minor phyla -Spiralia (Rotifera, Gastrotricha, Entoprocta, Ectoprocta, Phoronida, Chaetognatha) and Ecdysozoa (Kinorhyncha, Loricifera, Priapulida, Tardigrada, Onychophora),

UNIT III

Classification and Comparative Anatomy of Vertebrates 15 Hrs

Classification of Vertebrates up to subdivisions. Structure and functional adaptations of Protochordates, Integumentary system – Structure, modifications, and derivatives in vertebrates. Evolution of respiratory structures, gills, lungs, and accessory respiratory organs. Circulatory system – Aortic arches, portal circulation, and adaptations for high-altitude survival. Nervous system – Brain organization and sensory structures.

UNIT IV

Reproductive strategies and specialized adaptations in vertebrates 14 Hrs

External and internal fertilization – Oviparity, viviparity, parental care, paedogenesis and neoteny. Regeneration and metamorphosis, Evolutionary Trends in Reproductive Adaptations, Thermoregulation – Ectothermy and endothermy in vertebrates. Digestive specializations – Ruminant and non-ruminant digestion, adaptations for carnivory, herbivory, and omnivory. Excretory system – Comparative nephric systems in vertebrates. Special senses: Lateral line electroreception in pisces, vomeronasal organ.

UNIT V

Comparative Vertebrate Osteology 15 Hrs

Skeletal system –Origin of Jaw and modification of Jaw bones and types. Jaw kinetics in feeding, Skull types and their functional significance. Embryonic development of neurocranium, splanchnocranium and dermatocranium. 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 Adaptive modifications in tetrapods – Limb structure and locomotion in reptiles, birds, and mammals.

TEXT BOOKS

S. No.	Authors	Title of the Book	Publishers	Year & Edition
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.
4.	Nigam, H. C.	Biology of chordates	Vishal Publications	2017, Revised 25th Edition
5.	Colbert, E.H.	Evolution of the Vertebrates: A History of the Backboned Animals Through Time	Willey Eastern Ltd	2011, 5th Edition.

REFERENCE BOOKS

S. No.	Authors	Title of the Book	Publishers	Year & Edition
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.
5.	Narendran, T. C.	An introduction to Taxonomy	Zoological Survey of India	2015, 7th Edn.
3	Beer, G.D.	Vertebrate Zoology	Sidgwich & Jackson	2011, 1st Edn.
4	Mcewen, R. S.	Vertebrate Embryology	Oxford And Ibh Publications	2007, 1st Edn.
5	Kent G.C and Carr R.K	Comparative Anatomy of the Vertebrates	C.V Mosby And Company	2000, 1st Edn.

Course Designers:

1. Dr. P. Susheela
2. Dr. S. Gandhimathy

COURSE CODE	COURSE TYPE	CATEGORY	L	T	P	CREDIT
MZO2502	ANIMAL PHYLOGENY AND EVOLUTION	THEORY	73	2	-	4

Preamble

This course provides an understanding of the major principles of evolutionary theory, species living in different environments and their descendants, and the structural and functional relationships of various organs.

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Understand key features for the classification of animals and interpret the phylogenetic tree of the metazoan in order to know the evolutionary history and relationships between the members of the animal kingdom.	K2
CLO2	Identify how the evolutionary forces and factors lead to speciation.	K3
CLO3	Analyse the origin of amphibians, reptiles and primates, and their evolutionary significance with measurable knowledge of the phylogeny, origin and evolution of animals and their significance.	K4
CLO4	Compare the evolution of biological diversity, how natural selection acts upon animals which forms the foundation for efforts in the conservation and protection of the earth's biodiversity.	K5
CLO5	Integrate the theories, concepts and process of evolution with social and ecological evolution.	K6

Mapping with Programme Learning Outcomes

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

S- Strong; M-Medium

ANIMAL PHYLOGENY AND EVOLUTION

MZO2502 (73 Hrs)

UNIT I **14 Hrs**

Phylogeny of Invertebrates

Metazoa-origin and theories. Bilateria-origin and theories. Protozoa-phylogenetic origin and evolution. Trilobites- structure and significance. Mollusca- origin and evolution. Jawless vertebrates-characteristic features of lampreys. Evolutionary position of Ostracoderms. Primitive jawed vertebrates- Origin of Placoderms. Overview of fish phylogeny- Chondrichthyes: Fossil history of Chondrichthyes, Tendencies in Elasmobranch evolution. Actinopterygii: Origin and evolution

UNIT II

Phylogeny of Vertebrates **14 Hrs**

Evolution of modern Amphibians, diversity, distribution, status and threats. Amphibian and reptilian features of Seymouria. Evolution of Reptilia - Saurischian and Ornithischian Dinosaurs- Rhynocephalia- Adaptive radiation of Reptiles. Mesozoic world of reptiles and extinction. Origin of birds: Fossil History of Birds, Palate in birds. Birds as glorified reptiles. Phylogeny of Mammalian orders. Adaptive radiation in lemuroids. Evolution of man-relation of man with other primates, fossil record of man's ancestry.

UNIT III **15 Hrs**

Mechanisms of Evolution

Lamarck; Darwin–concepts of variation, adaptation, fitness and natural selection; Mendelism; Geological time scale and species evolution; Cambrian explosion, Mass extinction, evolutionary tree. Gene pool, Gene frequency; Hardy-Weinberg Law; concepts and rate of change in gene frequency through natural selection, migration and random genetic drift; Adaptive radiation; Isolation mechanisms; Speciation; Allopatricity and Sympatricity; Convergent and divergent evolution; Co-evolution.

UNIT IV **15 Hrs**

Community Evolution

Evolution of Social interaction and Cooperation; Sexual selection, Group selection, Hamilton's Rule, Red queen hypothesis, Kin selection, Parent – offspring conflict. Evolutionary pattern of mammals; Human and Horse; Evolutionary pattern of Birds; Evolutionary pattern of invertebrate; Cladogenesis and anagenesis.

UNIT V **15 Hrs**

Ecological Evolution

Population and structure, Population growth: Density dependent and independent, Survivorship, life history strategies (r and K selection), Competitions among species: Intraspecific and Interspecific, Lotka-Volterra interspecific competition model, Mimicry and Animal coloration, Island communities and colonization. Applications of artificial intelligence in animal ecology and Robotic ecology.

TEXT BOOKS

S. No	Authors	Title of the Book	Publishers	Publication & Edition
1	Agarwal, V. K and Verma, P. S.	Cell Biology Genetics Evolution and Ecology	D.S. Chand and Company	2006, 3rd Edn.
2	Stebbine, G. L.	Process of Organic Evolution	Prentice Hall India, New Delhi	1979, 1st Edn.
3	Strickberger.	Strickberger's Evolution	Jones & Bartlett	2007, 4th Edn.
4	Jha, A. P.	Genes and Evolution	John Publication, New Delhi.	1992, 1st Edn.

REFERENCE BOOKS

S. No.	Authors	Title of the Book	Publishers	Publication & Edition
1	Kapoor, V.C.	Theory and Practice of Animal Taxonomy.	Oxford & IBH Publishing Co. New Delhi.	1995, 1st Edn.
2	Walker Louis J.	Evolutionary ecology of birds life histories, mating systems and extinction.	Random Publications	2013, 1st Edn.
3	Chiarelli, A.B.	Evolution of the primates	Academic Press	1973, 1st Edn.
	Colbert Edwin, H.	Colbert's Evolution of the vertebrates.	Wiley-India	2012, 5th Edn.
3	Moody, P. A.	Introduction to Evolution.	Harper International.	1978, 1st Edn.
4	Minkoff, E. C.	Evolutionary Biology	Addison – Wesley, London.	1984, 1 Edn.

Course Designers:

1. Dr. S. Gandhimathy
2. Dr. Anjana V.J

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDIT
MZO2503	DEVELOPMENTAL BIOLOGY	THEORY	73	2	-	4

Preamble

This course offers an advanced study of the growth and development of multicellular organisms, covering a range of topics from fundamental processes like cell division to more complex concepts such as reproduction. Students will explore the mechanisms that govern developmental stages, focusing on both basic and advanced aspects of organismal development.

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1.	Recognize key mechanisms that determine cell fate and cell signaling involved in development.	K_2
CLO2.	Interpret the concepts involved in the determination, differentiation, and development of different tissues and organs.	K_3
CLO3.	Compare and contrast the involvement of various signals, environmental cues and cells from birth to death of an organism.	K_4
CLO4.	Critically evaluate the role of genetic, environmental, and hormonal factors in normal development and developmental disorders.	K_5
CLO5.	Integrate knowledge of developmental biology to design and propose experimental approaches to study complex biological phenomena such as senescence, apoptosis, and regeneration, focusing on both cellular and environmental influences.	K_6

Mapping with Programme Learning Outcomes

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

S- Strong; M-Medium; L-Low

DEVELOPMENTAL BIOLOGY

MZO2503 (73 hrs)

UNIT I **14 Hrs**

Introduction to Developmental Biology

Scope of Developmental Biology and Future impact -Principles of Developmental Biology - Potency, commitment, specification, induction, competence-Determination and differentiation; morphogenetic gradients. Genomic equivalence and the cytoplasmic determinants. Cell fate and cell lineages. Cell signalling pathways in development- Wnt, Hedgehog, Notch, BMP, FGF pathways.

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 a frog.

UNIT III **15 Hrs**

Embryogenesis Metamorphosis and organogenesis in model animal system:

Axes, compartment formation and pattern formation in Drosophila. Sea urchin axis specification and coiling genetics of snail embryos. Organogenesis – vulva formation in *Caenorhabditis elegans.* - Mesoderm specification, metamorphosis in Xenopus, Neurulation in Zebra fish, Limb development and regeneration in vertebrates.

UNIT IV **15 Hrs**

Sex determination and Environmental regulation of Development

Sex determination- Timing and gene expression in mammalian sex determination- Brain sex determination pathways in vertebrates and flies, Temperature-dependent sex determination in turtles. Hormone disruptors and teratology. Environmental regulation of normal development - Predator- induced polyphenism and toxicity testing.

UNIT V

Ageing, Senescence and Apoptosis **15 Hrs**

Ageing and Senescence - Mitochondrial control of ageing-Insulin pathway control of ageing and possible relation to oxygen radicals - “Ageless” animals and environmental control of ageing- Senescence and cell death, Apoptosis in mammals and C. elegans.

TEXT BOOKS

S. No.	Authors	Title of the Book	Publishers	Publication & Edition
1	Gilbert, S. F.	Developmental Biology	Publisher-Sinauer Associates Inc, Massachusetts, USA.	2019, 12th 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	Publication & Edition
1	Kalthoff	Analysis of biological development	McGraw - Hill.	2000. 1st Edn.
2	Wolpert, Beddington, Brockes, Jessell, Lawrence, Meyerowitz	Principles of Development	Oxford University Press, New Delhi, India.	2006, 3rd Edn.

Course Designer

1. Dr. Charumathi Pushparaj

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDIT
MZO2504	MICROBIOLOGY	CORE	73	2	-	4

Preamble

This course provides a comprehensive understanding of microbial diversity, cultivation, pathogenesis, and applications in environmental, food, agricultural, and industrial microbiology, with insights into biotechnology and genetic modifications.

Course Learning Outcomes

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

CLO	Learning Outcome	Knowledge Level
CLO1	Understand microbial diversity, classification, and structural differences among bacteria, archaea, viruses, and sub-viral particles.	K2
CLO2	Apply various microbial cultivation and staining techniques, analyze microbial growth dynamics, and interpret microscopy results.	K3
CLO3	Assess microbial pathogenicity, disease mechanisms, and control strategies, including antibiotic resistance and chemotherapy.	K4
CLO4	Evaluate the role of microorganisms in environmental, food, and agricultural systems and their regulatory standards.	K5
CLO5	Develop industrial microbiological applications, understand genetic modifications, and critically analyze ethical and patenting concerns.	K6

Mapping with Programme Learning Outcomes

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

S- Strong; M-Medium

MICROBIOLOGY

MZO2504 (58 hours)

UNIT I **12 hours**

Introduction to Microbiology and Microbial Diversity

Scope and history of microbiology. Overview of bacteria, archaea, viruses, and subviral particles. Bacteria: Acetic acid bacteria, Cyanobacteria, Propionic acid bacteria, Pseudomonads, and Mycoplasma. Archaea: Halophiles, Methanogens, Hyperthermophilic archaea, Thermoplasm, and Extremophiles. Viruses and bacteriophages.

UNIT II **12 hours**

Microbial Cultivation and Growth Dynamics

Preparation and types of solid and liquid culture media. Nutritional classification of microorganisms. Factors affecting microbial growth: temperature, atmosphere, pH, hydrostatic pressure, and radiation. Phases of the growth curve and growth measurement techniques. Bacterial culture methods – pure culture techniques (tube dilution, pour plate, spread plate, and streak plate methods). Anaerobic culture techniques – Wright's tube, roll tube, McIntosh-Fildes anaerobic jar, Gaspak, and anaerobic chamber (glove box).

Microscopy – types and applications of Light, Phase contrast, Fluorescent, Confocal, and Electron Microscopy. Microscopic identification – Simple, Negative, and Differential staining (Gram staining, Acid-fast staining).

Microbial communication system, Bacterial Quorum sensing and biofilm formation.

UNIT III **12 hours**

Microbial Pathogenesis and Disease Management

Microbial diseases – causative agents, symptoms, and control measures of bacterial (Strep & Staph infections, Typhoid, Cholera, Bacillary dysentery, Tuberculosis), viral (AIDS, Hepatitis, Influenza, SARS, MERS, Covid-19), fungal (Candidiasis, Mucormycosis), and protozoan (Malaria) infections. Control of microorganisms – sterilization, disinfection, antisepsis, and antimicrobial agents. Antibiotics – classification, mode of action, and bacterial resistance mechanisms. Chemotherapy and its applications. Multi-drug resistance – causes, impact, and strategies to combat resistance.

UNIT IV **11 hours**

Environmental, Food, and Agricultural Microbiology

Soil microbiology – nitrogen fixation, CO_2 fixation, and organic matter degradation. Aquatic microbiology – waterborne microbes, pollution, and wastewater treatment. Aeromicrobiology – airborne pathogens, aeroallergens, and their effects on human health. Food microbiology – microbial contamination, spoilage, foodborne diseases, preservation methods, and probiotics (Lactobacillus, Bifidobacterium). Microbiological quality standards and regulatory policies (FDA, HACCP, ISI). Agricultural microbiology – biofertilizers (Rhizobium, Azotobacter, BGA, VAM) and biopesticides (Bacillus thuringiensis).

UNIT V **11 hours**

Industrial Applications and Biotechnological Advancements

Industrial microbiology – fermentation technology, ethanol production, lactic acid, antibiotics, and microbial enzymes. Bioremediation – degradation of xenobiotics, petroleum hydrocarbons, and pesticides. Genetically modified organisms (GMOs) – applications, environmental impact, and ethical concerns. Intellectual property rights (IPR) – patents, trademarks, and implications of patenting genes and DNA sequences.

TEXTBOOKS

S. No.	Authors	Title of the Book	Publishers	Publication & Edition
1	Prescott, Harley & Klein	Microbiology	McGraw Hill	2021, 11th Edn.
2	Pelczar, Chan & Krieg	Microbiology: Concepts and Applications	McGraw Hill	2019, 16th Edn.
3	Tortora, Funke & Case	Microbiology: An Introduction	Pearson	2021, 13th Edn.
4	Madigan, Bender, Buckley & Sattley	Brock Biology of Microorganisms	Pearson	2022, 16th Edn.

REFERENCE BOOKS

S. No.	Authors	Title of the Book	Publishers	Publication & Edition
1	Willey, Sherwood & Woolverton	Prescott's Microbiology	McGraw Hill	2020, 11th Edn.
2	Atlas, R.M.	Principles of Microbiology	McGraw Hill	2018, 2nd Edn.
3	Stanier, Ingraham, Wheelis & Painter	General Microbiology	Macmillan	2019, 5th Edn.
4	Dubey, R.C. & Maheshwari, D.K.	A Textbook of Microbiology	S. Chand & Co.	2020, 4th Edn.

Course Designer

1. Dr. R. Yamuna

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDIT
MZO2505	NATURAL RESOURCE MANAGEMENT AND SUSTAINABLE ECOSYSTEMS	THEORY	73	2	-	4

Preamble

This course aims to equip students with a comprehensive understanding of ecological principles, biodiversity conservation, and sustainable resource management.

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Explain the fundamental concepts of ecosystem dynamics, biodiversity conservation, and the role of protected areas in ecological sustainability.	K2
CLO2	Apply sustainable resource management practices to forests, freshwater and marine ecosystems, and wildlife conservation, integrating traditional ecological knowledge.	K3
CLO3	Analyze national and international conservation policies, environmental governance frameworks, and the role of NGOs and communities in sustainable development.	K4
CLO4	Evaluate the impacts of climate change, disaster management strategies, and the effectiveness of sustainability initiatives in achieving environmental goals.	K5
CLO5	Design and propose innovative solutions using advanced techniques such as GIS, AI, and nature-based approaches to mitigate human-wildlife conflicts and promote sustainable ecotourism.	K6

Mapping with Programme Learning Outcomes

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

S- Strong; M-Medium

NATURAL RESOURCE MANAGEMENT AND SUSTAINABLE ECOSYSTEMS

MZO2505 (73 hrs)

Unit I **14 Hours**

Ecosystem Dynamics and Biodiversity Conservation

Ecosystems function - trophic levels, energy flow, and nutrient cycling. Biodiversity hotspots conservation. Ecological succession, Keystone and umbrella species - conservation efforts. Protected area- national parks, wildlife sanctuaries, and biosphere reserves. Case studies- successful conservation and ecosystem restoration strategies.

Unit II **14 Hours**

Natural Resource Management and Sustainable Use

Forest ecosystems, sustainable management - afforestation, agroforestry, and conservation initiatives. Freshwater and marine ecosystems, threats - overexploitation, wetland protection, sustainable fisheries, and marine protected areas. Soil and land resources, erosion control, desertification, and degradation. Wildlife resources, strategies to counter overexploitation and illegal trade. Traditional ecological knowledge in sustainable resource conservation.

Unit III **15 Hours**

Conservation and Environmental Governance

IUCN- Red List. International conservation treaties - the Convention on Biological Diversity (CBD), CITES, and the Ramsar Convention. Indian conservation laws -Wildlife Protection Act (1972), Forest Conservation Act (1980), Environment Protection Act (1986), and Biodiversity Act (2002). National Action Plan on Climate Change (NAPCC) (2008). Environmental Impact Assessment (EIA) ecological impacts. NGOs, community participation, and corporate social responsibility (CSR) towards environmental governance.

Unit IV **15 Hours**

Climate Change, Disaster Management, and Sustainability

Climate change effects - ecosystems and wildlife through altered habitats, extreme weather events, and shifting species distributions. Global warming - Greenhouse gases, necessitating carbon sequestration and adaptation strategies. Natural disasters- floods, wildfires, droughts, and cyclones in significant ecological consequences. Sustainable development goals (SDGs) to promote environmental sustainability at global and local levels.

Unit V **15 Hours**

Advanced Techniques, Resource Management and conflict

Remote sensing and GIS for ecosystem monitoring and conservation planning. Artificial intelligence and machine learning in biodiversity research. Sustainable ecotourism, Carbon footprint analysis and nature-based solutions for sustainability and climate resilience. Man-animal conflict in India; Human-wildlife Coexistence.

TEXT BOOKS

S. No.	Authors	Title of the Book	Publishers	Publication & Edition
1	Odum, E.P., & Barrett, G.W.	Fundamentals of Ecology	Brooks/Cole, Cengage Learning.	2005, 5th Edn.
2	Primack, R.B.	Essentials of Conservation Biology	Oxford University Press.	2022, 7th Edn.
3.	Chapin, F.S., Matson, P.A., & Vitousek, P.M.	Principles of Terrestrial Ecosystem Ecology	Springer	2011, 2nd Edn.

REFERENCE BOOKS

S. No.	Authors	Title of the Book	Publishers	Publication & Edition
1.	Hunter, M.L., & Gibbs, J.P.	Fundamentals of Conservation Biology	Wiley-Blackwell.	2020, 4th Edn.
2.	Sharma, P.D.	Ecology and Environment	Rastogi Publications	2021, 14th Edn.
3.	Molles, M.C., & Sher, A.	Ecology: Concepts and Applications	McGraw-Hill Education.	2018, 8th Edn.

Course Designer

1. Dr. R. Yamuna

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDIT
MZO25P1	ZOOLOGY LAB COURSE -I	PRACTICALS	-	-	90	4

Preamble

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

To apply the knowledge in isolating biomolecules.

Course Outcomes:

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Understand and classify the invertebrate forms, their characteristics and the evolutionary process and behavioural patterns of animals.	K_2
CLO2	Analyse the developmental process involved in various organisms.	K_3
CLO3	Apply the knowledge of molecular biology in visualizing andquantifying the biomolecules.	K_4
CLO4	Compare different ecosystems using various parameters and service for the ecosystem.	K_5
CLO5	Demonstrate the ability to analyze and interpret biological, microbiological, and ecological data through practical experiments and fieldwork.	K_6

Mapping with Programme Learning Outcomes

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

S - Strong; M-Medium

ZOOLOGY LAB COURSE – I

MZO25P1 (90 hrs)

STRUCTURE AND FUNCTIONAL ORGANIZATION OF INVERTEBRATES

1.	Museum specimen study of different groups of invertebrates and vertebrates	**8 hrs**
2.	Composition assessment of taxonomical diversity or biodiversity of invertebrates in habitat from different ecosystems- Field Study	**5 hrs**
3.	Qualitative analysis of freshwater and marine plankton	**4 hrs**

ANIMAL PHYLOGENY AND EVOLUTION (Slides/Specimens)

4.	Observation of leaf insects and stick insects to study adaptation by cryptic colouration and natural selection.	**8 hrs**

DEVELOPMENTAL BIOLOGY

5.	Identification of the developmental stage of Chick embryo	**7 hrs**
6.	Spotters: a. Chick: 36 Hours stage, 48 Hours stage, 72 Hours stage, 96 Hours stage	**3 hrs**
7.	Sperm smear and staining	**2 hrs**

MICROBIOLOGY

8.	Preparation and use of glassware cleaning solutions (Acid Cleaning Solution)	**4 hrs**
9.	Microbial analysis of food products - bacterial and fungi	**6 hrs**
10.	Preparation of bacterial smear and Gram Staining	**8 hrs**
11.	Biochemical tests for microorganisms	**6 hrs**
12.	Study of bacterial growth curve by turbidimetry	**4 hrs**
13.	Determination of the susceptibility of bacteria against different antibiotic agents	**3 hrs**

NATURAL RESOURCE MANAGEMENT AND SUSTAINABLE ECOSYSTEM

14.	Anyone environmental service to be submitted with a report.	**8 hrs**
15.	Water quality of water samples (Any 3 chemical parameters).	**3hrs**
16.	Field trip: Eco tour (report to be submitted along with photographs and video)	**5 hrs**
17.	Soil texture analysis: Triangle test	**2 hrs**
18.	Marking major national parks and tiger reserves of India	**2 hrs**
19.	Marking biodiversity hotspots of India	
20.	Calculating capture and recapture method of estimating animals using bean seeds	**2 hrs**

REFERENCE BOOKS

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

Course Designer:

1. Dr. Charumathi Pushparaj

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDIT
MZO25P2	ZOOLOGY LAB COURSE - II	PRACTICAL	-	-	90	4

Preamble

This practical course equips students with hands-on skills in cell biology, genetics, biochemistry, animal physiology, and forensic science. Through laboratory experiments, students will perform biochemical assays, physiological measurements, genetic analysis, and forensic investigations.

Course Outcomes:

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Understand the fundamental concepts of cell biology, genetics, and biochemical processes in living organisms.	K_2
CLO2	Apply appropriate laboratory techniques for cellular measurements, biochemical analysis, and physiological investigations.	K_3
CLO3	Evaluate inheritance patterns, metabolic functions, and physiological responses in different biological systems.	K_4
CLO4	Analyze forensic evidence, including fingerprint detection, blood spatter patterns, and biochemical tests, for investigative purposes.	K_5
CLO5	Design and conduct experiments to explore biochemical, physiological, and forensic applications in research and diagnostics.	K_6

Mapping with Programme Learning Outcomes

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

S - Strong; M-Medium

ZOOLOGY LAB COURSE - II

MZO25P2 (90 hrs)

ADVANCED CELL BIOLOGY AND GENETICS

1.Spotters - Down syndrome, Turner's syndrome, Klinefilter's syndrome and William's syndrome	**3 hrs**
2. Measurement of the cell sample using micrometry (Ocular and stage micrometer)	**3 hrs**
3. Determination of osmosis and haemolysis of RCB	**3 hrs**
4. Preparation of microvesicles from egg yolk	**6 hrs**
5. Isolation of cell organelles by differential centrifugation (Demonstration)	**2 hrs**
6. Determination of size by Nanoparticle Track Analyser (Demonstration)	**1 hr**
7. Isolation of DNA from animal tissues	**6 hrs**
8. Report on Inheritance patterns of genetic disorders through pedigree analysis and interpret the transmission of traits across generations.	

BIOCHEMISTRY

8.Effect of Different Temperatures on the Activity of Salivary Amylase on Starch	**3 hrs**
9. Effect of different pH on the activity of salivary amylase.	**3 hrs**
10. Qualitative analysis of Carbohydrates.	**6 hrs**
11. Qualitative analysis of proteins	**6 hrs**
12. To carry out the separation of amino acids by thin layer chromatography.	**3 hrs**
13. Qualitative analysis of urine - protein, glucose, Ketone bodies	**6 hrs**

ANIMAL PHYSIOLOGY

14. Spotters - 4. Principle and Application of Sphygmomanometer, Kymograph, Haemoglobinometer, ESR.	**3 hrs**
15. Rate of oxygen consumption in fishes.	**6 hrs**
16. Heart beat measurement in Daphnia in relation to temperature	**6 hrs**
17. Qualitative analysis of excretory products- ammonia, urea, Uric acid.	**6 hrs**
18. Estimation of ESR.	**3 hrs**
19. Measurement of premenstrual tension through blood pressure measurement	**3 hrs**
20. Comparison of ovulatory cycle and basal body temperature.	**3 hrs**

FORENSIC SCIENCE

21. Forensic detection of fingerprints on paper using Ninhydrin	**3 hrs**
22. To carry out the crystal test on a blood sample	**3hrs**
23. Blood spatter analysis using fake blood to identify the pattern variation with height and angle	**3 hrs**

REFERENCE BOOKS:

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1	Dr. Veena SinghGhalaut, Dr.S.K Gupta, Dr.AnjuJain	Manual of Practical Biochemistryfor MBBS	Arya Publishing Company	2018, (3rd Edition)
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Course Designer:

Dr. Charumathi Pushparaj