GOKUL GLOBAL UNIVERSITY

Approved By Govt. of Gujarat
(Recognized by UGC under Section 22 & 2(f) of 1956)
(Gujarat Private State University Act 4 of 2018)

COURSE STRUCTURE

Master of Science

Zoology

Under

Choice Based Credit System (CBCS)

Faculty of Science
Gokul Science College
University Campus, State Highway-41,
Siddhpur - 384151, **Dist.** Patan, Gujarat, INDIA, **Mobile :** 9510973863
E- Mail : dean.fac.sci@gokuluniversity.ac.in, **Website :** www.gokuluniversity.ac.in

Master of Science Program outcomes (PO)

PO No.	Program Outcome Description
PO1	Advanced Subject Knowledge: Graduates will demonstrate advanced knowledge and expertise in their specialized field, including a comprehensive understanding of advanced concepts and theories.
PO2	Research Proficiency: Students will develop advanced research skills, including the ability to design and conduct independent research, analyze data, and draw meaningful conclusions.
PO3	Critical Analysis and Synthesis: Graduates will demonstrate advanced critical thinking abilities, the capacity to analyze complex scientific problems, synthesize information from diverse sources, and propose innovative solutions.
PO4	Scholarly Communication: Students will possess advanced skills in scientific writing, oral presentation, and effective communication of research findings to scientific and non-scientific audiences.
PO5	Independent Thinking: Graduates will exhibit independent thinking and creativity in problem-solving, research design, and the development of novel approaches in their field of specialization.
PO6	Leadership and Collaboration: Students will develop leadership skills and the ability to collaborate effectively with diverse teams, providing guidance and fostering a collaborative research environment.
PO7	Advanced Technology and Techniques: Graduates will be proficient in utilizing advanced technology, tools, and techniques specific to their discipline to enhance research and analysis capabilities.
PO8	Ethical Research Practices: Students will adhere to high ethical standards in research, ensuring the responsible conduct of research, integrity, and respect for intellectual property rights.
PO9	Continuous Learning and Adaptability: Graduates will demonstrate a commitment to continuous learning, keeping pace with emerging trends and technologies, and adapting to new challenges in their field.
PO10	Contribution to the Field: Students will make significant contributions to their specialized field, actively participating in conferences, publishing research, and advancing scientific knowledge through their research work.

Master of Science Program specific outcomes (PSO)

M.Sc. Zoology:

PSO No.	Program Specific Outcome Description
PSO1	Advanced Zoological Knowledge and Research: Graduates of the M.Sc. Zoology program will acquire advanced knowledge and expertise in the study of animal biology, including animal behavior, ecology, physiology, and evolution. They will engage in advanced research, investigating specialized areas within zoological science.
PSO2	Wildlife Conservation and Management: Graduates will contribute to wildlife conservation efforts, developing strategies for the conservation and sustainable management of animal species and habitats. They will apply advanced techniques and technologies to study animal populations, behavior, and ecosystem dynamics.

M.Sc. SEM 1 Zoology

Sr No.	Course Type	Course Code	Corse Name	Lecture (hrs.)	Practical (hrs.)	Credits	Examination		Total Marks
							Internal	External	
1	DISCIPLINE SPECIFIC COURSE (DSC)	MZOO101DSC	Cell Structure and Functions	4	0	4	30	70	100
2	DISCIPLINE SPECIFIC COURSE (DSC)	MZOO102DSC	Evolutionary Biology and Genetics	4	0	4	30	70	100
3	DISCIPLINE SPECIFIC COURSE (DSC)	MZOO103DSC	Molecular Biology and Genetics	4	0	4	30	70	100
4	DISCIPLINE SPECIFIC COURSE (DSC)	MZOO104DSC	Animal Taxonomy-1	4	0	4	30	70	100
7	Elective Course	MZOO105SE	Wildlife and Conservation Biology	2	0	2	15	35	50
		MZOO106SE	Fisheries and Aquaculture						
		MZOO107SE	Environmentally Sound Technologies-1						
5	PRACTICAL COURSE (PRA)	MZOO101PRA	Lab-1	0	4	3	0	75	75
6	PRACTICAL COURSE (PRA)	MZOO102PRA	Lab-2	0	4	3	0	75	75
		Total		**18**	**8**	**24**	**135**	**465**	**600**

GOKUL GLOBAL UNIVERSITY, SIDHPUR

M.Sc. SEM 2 (Zoology)

Sr No.	Course Type	Course Code	Corse Name	Lecture (hrs.)	Practical (hrs.)	Credits	Examination		Total Marks
							Internal	External	
1	DISCIPLINE SPECIFIC COURSE (DSC)	MZOO201DSC	Biochemistry	4	0	4	30	70	100
2	DISCIPLINE SPECIFIC COURSE (DSC)	MZOO202DSC	Instrumentation and Analytical Techniques	4	0	4	30	70	100
3	DISCIPLINE SPECIFIC COURSE (DSC)	MZOO203DSC	Biostatistics and Research Methodology	4	0	4	30	70	100
4	DISCIPLINE SPECIFIC COURSE (DSC)	MZOO204DSC	Animal Taxonomy -2	4	0	4	30	70	100
5	Elective Course	MZOO205SE	Fisheries and Aquaculture -2	2	0	2	15	35	50
		MZOO206SE	Wildlife Biology - 2						
		MZOO207SE	Environmentally Sound Technologies-2						
6	PRACTICAL COURSE (PRA)	MZOO201PRA	Lab-1	0	4	3	0	75	75
7	PRACTICAL COURSE (PRA)	MZOO202PRA	Lab-2	0	4	3	0	75	75
		Total		**18**	**8**	**24**	**135**	**465**	**600**

GOKUL GLOBAL UNIVERSITY

M.Sc. SEM 3

Sr No.	Course Type	Course Code	Corse Name	Lecture (hrs.)	Practical (hrs.)	Credits	Examination		Total Marks
							Internal	External	
1	DISCIPLINE SPECIFIC COURSE (DSC)	MZOO301DSC	Animal Physiology	4	0	4	30	70	100
2	DISCIPLINE SPECIFIC COURSE (DSC)	MZOO302DSC	Immunology and Endocrinology	4	0	4	30	70	100
3	DISCIPLINE SPECIFIC COURSE (DSC)	MZOO303DSC	Developmental Biology and Evolution	4	0	4	30	70	100
4	DISCIPLINE SPECIFIC COURSE (DSC)	MZOO304DSC	Advance Techniques in Zoology	4	0	4	30	70	100
7	Elective Course	MZOO305SE	Fisheries and Aquaculture -3	2	0	2	15	35	50
		MZOO306SE	Wildlife Biology- 3						
		MZOO307SE	Environmentally Sound Technologies-3						
5	PRACTICAL COURSE (PRA)	MZOO301PRA	Practical Paper-I	0	4	3	0	75	75
6	PRACTICAL COURSE (PRA)	MZOO302PRA	Practical Paper-II	0	4	3	0	75	75
		Total		**18**	**8**	**24**	**135**	**465**	**600**

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M.Sc. SEM 4

Sr No.	Course Type	Course Code	Corse Name	Lecture (hrs.)	Practical (hrs.)	Credits	Examination		Total Marks
							Internal	External	
1	DISCIPLINE SPECIFIC COURSE (DSC)	MZOO401DSC	Histology, Histochemistry and Parasitology	4	0	4	30	70	100
2	DISCIPLINE SPECIFIC COURSE (DSC)	MZOO402DSC	Animal Behaviour	4	0	4	30	70	100
3	DISCIPLINE SPECIFIC COURSE (DSC)	MZOO403DSC	Toxicology and Environmental Biology	4	0	4	30	70	100
4	DISCIPLINE SPECIFIC COURSE (DSC)	MZOO404DSC	Entomology	4	0	4	30	70	100
7	Elective Course	MZOO405SE	Fisheries and Aquaculture -4	2	0	2	15	35	50
		MZOO406SE	Wildlife Biology- 4						
		MZOO407SE	Environmentally Sound Technologies-4						
5	PRACTICAL COURSE (PRA)	MZOO401PRA	Practical Paper-I	0	4	3	0	75	75
6	PRACTICAL COURSE (PRA)	MZOO402PRA	Practical Paper-II	0	4	3	0	75	75
		Total		**18**	**8**	**24**	**135**	**465**	**600**

Program: Master of science **Subject / Branch:** Zoology

Year : 2022/23 **Semester:** I

Course title:	CELL STRUCTURE AND FUNCTIONS	**Course code :**	MZOO101UDSC
Course type:	Discipline Specific Course	**Course credit :**	04

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
60	0	0	20	10	70	100

Course Objective:

1. Cell Structure and Function: Covers cell wall, plasma membrane, intracellular organelles, and cytoskeleton, providing insights into cellular architecture and functions.
2. Nucleus and Chromatin: Explores nucleus structure, chromatin organization, and specialized chromosomes, along with experimental techniques for cell study.
3. cell Division and Signaling: Focuses on cell division, cell cycle regulation, cell signaling mechanism, and cellular communication, including apoptosis.
4. Cancer Biology: introduces cancer development, propagation, and treatment, including genetic aspects, metastasis, and therapeutic interventions for uncontrolled cell growth.

Course Outcome:

After thorough understanding of the content student will be able to explain:

CO1	In this concept of cell structure students will understand structure and furcation of plasma membrane. And structural organization and also understand function of intracellular organelles
CO2	In this concept of cell structure students will understand structure and furcation of nucleus and DNA
CO3	In this concept of cell structure students will understand Cell Division and Cell Cycle and Cell Signaling also understand cellular commutation
CO4	In this concept of cell structure students will understand basic introduction to cancer biology and cancer treatment

Content

Unit	Description in detail	Credit	Weightage
I	Cell wall: Structure and functions; Plasmodesmata: Structure; role in movement of molecules and macromolecules; comparison with gap junctions. Plasma membrane: Structure, models, and functions; sites for ATPases, ion carriers, channels and pumps; receptors. Structural organization and function of intracellular organelles: Plastids, Mitochondria, Chloroplast, Golgi bodies, Lysosomes, Peroxisomes, Endoplasmic reticulum, Ribosomes Cytoskeleton- microtubules, microfilaments and intermediate filaments	1	25 %
II	Nucleus: Structure and functions; nuclear pores; nucleosome organization, Nucleolus Chromatin organization: Chromosome structure and packaging of DNA, molecular organization of centromere and telomere Specialized types of chromosomes: Structure and functions of polytene and lamp brush, B-chromosomes and sex chromosomes Experimental approaches for studying cells, Cell Fixation and Staining Nucleus: Structure and functions; nuclear pores; nucleosome organization, Nucleolus.	1	25 %
III	Cell division and cell cycle: Mitosis and meiosis, them regulation, steps in cell cycle, regulation and control of cell cycle Cell Signaling: Cell signaling Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, secondary messengers, regulation of signaling pathways Cellular communication: General principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, regulation of hematopoiesis, neurotransmission and its regulation Apoptosis and Programmed Cell Death (PCD).	1	25 %
IV	Introduction to cancer biology: Cancer development: Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer. Cancer propagation: Metastasis, interaction of cancer cells with normal cells.	1	25 %

	Cancer treatment: Therapeutic interventions of uncontrolled cell growth.		

Reference Books:

1. Lodish et. al., 2007 Molecular Cell Biology, W.H. Freeman and Company, New York, USA
2. Alberts et. al., 2008 Molecular Biology of the Cell, Garland Science, Taylor & Francis Group, New York, USA.
3. Sperelakis 2001 Cell Physiology Source Book: A Molecular approach, Academic Press, New York, USA.4.
4. Powar C. B. 1983 Cell Biology, Himalaya Publishing House, Mumbai, India.

Online Resources

https://youtu.be/-zCb69sqDLo?si=QxCFCnSIfvgRcLqt

https://youtu.be/R93LveFyrjo?si=b8IP_iaANtxOpxR-

https://youtu.be/Tf_brxRKQyk?si=NNNddUHn4PQmnivF

https://youtube.com/playlist?list=PLpjejUZhokbMWN0_egYHnp_6GrTuai8tZ&si=UJYHwNiFUQZ1AKjm

https://youtu.be/fICSnB2RRYc?si=jtAKTych82F_Hg-s

Practical:

CELL BIOLOGY, MOLECULAR BIOLOGY AND GENETICS

Cell Biology:

1. Isolation of mitochondria from given sample
2. Mitosis and the Cell Cycle in Onion Root-Tip Cells
3. Preparation of Buccal smear and Identification of Barr Body
4. Micrometry – Measurement of cell size
5. To measure mitotic index in tissue provided
6. To perform gram stating for identification of gram positive and gram-negative bacteria

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1-Less Relevant, 2- Mild Relevant, 3-Highly Relevant)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**3**	**2**	**-**	**1**	**-**	**-**	**-**	**-**	**1**	**1**	**2**	**1**
CO2	**2**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**1**	**1**	**2**	**1**
CO3	**2**	**2**	**-**	**2**	**1**	**-**	**-**	**-**	**2**	**2**	**1**	**1**
CO4	**2**	**2**	**-**	**1**	**1**	**-**	**1**	**-**	**2**	**2**	**1**	**1**

Program: Master of science **Subject / Branch:** Zoology

Year: 2022/23 **Semester:** I

Course Title:	EVOLUTIONARY BIOLOGY AND DIVERSITY	**Course code:**	MZOO102UDSC
Course type:	Discipline Specific Course	**Course credit:**	04

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
60	0	0	20	10	70	100

Course Objective:

1. Explore the foundations of evolutionary biology and its relevance.
2. Examine mechanisms influencing genetic variations and speciation.
3. Analyze biodiversity, conservation, and environmental priorities.
4. Understand protected areas, threats to biodiversity, and relevant legislation.
5. Comprehend bioremediation concepts and applications in environmental management.

Course Outcome:

After thorough understanding of the content student will be able to explain:

CO1	In this concept of cell structure students will understand importance of evolution in biology and the development of evolutionary theory (Lamarckism, Darwinism natural selection, Neo-Darwinism and mutation)
CO2	In this concept of cell structure students will understand genetic drift and recombination and gene flow
CO3	In this concept of cell structure students will understand genetics and species and ecosystem diversity and biodiversity at global and national level and also biogeographic classification
CO4	In this concept of cell structure students will understand national park and wildlife sanctuaries and biosphere reserves and also threats to biodiversity and endangered and endemic species of India

Content

Unit	Description in detail	Credit	Weightage
I	Importance of evolution in biology A brief history of life. The development of evolutionary theory Lamarckism, Darwinism, Natural selection, Neo-Darwinism and Mutation theory. Evolution of diseases: some examples.	1	25 %
II	Mechanisms that decrease and increase variations (natural selection, genetic drift, mutation, recombination and gene flow) Speciation: Modes of speciation, isolating mechanisms, speciation in time.	1	25 %
III	Genetic, species and ecosystem diversity. Biodiversity at global, national levels. Biogeographic classification of India, India as a mega diversity nation Conservation of Biodiversity, in-situ and ex-situ conservation, Keystone species, measurement of biodiversity.	1	25 %
IV	National Parks, Wild life Sanctuaries and Biosphere Reserves Threats to biodiversity- habitat loss, poaching and man-wildlife Conflicts Endangered and Endemic species of India: Common plant and animal species Environmental Priorities, strategies and Environmental Legislation (Acts) in India, Environmental Impact Assessment. Bioremediation: Concept need and scope, environmental applications.	1	25 %

Reference Books:

1. Population, Species and Evolution- Ernst Mayr the theory of Evolution- J. Maynard Smith

2. Molecular Evolution and Origin of Life- Widney W. Fox and Klous Dose Animal species and their evolution- A.J. Cain 29+ Evidences for Macroevolution- Douglas Theobald (http://www.talkorigins.org/faqs/comdesc/)

3. Textbook for Environmental Studies- Erach Bharucha, UGC, New Delhi (2004) Environmental

Biology- K.C. Agrawal Ecology & Environment- P.D. Sharma

4. Biodiversity- E.O. Wilson The Biology of Diversity- M.Kato The Diversity of Life- E.O. Wilson

Online Resources

https://youtu.be/RjHtvV_0Fh4?si=CkIiOfCNr5YsY2BV

https://youtu.be/aYvOstG_ynY?si=uLT7VlaoatTeqSDL

https://youtu.be/ag_2tDJPLSI?si=9Ls1xKeltJG0ObMY

https://youtu.be/GZKX2tvsCmk?si=53mVqZ0WR1HAUqiI

Practical:

Molecular Biology and Genetics

1. Spectrometric analysis of DNA
2. Estimation of RNA by Orcinol method
3. Preparation of Drosophila Polytene Chromosome Squashes
4. Construction of normal human karyotype
5. Diagnosis of genetical disorders using karyotypes
6. To study test cross and back cross inheritance related genetic problems
7. Study of human pedigree analysis.

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1-Less Relevant, 2- Mild Relevant, 3-Highly Relevant)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**2**	**2**	-	-	-	-	-	-	**1**	-	**2**	**1**
CO2	**2**	**2**	-	-	-	-	-	-	**1**	-	**2**	**2**
CO3	**3**	**2**	-	-	-	-	-	-	**2**	-	**1**	**3**
CO4	**1**	**2**	-	-	-	-	-	-	**1**	-	**1**	**2**

Program: Master of science **Subject / Branch:** Zoology

Year : 2022/23 **Semester:** I

Course title :	MOLECULAR BIOLOGY AND GENETICS	**Course code :**	MZOO103UDSC
Course type :	Discipline Specific Course	**Course credit :**	04

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
60	0	0	20	10	70	100

Course Objective:

1. Comprehend nucleic acid principles, composition and nucleotide synthesis.
2. Explore DNA and RNA organization, replication, and related enzymes.
3. Examine transcription, translation, and gene regulation in prokaryotes and eukaryotes.
4. Master recombinant DNA technology, encompassing restriction enzymes, cloning, vectors, libraries, DNA synthesis, and sequencing.

Course Outcome:

After thorough understanding of the content student will be able to explain:

CO1	In this concept of Molecular Biology students will understand Lear about nucleic acid principles, including composition and synthesis. and molecular organization and type of DNA & RNA also transcription in prokaryotes and eukaryotes
CO2	In this concept of Molecular Biology students will understand regulation gene and recombinant DNA technology classification of enzymes gene cloning
CO3	In this concept of Molecular Biology students will understand gene structure and expression and gene code also molecular basic of gene mutations
CO4	In this concept of Molecular Biology students will understand spontaneous and induced mutation and physical and chemical mutagens also factor affecting gene frequency

Content

Unit	Description in detail	Credit	Weightage
I	Nucleic Acids: Composition of Nucleic Acids and Synthesis of Nucleotides; Molecular Organization and types of DNA and RNA. DNA Replication in Prokaryotes and Eukaryotes; Enzymes involved in Replication. Transcription in Prokaryotes and Eukaryotes; RNA Polymerases. Translation: Process of Protein synthesis.	1	25 %
II	Regulation of gene expression in Prokaryotes and Eukaryotes. Recombinant DNA technology: Classification of Restriction enzymes, Gene Cloning principles and technique Prokaryotic and Eukaryotic cloning Vectors. Construction of Genomic and cDNA libraries, DNA synthesis and sequencing. Extra chromosomal inheritance: Male sterility-origin, induction and application, inheritance of chloroplast and mitochondrial gene.	1	25 %
III	Gene structure and expression: Gene vs allele, a new concept of Allelomorphic, fine structure of gene, cistron, recon and muton. Genetic code: Deciphering genetic code, properties of genetic code, initiation and termination codons, mutation Wobble hypothesis, new genetic codes, second genetic code, overlapping and split genes. Spontaneous and induced mutation, Physical and chemical mutagens; Molecular basis of gene mutations	1	25 %
IV	Spontaneous and induced mutation, Physical and chemical mutagens; Molecular basis of gene mutations Transposable elements in Prokaryotes and Eukaryotes; mutations induced by transposons; site-directed mutagenesis. Principal of Mendelian Genetics and Hardy – Weinberg genetic Equilibrium Factors affecting gene frequency – Natural selection and Genetic polymorphism and Genetic drift.	1	25 %

Reference Books:

1. Lodishet. al., 2007 Molecular Cell Biology, W.H. Freeman and Company, New York, USA \2

2. Sambamurty A.V. S. S. 2008 Molecular Biology, Narosa Publishing House, New Delhi.

3. Sandhu G. S. 2002 Molecular Cell Biology, Campus books, New Delhi.

4. Verma P. S. and Agrawal V. K. 2010 Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, S. Chand & Company Ltd.

Online Resources

https://www.youtube.com/live/CItaTYQEa5A?si=yjTNW1PWfnWhJniH

https://youtu.be/MHpa5z-yPSw?si=aYNrZ_GKdm_rvr58

https://www.youtube.com/live/MVakZ9dTJag?si=ja8LPfKm1LeYIyBo

https://youtu.be/25c7XDLygFE?si=TGvVxpZepmUSNlKp

https://youtu.be/VtKR_w6DXTE?si=incl_dyTnc6yhKVk

Practical:

Biodiversity and Ecology:

1. Determination of different population parameters: a. Density b. Abundance c. Frequency of occurrence d. Dominance
2. Species-area curve method
3. Study of population dynamics using examples a. Population growth rate b. Carrying capacity c. Population doubling time
4. Study and determination of physical and chemical properties of soil
5. Study and determination of physical and chemical properties of water
6. Calculation of similarity and diversity indices for given data
7. Mapping of faunal diversity found in different zoogeographical realms
8. Mapping of protected area and distribution of endangered fauna of India

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1-Less Relevant, 2- Mild Relevant, 3-Highly Relevant)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**2**	**2**	**-**	**1**	**-**	**-**	**-**	**-**	**1**	**2**	**2**	**1**
CO2	**2**	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**1**	**1**	**1**	**2**
CO3	**2**	**2**	**-**	**1**	**-**	**-**	**-**	**-**	**1**	**2**	**2**	**1**
CO4	**1**	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**1**	**2**	**1**	**2**

Program: Master of science **Subject / Branch:** Zoology

Year : 2022/23 **Semester:** I

Course title:	ANIMAL TAXONOMY I	**Course code :**	MZOO104UDSC
Course type:	Discipline Specific Course	**Course credit :**	04

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
60	0	0	20	10	70	100

Course Objective:

1. Understand the grades of organization and body plans in the animal kingdom.
2. Explore the formation of germ layers and components of metazoan bodies.
3. Learn the history of classification, species concepts, and major subdivisions within the animal kingdom.
4. Examine the characteristics and diversity of key non-chordate phyla, including Protozoa, Porifera, Cnidaria, Platyhelminthes, and Nematoda.
5. Introduce chordate characteristics, evolution, and classifications, including subphylum Urochordates and cephalochordates.

Course Outcome:

After thorough understanding of the content student will be able to explain:

CO1	In this concept of Animal Taxonomy students will understand After thorough understanding of the content student will be able to explain: Gain a deep understanding of animal body complexity, organization, and body plans.
CO2	In this concept of Animal Taxonomy students will understand history and classification and characteristic and diversity of protozoan also species concept
CO3	In this concept of Animal Taxonomy students will understand classification and characteristic and diversity of (porifera, cnidaria, platyheminthes, Nematoda)

CO4	In this concept of Animal Taxonomy students will understand characteristic of subphylum and urochordates also cephalochordates

Content

Unit	Description in detail	Credit	Weightage
I	Grades of organization in animal body complexity Animal body plans Body cavity and formation of germ layers Components of metazoan body	1	25 %
II	History of classification Species concepts Major subdivisions of animal kingdom Classification, characteristics and diversity of Protozoan.	1	25 %
III	Introduction to non-chordate phylum Classification, characteristics and diversity of Porifera Classification, characteristics and diversity of Cnidaria Classification, characteristics and diversity of Platyhelminthes Classification, characteristics and diversity of Nematoda	1	25 %
IV	Introduction to chordate characteristics Ancestry and evolution of chordates Classification of chordates (up to class) Classification, characteristics and diversity of subphylum Urochordates and cephalochordates	1	25 %

Reference Books:

1.Sinclair A. R., Fryxell J M and Caughly G. (2006) Wildlife Ecology, Conservation and Management.

Blackwell Publishing, U.S.A.

2. Gopal R. (1992) Fundamentals of Wildlife Management. Justice Home, Allahabad, India.

3. Jairajpuri M. S. (1990) Collection and preservation of animals. Zoological Survey of India.

4. Magguran, A.E. (1996). Ecological diversity and its measurements. Princeton University.

5. Gadgil, M. (2002) A methodology mannual for scientific inventorying, monitoring and conservation of

Biodiversity

6. Hickman C. P., et al. 2006 Integrated principals of Zoology, McGraw Hill Higher Education. 931pp.

14th edition.

Online Resources

https://youtu.be/axfBuBrUdg0?si=D6LYxI3K6NscUEfQ

https://mycbseguide.com/blog/animal-kingdom-class-11-notes-biology/

https://www.askiitians.com/revision-notes/biology/animal-kingdom/phylum-protozoa-and-porifera.html

Practical:

Animal Taxonomy-1

1. Study of general body organization
2. study of Classification of protozoans using laboratory specimens.
3. Study of Classification of porifera using laboratory specimens.
4. Study of Classification of cnidaria using laboratory specimens.
5. Study of Classification of platyhelminthes using laboratory specimens.
6. Study of Classification of Nematoda using laboratory specimens.
7. Study of Classification of urochordata and cepahlochordata using laboratory specimens

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1-Less Relevant, 2- Mild Relevant, 3-Highly Relevant)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**2**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**1**	**1**	**2**	**1**
CO2	**2**	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**1**	**1**	**1**	**2**
CO3	**2**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**1**	**2**	**2**	**2**
CO4	**1**	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**1**	**2**	**1**	**1**

Program: Master of science **Subject / Branch:** Zoology

Year : 2022/23 **Semester:** I

Course title:	WILDLIFE AND CONSERVATION BIOLOGY	**Course code :**	MZOO105USE
Course type:	Subject Elective	**Course credit :**	02

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
30	0	0	10	5	35	50

Course Objective:

1. Comprehend wildlife's vital role as a natural resource.
2. Examine the history, types, and background of conservation efforts.
3. Recognize global importance and ecological implications of wildlife conservation.
4. Analyze Indian subcontinent habitat and their biodiversity role.

Course Outcome:

After thorough understanding of the content student will be able to explain:

CO1	Understanding of Wildlife: Define wildlife, its scope, and recognize it as a vital natural resource for ecological balance and human sustenance.
CO2	Conservation Awareness: Comprehend the historical context and various types of conservation efforts, highlighting the significance of wildlife preservation.
CO3	Indian Subcontinent Wildlife: Identify wildlife habitats in the Indian subcontinent and their significance in global biodiversity.
CO4	Wildlife Management and Protection: Trace the evolution of wildlife management, appreciate current advances, and acknowledge the pivotal role of protected areas and community engagement in wildlife conservation, with a focus on contemporary practices in India.

Content

Unit	Description in detail	Credit	Weightage
I	Wildlife: Definition, Scope and wildlife as natural resource Conservation: Definition, History and Background and types of Conservation Significance of wildlife conservation Wildlife habitats in Indian subcontinent	1	50 %
II	Wildlife management (History and current advances) Protected areas and role of PAs in wildlife conservation Community and conservation Current wildlife conservation practices in India	1	50%

Reference Books:

1. Sinclair A. R., Fryxell J M and Caughly G. (2006)

2. Wildlife Ecology, Conservation and Management. Blackwell Publishing, U.S.A.

3. Gopal R. (1992) Fundamentals of Wildlife Management. Justice Home, Allahabad, India.

4. Jairajpuri M. S. (1990) Collection and preservation of animals. Zoological Survey of India.

5. Magguran, A.E. (1996). Ecological diversity and its measurements. Princeton University.

6. Gadgil, M. (2002) A methodology mannual for scientific inventorying, monitoring and conservation of Biodiversity

7. Hickman C. P., et al. 2006 Integrated principals of Zoology, McGraw Hill Higher Education. 931pp. 14th edition.

Online Resources:

https://www.environmentalscience.org/conservation#:~:text=Defining%20Conservationism,natural%20state%20and%20maintaining%20equilibrium.

https://unacademy.com/content/cbse-class-11/study-material/geography/wildlife-conservation-and-its-importance/

https://getlegalindia.com/wildlife-conservation-efforts-in-india/

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1-Less Relevant, 2- Mild Relevant, 3-Highly Relevant)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**2**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**1**	**1**	**2**	**3**
CO2	**1**	**1**	**-**	**2**	**-**	**-**	**-**	**-**	**1**	**1**	**3**	**2**
CO3	**2**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**1**	**2**	**1**	**2**
CO4	**1**	**1**	**-**	**2**	**-**	**-**	**-**	**-**	**1**	**2**	**1**	**2**

Program: Master of science **Subject / Branch:** Zoology

Year : 2022/23 **Semester:** II

Course title:	Biochemistry	**Course code :**	MZOO201DSC
Course type:	Discipline Specific Course	**Course credit :**	04

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
4	0	3	20	10	70	100

Course Objective:

1. To provide a solid foundation in biochemistry by understanding chemical bonds, water's properties, and energy flow in biological systems.
2. To explore the structure, function, and metabolism of key biomolecules such as carbohydrates, lipids, and amino acids.
3. To grasp the role of enzymes in catalysing biochemical reactions and the impact of vitamins on overall health.
4. To establish a comprehensive understanding of essential biochemical concepts, facilitating their application in biological sciences and related fields.

Course Outcome:

After thorough understanding of the content student will be able to explain:

CO1	Understand the fundamental chemical bonds and interactions in biochemistry, including Van der Waals, electrostatic, hydrogen bonding, and hydrophobic interactions.
CO2	Gain knowledge of key concepts such as water's role in weak interactions, ionization, pH, and buffering in biological systems.
CO3	Explore biomolecules like carbohydrates and lipids, their structures, functions, and metabolism pathways.
CO4	Comprehend the significance of enzymes, their classification, mechanisms, kinetics, and regulation, as well as the role of vitamins in maintaining biochemical processes and preventing deficiency diseases.

Content

Unit	Description in detail	Credit	Weightage
I	**Fundamentals of Biochemistry** Chemical bonds and Stabilizing interactions: Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction. Water: weak interactions in aqueous systems, ionization of water, weak acids, and weak bases, pH and buffer: pH and buffer and buffering against pH changes in biological systems. Energy flow: principles of thermodynamics, free energy and chemical potential, redox reactions, structure and function of ATP.	1	25 %
II	**Biomolecules and Metabolism-1** Carbohydrates: Classification, Occurrence, Structure, properties and functions of Monosaccharides (Triose, Pentose and Hexose), Disaccharides and Polysaccharides (Starch, glycogen and Cellulose). Carbohydrate metabolism: Glycolysis, Glycogenesis, TCA cycle, Electron transport system, Oxidative phosphorylation and photophosphorylation, Hexose monophosphate shunt. Lipids: Classification of Lipids, Occurrence, Structure, properties and Function of Simple lipids (Triglycerides and Waxes) and Complex lipids (Phospholipids and Sphingolipids). Lipid metabolism: Biosynthesis of fatty acids and Phospholipids, Catabolism of fatty acids and β- Oxidation of fatty acids.	1	25 %
III	**Biomolecules and Metabolism-2** Amino Acids: Structure, Properties, and Classification of Amino Acids. Amino acid metabolism: Biosynthesis and break down of amino acids, transamination and deamination Protein: Classification of Proteins, properties, Function and Conformation of Proteins (primary, secondary, tertiary and quaternary structure), Ramachandran Plot, protein domains and folds, Protein denaturation and stability Interrelationship between metabolism of Carbohydrate, Lipid and Protein	1	25 %
IV	**Enzymes and Vitamins** Enzymes: An introduction to Enzymes, Nomenclature, Classification of Enzymes. Properties of enzymes, Apo-enzymes, coenzymes, cofactors and prosthetic groups.	1	25%

	Mechanisms of enzyme action, Kinetics of an enzyme- catalyzed reaction and inhibition. Enzyme regulation: Allosteric enzyme regulation, Covenant modification Vitamins: Occurrence, Classification, Structure and function of various Vitamins and their deficiency diseases.		

Reference books

1. Harper H. A. 1993 Review of Physiological Chemistry (Lange Publications).
2. Lehninger A. l., Nelson D. L. and Cox M.M. 1993. Principles of Biochemistry (CBCPublishers).
3. Rastogi S. C. 2003 Biochemistry (Tata Mc GrawHill Publishing Co. Ltd.).

Practical:

Biochemistry

1. Estimation of reducing and non-reducing sugars from given sample
2. Estimation of total carbohydrates from given tissue sample
3. Estimation of glycogen from given tissue sample
4. To estimate total protein content from given tissue sample
    a. Folin-lawry method
    b. Bradford method
5. Colorimetric quantification of amino acids by Ninhydrin method
6. Estimation of ascorbic acid from given tissue sample
7. Estimation of total lipid content from given tissue samples
8. Estimation of cholesterol content from given tissue samples
9. Enzymatic assay of Catalase, peroxidase etc.

Online Resources

https://open.oregonstate.education/animalnutrition/chapter/chapter-3/

https://www.biologydiscussion.com/proteins/proteins-functions-structure-properties-and-classification/16912

https://dhingcollegeonline.co.in/attendence/classnotes/files/1602006237.pdf

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1-Less Relevant, 2- Mild Relevant, 3-Highly Relevant)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**3**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**1**	**2**	**3**	**1**
CO2	**2**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**1**	**1**	**1**	**1**
CO3	**2**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**1**	**1**	**2**	**1**
CO4	**2**	**1**	**-**	**2**	**-**	**-**	**-**	**-**	**1**	**2**	**2**	**1**

Program: Master of science **Subject / Branch:** Zoology

Year : 2022/23 **Semester:** II

Course title:	INSTRUMENTATION AND ANALYTICAL TECHNIQUES	**Course code :**	MZOO202DSC
Course type:	Discipline Specific Course	**Course credit :**	04

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
4	0	3	20	10	70	100

Course Objective:

1. Develop proficiency in utilizing essential laboratory instruments and techniques, including pH meters, laminar airflow, and centrifugation, for scientific research and experimentation.
2. Gain hands-on experience in chromatography and electrophoresis methods, enabling the separation and analysis of biomolecules with precision.
3. Master spectroscopic and microscopic techniques, such as UV-visible spectrometry, mass spectrometry, and various microscopy methods, to investigate molecular and cellular structures.
4. Acquire expertise in immunoassays, flow cytometry, and radio isotopic techniques for molecular detection, localization, and quantification in biological systems, advancing skills crucial in biotechnology and life sciences

Course Outcome:

After thorough understanding of the content student will be able to explain:

CO1	Proficiency in operating laboratory instruments and executing techniques crucial for scientific research and experimentation.
CO2	Capability to perform precise biomolecule separation and analysis through chromatographic and electrophoretic methods.
CO3	Competence in utilizing spectroscopic and microscopic techniques to explore molecular and cellular structures.

CO4	Profound understanding and practical application of immunoassays, flow cytometry, and radio isotopic techniques for molecular detection and quantification, empowering students for careers in biotechnology and life sciences.

Content

Unit	Description in detail	Credit	Weightage
I	**Basic Laboratory Instruments** Principle and working of pH meter, Laminar-air flow Centrifugation: Types of centrifuge machines, preparative and analytical centrifuges, differential centrifugation, sedimentation velocity, sedimentation equilibrium, density gradient methods and their applications	1	25 %
II	**Chromatographic and Electrophoresis Techniques** Principle and applications of Native-PAGE, SDS-PAGE, Agarose and 2D gel Electrophoresis. Capillary electrophoresis and its applications. Principle, methodology and applications of gel – filtration, ion – exchange and affinity Chromatography; Thin layer and High-Performance Thin Layer Chromatography (HPTLC). Gas chromatography, High performance liquid chromatography (HPLC)and FPLC.	1	25 %
III	**Spectroscopy and Microscopy** Spectroscopy Technique: Principle and application of UV- visible spectrometer, AAS and Plasma Emission Spectroscopy. Mass Spectroscopy: Principle of MALDI, Types of Detectors Microscopic Techniques: Principle and applications of Light, Phase contrast and Fluorescence Microscopy, Principle and applications of SEM and TEM	1	25 %
IV	**Immuno Techniques and Radio-isotopic Technique** Antibody generation, detection of molecules using ELISA, RIA, Western blot, immunoprecipitation, Immunofluorescence microscopy, detection of molecules in living cells- in-situ localization by FISH Principle and applications of Flow cytometry Radiolabeling techniques: Properties of different types of radioisotopes used in Biology, their detection and measurement, Autoradiography	1	25%

Suggested Readings:

1. Wilson, K. and Walker, J., (2010). Principles and Techniques of Biochemistry and Molecular Biology, 7th edition, Cambrige University Press (Low price edition), New York.
2. Webster J. G., (2009). Bioinstrumentation, Student edition, Wiley India (P) Ltd. New Delhi.
3. Sharma, B. K., (2005). Instrumental methods of chemical analysis, 24th edition, GOEL publishing house, Meerut.

Practical:

Instrumentation and analytical Techniques

1. Agarose gel electrophoresis
2. Preparation of native and SDS-PAGE
3. Thin Layer chromatography
4. Paper chromatography
5. Principle and application of Instruments available in your department

Online Resources

https://microbenotes.com/types-of-spectroscopy/

https://www.nanoscience.com/techniques/scanning-electron-microscopy/

https://microbenotes.com/scanning-electron-microscope-sem/

https://www.ggu.ac.in/Admin/Files/Document/Biotechnology%20%2020.02.23.pdf

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1-Less Relevant, 2- Mild Relevant, 3-Highly Relevant)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**2**	**2**	**-**	**2**	**1**	**-**	**2**	**-**	**1**	**-**	**3**	**1**
CO2	**2**	**2**	**-**	**1**	**1**	**-**	**1**	**-**	**1**	**2**	**2**	**2**
CO3	**2**	**2**	**-**	**1**	**2**	**-**	**1**	**-**	**1**	**1**	**2**	**1**
CO4	**2**	**1**	**-**	**2**	**2**	**-**	**1**	**-**	**1**	**-**	**1**	**1**

Program: Master of science **Subject / Branch:** Zoology

Year : 2022/23 **Semester:** II

Course title:	BIOSTATISTICS AND RESEARCH METHODOLOGY	**Course code**	:	MZOO203DSC
Course type:	Discipline Specific Course	**Course credit**	:	04

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
4	0	3	20	10	70	100

Course Objective:

1. To equip students with a solid foundation in biostatistical techniques for data analysis and interpretation in biological research.
2. To provide essential knowledge and skills in research methodology, including experimental design and data collection strategies.
3. To enhance students' ability to effectively communicate scientific research through writing, presentation, and publication.
4. To prepare students for ethical and impactful contributions to the field of biology by fostering critical thinking and research ethics.

Course Outcome:

After thorough understanding of the content student will be able to explain:

CO1	Proficiency in applying statistical methods to analyze biological data, enabling evidence-based decision-making in research.
CO2	Competence in designing and conducting scientifically rigorous experiments and surveys, enhancing the quality of research outcomes.
CO3	Effective scientific communication skills, including writing research proposals and papers, facilitating successful publication and dissemination of research findings.
CO4	Familiarity with the principles of research methodology and ethical practices, equipping students to contribute meaningfully to the field of biological sciences.

Content

Unit	Description in detail	Credit	Weightage
I	**Biostatistics and Research Methodology** Definition and scope, Organizing a statistical survey and presentation of statistically analysed information Basic statistical methods: Measures of central tendency, dispersion and standard error; Probability distributions: binomial, poison and normal distribution Statistical significance: Hypothesis testing, types of error, level of significance, Student's t test, F test and Chi square goodness of fit Simple linear regression and correlation analysis	1	25 %
II	**Non parametric statistics** Comparing Parametric and Non parametric statistics, Rank test, F-max test, Mann – Whitney (U) test, and Sign test Applications of non-parametric statistics in biological research Basic computing: MS Office ®, Internet Data base management, Use of computers in statistical analysis	1	25 %
III	**Research methodology** Characteristics and types of scientific research Basics of research methodology Research and Experimental design Method of Data collection	1	25 %
IV	**Scientific deliveries** Scientific Deliveries and Communications: Writing Research proposal, Paper, Thesis, Report and Citations Citations, H-Index, I10-Index, Impact factor and selection criteria of scientific journals for research publications Presenting scientific research: Power point presentations, Posters, Flyers, etc. Publication processes, Review Processes and Significance of scientific Communications	1	25%

Suggested Readings:

1. Milton, J.S 1992 Statistical Methods in Biological and Health Science. McGraw-Hill Inc, New York.
2. Schefler, W.C. 1963 Statistics for biological sciences. Addition – Wesely Publication Co., London.
3. Snedecor, G. Wand Cocham, W. G. 1967 Statistical Methods. Oxford Publication Co., New Delhi.
4. Spiegel, M.R. 1981 Theory and problems of statistics, Schaum's Outline Series McGraw –Hill International Book Co., Singapore.
5. Day R.A. 7th Edition. How to write and publish a scientific paper

Practical

Biostatistics

1 Computation of different measures of central tendency

a. Arithmetic Mean

b. Harmonic Mean

c. Geometric Mean

d. Median

e. Mode

2 Computation of various measures of dispersion

a. Range and Co efficient of Range

b. Mean Deviation

c. Standard Deviation

3 Estimating standard error and coefficient of variation

4. Estimating confidence intervals for population mean

5 To perform Student's t test

a. Paired t test

b. Unpaired t test

6 To perform single factor Analysis of Variance (ANOVA) or F test

7 To study and perform regression analysis and prediction of future events

8 To study and perform correlation analysis

9 To perform Chi Square test of goodness of fit

10 To perform different non-parametric test

a. Sign test

b. Rank test

c. F max test

d. U test

Research Methodology

1 Defining Goal, Objectives, Stakeholders and parameters of research

2 Risk identification and analysis

3 Scientific writing practice –I (Log frame and Review writing)

4 Scientific writing practice –II (Citation)

5 Scientific reference management

Online Resources

https://www.educba.com/types-of-research-methodology/

https://www.lkouniv.ac.in/site/writereaddata/siteContent/202003241550010409rajeev_pandey_Non-Parametric.pdf

https://www.simplilearn.com/tutorials/statistics-tutorial/chi-square-test

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1-Less Relevant, 2- Mild Relevant, 3-Highly Relevant)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**2**	**3**	**-**	**2**	**1**	**1**	**2**	**-**	**1**	**1**	**2**	**1**
CO2	**2**	**2**	**-**	**1**	**1**	**2**	**1**	**-**	**1**	**2**	**2**	**1**
CO3	**2**	**3**	**-**	**2**	**2**	**1**	**1**	**-**	**1**	**1**	**3**	**1**
CO4	**2**	**2**	**-**	**2**	**2**	**2**	**1**	**-**	**1**	**1**	**1**	**1**

Program: Master of science **Subject / Branch:** Zoology

Year : 2022/23 **Semester:** II

Course title:	ANIMAL TAXONOMY -2	**Course code :**	MZOO204DSC
Course type:	Discipline Specific Course	**Course credit :**	04

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
4	0	3	20	10	70	100

Course Objective:

1. To impart a thorough understanding of non-chordates and vertebrates, including their classification, characteristics, and diverse adaptations.
2. To introduce students to the evolutionary history and ecological significance of different animal classes, fostering a holistic view of the animal kingdom.
3. To equip students with practical skills in taxonomy methods like DNA barcoding and specimen collection, promoting hands-on experience in biological research.
4. To prepare learners for further academic pursuits or careers in zoology, ecology, and related fields by providing a strong foundation in animal biology.

Course Outcome:

After thorough understanding of the content student will be able to explain:

CO1	Develop a comprehensive understanding of the classification, characteristics, and diversity of non-chordates and vertebrates, facilitating in-depth knowledge of animal biology.
CO2	Gain insights into the structural and functional adaptations of various animal classes, enabling an appreciation of their ecological roles and evolutionary history.
CO3	Acquire practical skills in zoological taxonomy, including DNA barcoding and specimen handling, essential for biological research and species identification.
CO4	Prepare students for advanced studies and careers in fields such as zoology, ecology, and wildlife biology by building a strong foundation in animal biology and taxonomy.

Content

Unit	Description in detail	Credit	Weightage
I	**Classification of non-chordates-2 (up to classes)** Classification, characteristics and diversity of Annelida Classification, characteristics and diversity of Mollusca Classification, characteristics and diversity of Arthropoda Classification, characteristics and diversity of Echinodermata. Classification, characteristics and diversity of Hemichordate	1	25 %
II	**Introduction to vertebrates-1** Classification and characteristics of subphylum vertebrata Classification, characteristics and diversity of different classes of fishes Structural and functional adaptation of fishes Evolution of terrestrial vertebrates	1	25 %
III	**Introduction to vertebrates-2 (up to order)** Classification, characteristics and diversity of class amphibia Classification, characteristics and diversity of class reptilian Classification, characteristics and diversity of class Aves Classification, characteristics and diversity of class mammals	1	25 %
IV	**Methods in Taxonomy** Zoological nomenclature and ICZN rules and regulation Type concept DNA barcoding of animal species Procedure of collection, preservation and identification of species	1	25%

Suggested Readings:

1. Hickman C. P., et al. 2006 Integrated principals of Zoology, McGraw Hill Higher Education. 931pp. 14th edition.
2. Ekambarantha Ayyar, M and T.N. Ananthakrishnan. 1992. A manual of Zoology Vol. II[Chordata]. S. Viswanaathan (Printers and Publishers] Pvt. Ltd., Madras.
3. Jordan E.L. and P.S. Verma 1995. Chordata Zoology and Elements of Animal Physiology. S. Chand and Co., New Delhi.
4. Kotpal R.L. 1992. Vertebrata, Rastogi Publications, Meerut

Practical:

Animal Taxonomy-2

1. Study of Classification of Annelida using laboratory specimens.
2. Study of Classification of Mollusca using laboratory specimens.

Online Resources

https://infinitylearn.com/surge/biology/classification-of-animal-kingdom/

https://testbook.com/key-differences/vertebrates

https://www.iczn.org/the-code/the-code-online/

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1-Less Relevant, 2- Mild Relevant, 3-Highly Relevant)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**2**	**3**	**-**	**1**	**-**	**-**	**2**	**-**	**-**	**1**	**2**	**1**
CO2	**2**	**2**	**-**	**1**	**-**	**-**	**1**	**-**	**-**	**2**	**2**	**1**
CO3	**2**	**3**	**-**	**2**	**-**	**-**	**1**	**-**	**-**	**2**	**2**	**1**
CO4	**2**	**2**	**-**	**2**	**-**	**-**	**1**	**-**	**-**	**2**	**1**	**2**

Program: Master of science **Subject / Branch:** Zoology

Year : 2022/23 **Semester:** II

Course title:	WILDLIFE BIOLOGY - 2	**Course code :**	MZOO206SE
Course type:	Subject Elective	**Course credit :**	02

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
4	0	3	10	05	35	50

Course Objective:

1. Equip students with essential skills for accurately estimating wildlife populations and evaluating habitat use, fostering informed conservation decisions.
2. Prepare learners to address and mitigate human-wildlife conflicts, promoting coexistence and sustainable wildlife management.
3. Provide practical training in wildlife immobilization and rescue techniques, enabling effective intervention for wildlife welfare.
4. Empower students for careers in wildlife conservation, research, and management by imparting knowledge and practical expertise in wildlife assessment and conflict resolution.

Course Outcome:

After thorough understanding of the content student will be able to explain:

CO1	Proficiency in employing advanced techniques to estimate wildlife populations and assess their habitat use, contributing to evidence-based wildlife management.
CO2	Competence in addressing human-wildlife conflicts through effective management and conservation outreach, ensuring coexistence and biodiversity preservation.
CO3	Acquiring practical skills in wildlife immobilization and rescue, facilitating hands-on intervention for wildlife welfare and conservation.
CO4	Preparedness for impactful careers in wildlife conservation, research, and management, equipped with a comprehensive understanding of wildlife assessment and conflict resolution.

Content

Unit	Description in detail	Credit	Weightage
I	Estimating number of wildlife (Census techniques) Measuring habitat use and occupancy Wildlife habitat evaluation techniques Wildlife population monitoring techniques	1	50 %
II	Human-wildlife Interaction Management and mitigation of conflicts Conservation outreach programmed Immobilization and rescue of wildlife	1	50 %

Suggested readings:

1. T A Bookhout 1996. Research and Management Techniques for Wildlife and Habitats. The Wildlife Society, ML
2. D E Wilson 2002. Measuring and Monitoring Biological Diversity: Standard Methods. The Smithsonian Institution, USA
3. J P Sands et al. 2012. Wildlife Science: Connecting Research with Management. CRCPress, Taylor and Francis Group

Online Resources

https://www.mdpi.com/2073-445X/11/10/1754

https://conbio.onlinelibrary.wiley.com/doi/10.1111/csp2.568

https://india.wcs.org/Programmes/Human-wildlife-interactions

https://pdf.usaid.gov/pdf_docs/PA00KGF2.pdf

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1-Less Relevant, 2- Mild Relevant, 3-Highly Relevant)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**2**	**2**	**-**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**2**	**3**
CO2	**2**	**2**	**-**	**1**	**1**	**2**	**-**	**-**	**-**	**-**	**1**	**2**
CO3	**2**	**3**	**-**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**2**	**3**
CO4	**2**	**2**	**-**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**2**	**2**

Program: Master of science **Subject / Branch:** Zoology

Year : 2022/23 **Semester:** III

Course title:	Animal Physiology	**Course code :**	MZOO301DSC
Course type:	Discipline Specific Course	**Course credit :**	04

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
4	0	3	20	10	70	100

Course Objective:

1. To provide a comprehensive understanding of the physiological processes governing digestion, respiration, circulation, and sensory mechanisms in the human body.
2. To equip students with knowledge of the anatomy and function of key organ systems, including the urine-genital and thermoregulatory systems.
3. To enable students to identify and comprehend common physiological disorders, fostering the ability to analyze and address health-related issues.
4. To prepare learners for careers in healthcare, medicine, and life sciences by imparting a solid foundation in human physiology and its applications.

Course Outcome:

After thorough understanding of the content student will be able to explain:

CO1	Proficiency in understanding and explaining the complex physiological processes governing digestion, respiration, circulation, and sensory mechanisms.
CO2	Ability to analyze and recognize common physiological disorders, facilitating early diagnosis and intervention.
CO3	Knowledge of the anatomical and functional aspects of the urino-genital and thermoregulatory systems, contributing to a holistic understanding of human physiology.
CO4	Preparedness for careers in healthcare, medicine, and life sciences, with a strong foundation in human physiology and its practical applications.

Content

Unit	Description in detail	Credit	Weightage
I	**Physiology of digestion, respiration and circulation** Physiology of digestion Physiology of respiration Composition of blood Myogenic heart, cardiac cycle and ECG	1	25 %
II	**Physiology of muscles, neurons and sensory mechanism** Types and functions of muscles, process of contraction and relaxation of muscles Anatomy of central and peripheral nervous system; neurotransmitters and their physiological functions. Types and functions of receptors: photoreceptors, chemoreceptors, mechanoreceptors, thermoreceptors.	1	25 %
III	**Physiology of urino-genital system and thermoregulation** Excretory organs: anatomy and physiology Reproductive organs: anatomy and physiology Menstrual cycle, physiology of pregnancy Thermoregulatory organs and their function	1	25 %
IV	**Physiological disorders** Disorders of digestive and respiratory system Hematological and cardiac disorders Muscular and neuronal disorders Disorders of urino-genital systems	1	25%

Suggested Readings:

1) Bell, G.E. Davidson, J.N. and Emslie D. (1922) Smith Text Book of Physiology & Biochemistry
2) Dayson, (1964) A Text Book of General Physiology: Little Brown & Co. Boston.
3) Eckert R. and Randall D. (1983) Animal Physiology: 2nd Edn. W.H. Rexeman & Co.
4) Guyton, A.G. (1968) Textbook of Medical Physiology: 7th Edn. Saunders Pub.
5) Ganong W.F. (1981) Medical Physiology: 10th Edn. Lange Medical Publications.
6) Tortora Grabowski Principles of Anatomy and Physiology:, 9th Edn. John Willey &Sons.

Practical:

Animal Physiology

1. Total RBC count in blood sample.
2. Total WBC count in blood sample
3. Estimation of bleeding and clotting time.
4. Hemoglobin estimation in blood sample

5. Differential count of leucocytes.

6. Determination of blood group of given blood sample.

Online Resources

https://www.onlinebiologynotes.com/physiology-of-digestion/

https://www.hmpgloballearningnetwork.com/site/emsworld/article/10480389/physiology-respiration

https://open.oregonstate.education/aandp/chapter/10-3-muscle-fiber-excitation-contraction-and-relaxation/

https://emedicine.medscape.com/article/1948687-overview

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1-Less Relevant, 2- Mild Relevant, 3-Highly Relevant)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**3**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**2**
CO2	**2**	**2**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**1**
CO3	**2**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**
CO4	**2**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**1**

Program: Master of science **Subject / Branch:** Zoology

Year : 2022/23 **Semester:** III

Course title:	Immunology and Endocrinology	**Course code :**	MZOO302DSC
Course type:	Discipline Specific Course	**Course credit :**	04

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
4	0	3	20	10	70	100

Course Objective:

1. To foster a deep understanding of the immune system's components, innate and adaptive immunity principles, and antigen recognition mechanisms.
2. To elucidate the roles of immune receptors, signaling pathways, and regulation in immune responses, enabling students to grasp immune system functionality.
3. To familiarize students with disease-related aspects, including immunodeficiency, allergy, autoimmunity, and vaccine development, preparing them to address immunological challenges.
4. To equip learners with a solid foundation in immunology, empowering them for careers in healthcare, research, and immunotherapy development.

Course Outcome:

After thorough understanding of the content student will be able to explain:

CO1	Proficiency in comprehending the immune system's intricate workings, from innate and adaptive immunity to antigen recognition.
CO2	Ability to analyze and interpret immune responses, including immune receptor signaling and regulation.
CO3	Knowledge of immunological disorders, infectious diseases, allergies, and autoimmune conditions, facilitating their diagnosis and treatment
CO4	Preparedness for careers in immunology, research, vaccine development, and healthcare, with a strong foundation in immune system dynamics and applications.

Content

Unit	Description in detail	Credit	Weightage
I	**Overview of the immune system** Components of the immune system, principles of innate and adaptive immunity, the recognition and effector mechanisms of the adaptive immunity- antigen and immunogenicity, clonal selection theory. Antigen recognition by immune cells: Adaptive immunity- antibody structure, antigen recognition by B lymphocytes, TCR, antigen recognition by T cells, co- receptors, structure and function of MHC complex generation of lymphocyte antigen receptors- generation of diversity in immunoglobulins, T cell receptor gene are arrangement, structural variations in immunoglobulin constant regions	1	25 %
II	**Receptors of immune system** Antigen processing and presentation to T lymphocytes antigen presenting cells, generation of T cell receptor ligand, and MHC restriction, role of CDI in antigen presentation. Innate Immunity- pattern recognition in the innate immune system, role of TLRs in innate immune response. Complement and innate immunity, induced innate response to infection.	1	25 %
III	**Mechanism of immune system** **E**ffector mechanisms and regulation of immune responses: Signaling through immune system receptors- antigen receptor structure and signaling pathways Other signaling pathways that contribute to lymphocyte behavior; development and survival of lymphocytes- B lymphocyte development and survival, humoral immune response. T lymphocyte development and survival, production of effector T cells, cytotoxic T-cell effector mechanisms; NK and NKT cell functions; mucosal immunity; immunological memory; regulation of immune response cytokines and chemokines, complement system, leukocyte activation and migration, APC regulation of the immune response, T-cell mediated regulation of immune response, Immunological tolerance and anergy.	1	25 %
IV	**Disease of immune system** Immunity in health and disease: introduction to infectious disease, innate Immunity to infection, adaptive immunity to infection, evasion of the immune response by pathogens. immunodeficiency diseases inherited immunodeficiency diseases, acquired immune deficiency syndrome; allergy and hypersensitivity- IgE and allergic reactions, hypersensitivity diseases. Autoimmunity responses to self-antigens, transplant rejection- responses to all antigens. manipulation of immune responses, vaccines; evolution of immune system- evolution of innate immune system, evolution of adaptive immune system.	1	25%

References

1) Richard, Thomas, Barbara, Janis (2005) Kuby Immunology, W. H. Freeman and company, New York, USA.
2) Janeway, Travers, Walport and Shlomchik (2005) Immuno Biology- The immune system in health and disease, Garland Science Publishing, New York, USA.
3) David, Brostoff and Roitt (2006) Immunology, (7th Ed., 2006), Mosby & Elsevier Publishing, Canada, USA.
4) Mac Hadley. 1992. Endocrinology, 3 rd Edition. Prentice – Hall Inc. A Simon &Schuster Company, Englewood Cliffs, New Jersey. USA.
5) Ingleton, P.M. and Bangara, J.T. 1986. Fundamentals of comparative vertebrate endocrinology, Kluwer Academic Publishers.
6) Turner, C.D. and Bangara, J.T. 1986. General endocrinology. Saunders International Student edition. Toppan Company Limited. Tokyo.

Practical:

Immunology and Endocrinology

1. To study location of endocrine glands in animal body using charts
2. To study histology of endocrine glands using permanent slides.
3. To study various endocrine disorders via power point slide or photographs.
4. Preparation of report on prevalence of different endocrine diseases in Patan city.
5. Introduction to immunological test carried out in pathology laboratory.
6. Histology of lymphoid organs using permanent slides/charts
7. Effect of various digestive enzymes.
8. Study of haemin crystals.

Online Resources

https://www.niaid.nih.gov/research/immune-system-overview

https://www.nature.com/articles/nri35100529

https://www.ncbi.nlm.nih.gov/books/NBK279364/

https://www.niaid.nih.gov/research/immune-system-disorders

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1-Less Relevant, 2- Mild Relevant, 3-Highly Relevant)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**3**	**2**	**-**	**2**	**-**	**-**	**2**	**-**	**1**	**1**	**2**	**1**
CO2	**2**	**2**	**-**	**1**	**-**	**-**	**1**	**-**	**1**	**1**	**1**	**1**
CO3	**2**	**2**	**-**	**2**	**-**	**-**	**2**	**-**	**1**	**2**	**2**	**1**
CO4	**2**	**2**	**-**	**2**	**-**	**-**	**1**	**-**	**1**	**1**	**1**	**1**

Program: Master of science **Subject / Branch:** Zoology

Year : 2022/23 **Semester:** III

Course title:	Developmental Biology and Evolution	**Course code :**	MZOO303DSC
Course type:	Discipline Specific Course	**Course credit :**	04

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
4	0	3	20	10	70	100

Course Objective:

1. To provide a comprehensive understanding of developmental biology, spanning gametogenesis, embryonic development, organogenesis, and regeneration in animals.
2. To introduce students to the fundamentals of evolution, covering historical perspectives, evidences, and key experiments, including the origin of life.
3. To familiarize learners with genetic concepts crucial to evolution, including gene pools, genetic drift, and speciation.
4. To equip students with knowledge of human evolution and the evolutionary timelines of various faunal groups, fostering a holistic grasp of life's development and diversity.

Course Outcome:

After thorough understanding of the content student will be able to explain:

CO1	Gain a profound understanding of developmental biology, from gametogenesis and early embryonic processes to organogenesis and regeneration in animals.
CO2	Explore the principles and evidence of evolution, including key experiments like the Miller-Urey and Oparin-Haldane hypotheses
CO3	Comprehend genetic concepts related to evolution, such as gene pools, genetic drift, and speciation.
CO4	Acquire knowledge of human evolution and the evolutionary history of diverse faunal groups, providing a well-rounded perspective on the science of life's development and diversification.

Content

Unit	Description in detail	Credit	Weightage
I	**Introduction to developmental biology** History and basic concept of developmental biology Gametogenesis: spermatogenesis and oogenesis Fertilization, Parthenogenesis Early developmental process: cleavage and formation of blastula, gastrulation, neural tube formation, cell migration	1	25 %
II	**Axis formation, limb development and hormonal control** Genetics of axis formation in drosophila General concept of organogenesis: development of chick limb Regeneration in animals: Epimorphosis and morphallaxis The biology of ageing	1	25 %
III	**Introduction to evolution** Brief history of evolution, Direct and indirect evidences of evolution Experiments about origin of life: Miller-Urey experiment, Oparin-Haldane hypothesis Theories of evolution Gene pool, gene frequency, genetic drift and founder effect	1	25 %
IV	**Processes of evolution** Types of isolation, speciation Adaptive radiation, Micro, macro and Mega evolution Geological time scales and evolution of different faunal groups Human evolution	1	25%

Suggested Readings:

1) Riddle M. (1996) Evolution. 2nd edn. Blackwell.
2) Piyanka E.R. (1994) Evolutionary Ecology 5th edn Harper Collins
3) Verma P. S. and Agrawal V. K. 2010 Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, S. Chand & Company Ltd.
4) Gilbert, (2006) Developmental Biology, Sinauer Associates Inc., Massachusetts, USA. 2
5) Wolpert (2006) Principles of Development, Beddington, Brockes, Jessell, Lawrence, Meyerowitz, (3rd Ed., 2006), Oxford University Press, New Delhi, India.
6) Kalthoff (2000) Analysis of Biological Development, McGraw-Hill Science, New Delhi, India.

Practical:

Developmental Biology and Evolution

1. To study stages of gametogenesis using slides or charts.
2. To study embryonic development in fish, frog and chick using charts.
3. Study of different developmental stages of chick embryo using permanent slides or charts.
4. To study various larval stages of Arthropods.
5. To study various larval stages of Echinoderms.
6. To study evolution of heart in different vertebrates.
7. To study evolution of brain in different vertebrates.
8. Study of fossils.
9. Study of human evolution.

Online Resources

http://bgc.ac.in/pdf/study-material/developmental-biology-7th-ed-sf-gilbert.pdf

https://www.slideshare.net/sowndaryadhinchak/axis-formation-in-birds-and-mammals

https://www.vedantu.com/biology/theory-of-evolution

https://www.nationalgeographic.org/encyclopedia/speciation/

https://geologyscience.com/geology-branches/paleontology/geologic-time-scale/?amp

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1-Less Relevant, 2- Mild Relevant, 3-Highly Relevant)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**3**	**2**	**-**	**2**	**-**	**-**	**1**	**-**	**1**	**1**	**2**	**2**
CO2	**2**	**2**	**-**	**1**	**-**	**-**	**1**	**-**	**1**	**2**	**2**	**2**
CO3	**2**	**2**	**-**	**2**	**-**	**-**	**1**	**-**	**1**	**2**	**1**	**1**
CO4	**2**	**2**	**-**	**2**	**-**	**-**	**1**	**-**	**1**	**1**	**1**	**1**

Program: Master of science **Subject / Branch:** Zoology

Year : 2022/23 **Semester:** III

Course title:	Advance Techniques in Zoology	**Course code :**	MZOO304DSC
Course type:	Discipline Specific Course	**Course credit :**	04

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
4	0	3	20	10	70	100

Course Objective:

1. To equip students with essential techniques for quantitative biodiversity assessment, encompassing field surveys, population censuses, and molecular analysis.
2. To introduce remote sensing principles and image processing, enabling students to analyze spatial data and apply it to various domains, including land use and ecology.
3. To foster an understanding of GIS fundamentals and functions, empowering students to manipulate and present geospatial information effectively.
4. To prepare learners for careers in conservation, environmental research, and spatial analysis, providing them with valuable skills and knowledge in biodiversity assessment and geographic information systems (GIS)

Course Outcome:

After thorough understanding of the content student will be able to explain:

CO1	Proficiency in diverse techniques for assessing biodiversity, from field-based surveys to phylogenetic DNA analysis, facilitating comprehensive ecological research.
CO2	Competence in remote sensing and GIS applications, enabling students to analyze spatial data and contribute to land use planning and ecological modeling.
CO3	Ability to apply GIS tools to address environmental challenges, including species distribution modeling and fragmentation analysis.
CO4	Preparedness for careers in conservation, ecology, and environmental science, with practical skills and expertise in biodiversity assessment and spatial data analysis.

Content

Unit	Description in detail	Credit	Weightage
I	**Techniques for biodiversity assessment** Quantitative assessment of biodiversity: different types of transects, quadrates and data analysis. Population census techniques for vertebrates Invertebrate sampling techniques Phylogenetic analysis of DNA sequences.	1	25 %
II	**Remote Sensing and Applications** Introduction to remote sensing, History and scope Energy sources and EMR, RS sensors and platforms Image processing and classification Land cover and Land use analysis, Analysis of spatial data RS applications in different fields	1	25 %
III	**GIS Basics** Fundamentals of GIS and functions of GIS Software for GIS (GIS lab) Spatial data models Presentation of GIS data	1	25 %
IV	**GIS Applications** Ecological modeling through GIS Species distribution models Fragmentation analysis Applications of GIS	1	25%

References:

1) Krishnamurthy K. V. 2003 An Advanced Textbook on Biodiversity Principles and Practice. Oxford & IBH Publishing C. Pvt. Ltd. New Delhi.
2) Shantharam, S. and Montgomery, J.F. 1999. Biotechnology, Biosafety and Biodiversity. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

Practical:

Applied Zoology

1. Calculation of examples of Hardy-Weinberg principle
2. Generation of GIS enabled files.
3. Geo-referencing of toposheets.
4. Construction of a maps on the GIS platform
5. Data extraction using GIS
6. Processing & classification of satellite image

Online Resources

https://serc.si.edu/research/research-topics/biodiversity-conservation/biodiversity-assessment

https://gisgeography.com/remote-sensing-applications/

https://www.manage.gov.in/studymaterial/gis.pdf

https://www.sgligis.com/applications-of-gis/

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1-Less Relevant, 2- Mild Relevant, 3-Highly Relevant)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**3**	**2**	**-**	**2**	**-**	**1**	**2**	**-**	**-**	**1**	**2**	**1**
CO2	**2**	**2**	**-**	**1**	**-**	**1**	**2**	**-**	**-**	**2**	**2**	**1**
CO3	**2**	**2**	**-**	**2**	**-**	**1**	**1**	**-**	**-**	**2**	**1**	**1**
CO4	**2**	**2**	**-**	**2**	**-**	**2**	**2**	**-**	**-**	**1**	**1**	**1**

Program: Master of science **Subject / Branch:** Zoology

Year : 2022/23 **Semester:** III

Course title:	Wildlife Biology- 3	**Course code :**	MZOO306SE
Course type:	SUBJECT ELECTIVE	**Course credit :**	02

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
2	0	0	10	05	35	50

Course Objective:

1. To educate students on both conventional and cutting-edge research and monitoring techniques in wildlife biology, fostering proficiency in data collection and species conservation.
2. To introduce students to camera trapping, radio telemetry, non-invasive genetics, and technology-driven approaches, equipping them with practical skills for wildlife research.
3. To encourage the use of information technology and citizen science in wildlife research, empowering students to contribute to conservation efforts innovatively.
4. To prepare learners for impactful careers in wildlife biology, conservation, and research by providing comprehensive training in contemporary methodologies and technology applications.

Course Outcome:

After thorough understanding of the content student will be able to explain:

CO1	Proficiency in employing both conventional and advanced research and monitoring techniques for wildlife biology, enabling comprehensive data collection and species conservation.
CO2	Competence in camera trapping, radio telemetry, and noninvasive genetics, providing practical skills for studying wildlife and contributing to conservation efforts.
CO3	Ability to apply information technology and citizen science approaches in wildlife research, fostering innovative solutions for wildlife monitoring and protection.
CO4	Preparedness for careers in wildlife biology, conservation, and research, with a strong foundation in contemporary techniques and methodologies.

Content

Unit	Description in detail	Credit	Weightage
I	**Unit 1** Conventional Research & Monitoring techniques Advanced research & Monitoring techniques Camera trapping Radio telemetry	1	**50%**
II	**Unit 2** Noninvasive conservation genetics Wildlife research case studies Use of information technology in wildlife research (*in silico* wildlife research) Citizen science approach and Wildlife forensics	1	**50%**

References

1) Sinclair A. R., Fryxell J M and Caughly G. (2006) Wildlife Ecology, Conservation and Management. Blackwell Publishing, U.S.A.
2) Gopal R. (1992) Fundamentals of Wildlife Management. Justice Home, Allahabad, India.
3) Jairajpuri M. S. (1990) Collection and preservation of animals. Zoological Survey of India.
4) Magguran, A.E. (1996). Ecological diversity and its measurements. Princeton University.
5) Gadgil, M. (2002) A methodology mannual for scientific inventorying, monitoring and conservation of Biodiversity
6) Hickman C. P., et al. 2006 Integrated principals of Zoology, McGraw Hill Higher Education. 931pp. 14th edition.

Online Resources

https://www.researchgate.net/figure/Conventional-monitoring-system_fig1_283725311

https://link.springer.com/chapter/10.1007/978-3-030-65606-5_4

https://tnrf.org/files/E-INFO-Human-Wildlife_Conflict_worldwide_case_studies_by_Elisa_Distefano_no_date.pdf

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1-Less Relevant, 2- Mild Relevant, 3-Highly Relevant)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**2**
CO2	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**2**
CO3	**2**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**
CO4	**2**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**2**

Program: Master of science **Subject / Branch:** Zoology

Year : 2022/23 **Semester:** IV

Course title:	Histology, Histochemistry and Parasitology	**Course code** :	MZOO401DSC
Course type:	Discipline Specific Course	**Course credit** :	04

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
4	0	3	20	10	70	100

Course Objective:

1. Develop proficiency in histological techniques for tissue analysis and staining methods.
2. Gain comprehensive knowledge of various body tissues, including epithelial, connective, muscle, and digestive tissues.
3. Understand the diversity of parasitic infections, their hosts, and transmission modes, including bacteria, protozoans, helminths, and arthropods.
4. Equip students with the skills and knowledge necessary for careers in healthcare, biology, and research involving histology and parasitology.

Course Outcomes: At the end of the course, students shall be able to

CO1	In this concept of Histology students will understand the basic introduction of Histochemistry and tissue processing and also understand different strain method
CO2	In this concept of Histology students will understand the basic introduction of body tissue and histology of bones and cartilage and also different type of digestive tissue
CO3	In this concept of Parasitology students will understand the specific human parasites and the diseases they cause. Emphasis is placed throughout on the basic biology of the pathogens and their host-parasite relationships.
CO4	In this concept of Parasitology students will understand with the structure and classification of parasites and the mechanisms of parasitic diseases.

Content

Unit	Description in detail	Credit	Weightage
I	**Histological Techniques** Introduction to histology and histochemistry Tissue processing, fixation and microtomy Staining methods: acid, basic, neutral and vital stains and various histochemical stains Staining of frozen and paraffin sections	1	25 %
II	**Histology of body tissue** Introduction to types of body tissue Histology of Epithelial tissue and connective tissue Histology of muscle, bones and cartilage Histology of digestive system tissues (tongue, oesophagus, stomach, large intestine, pancreas, liver) and nervous tissue	1	25 %
III	**Parasitology 1** Introduction Parasitology Types of hosts and parasites Food and water-borne bacterial diseases Sexually transmitted bacterial diseases	1	25 %
IV	**Parasitology 2** Parasitic protozoans and human diseases Parasitic trematoda, cestoda and human diseases Parasitic nematode and human diseases Parasitic mites, ticks and their control	1	25%

Suggested Readings:

1) Bloom and Fawcett. D. 1972 Text book of histology 10th ed. 3.
2) David H.C. 1987 Histology 9th ed. (Horper International Pub)
3) McManus J.F.A. and Mowry R.W. 1960 Staining methods.
4) Cheng T.C. (1964) The Biology of animal parasites, Saunders International Student Edition
5) Panikar C.K.J (1988) 5. The Parasitology of Trematodes Oliver and Boyd Ltd. Edinburgh.
6) Sood Pamnik (1993) Parasitology (Protozoology and Helminthology) CBS Publication and Distrubution, Delhi.

Practical:

Histology, Histochemistry and Parasitology

1) Study of different types of microtomes.
2) To study histological structure of different types of epithelial tissue using permanent slides.
3) To study histological structure of different types of muscle tissue using permanent slides.
4) To study histological structure of bone and cartilage using permanent slides.
5) Study of parasitic protozoan causing disease in humans.
6) Study of parasitic platyhelminths causing diseases in humans.
7) Study of parasitic nematode causing diseases in humans.
8) Study of parasitic mites and ticks.

Online Resources

https://www.youtube.com/watch?v=1wiQsGNg0T0

https://byjus.com/biology/difference-between-host-and-parasite/

https://byjus.com/biology/protozoan-disease/

https://health.mo.gov/living/healthcondiseases/communicable/stds/

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1-Less Relevant, 2- Mild Relevant, 3-Highly Relevant)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**3**	**2**	**-**	**1**	**-**	**-**	**2**	**-**	**-**	**-**	**3**	**2**
CO2	**2**	**2**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**1**
CO3	**2**	**2**	**-**	**2**	**-**	**-**	**2**	**-**	**-**	**2**	**2**	**1**
CO4	**3**	**1**	**-**	**3**	**-**	**-**	**1**	**-**	**-**	**2**	**2**	**1**

Program: Master of science **Subject / Branch:** Zoology

Year : 2022/23 **Semester:** IV

Course title:	Animal Behavior	**Course code :**	MZOO402DSC
Course type:	Discipline Specific Course	**Course credit :**	04

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
4	0	3	20	10	70	100

Course Objective:

1. To introduce students to the fascinating field of animal behavior, its historical foundations, and core concepts.
2. To equip students with practical skills and methodologies for studying and analyzing animal behavior, including sensory perception and learning mechanisms.
3. To provide a comprehensive understanding of various types of animal behavior, from territoriality to social organization, and their ecological significance.
4. To explore the physiological underpinnings of animal behavior, including the roles of pheromones, hormones, biological clocks, and human ethology, fostering a well-rounded understanding of this interdisciplinary subject.

Course Outcomes: At the end of the course, students shall be able to

CO1	In this concept of animal behavior students will understand the basic introduction of history of animal behavior different approaches and methods of animal behavior
CO2	In this concept of animal behavior students will understand the different types of animal behavior
CO3	In this concept of animal behavior students will understand the behavioral ecology and social behavior
CO4	In this concept of animal behavior students will understand the physiology of animal behavior including pheromones in animal behavior and hormones in animal behavior also biological clocks

Content

Unit	Description in detail	Credit	Weightage
I	**Introduction to animal behavior** Introduction and history of animal behavior Concepts of animal behavior Imprinting animals Approaches and methods to study animal behavior and role of sense organs in behavior	1	25 %
II	**Types of animal behavior** Learning behavior: types and neural mechanism Aggressive behavior: types, causes and hormonal control Territorial behavior: types, functions and methods Parental care: Types and affecting factors	1	25 %
III	**Behavioral ecology and social behavior** Orientation in animals: types, kinesis and taxes Feeding strategies in animals Types of communication: Auditory, Visual, Chemical and Tactile Social organization in mammals	1	25 %
IV	**Physiology of animal behavior** Role of pheromones in animal behavior Role of hormones in animal behavior Biological clocks Human ethology	1	25%

Suggested Readings:

1) Alcock J. 2013 Animal Behavior: An Evolutionary Approach, 10th edition (Sinauer Associates, Inc.)
2) Bolhuis J. J. and Giraldeau L. (eds) 2005 The behaviour of animals (Blackwell Pub.)
3) Breed and Moore 2011 Animal Behavior, 1st Edition (Academic Press)
4) Mathur R. 2008 Animal behaviour (Rastogi Pub.: India)
5) Manning A. and Dawkins M. S. 1997 An Introduction to Animal behaviour (4th edition)
6) Sherman P. W. and Alcock J. 1997 Exploring animal behaviour (Sinauer Asso. Inc. Pub.: Sunderland, Massachusetts)
7) Slater P. J. B. 1999 Essentials of Animal Behaviour (Cambridge Uni. Press)

Practical:

Animal Behaviour

1) Study of mud balling behavior of burrowing crab.
2) To study food preference in *Tribolium castaneum.*
3) To study the different types of receptors in *Tribolium castaneum.*
4) To study location of receptors by antennalectomy in *Tribolium castaneum.*
5) To study the effect of water temperature and pH on breathing rate of fish.

Online Resources

https://www.nature.com/scitable/knowledge/animal-behavior-13228230/

https://www.jstor.org/journal/behaecolsoci

https://www.bbau.ac.in/dept/dz/TM/ZL%20202%20Animal%20Behaviour.pdf

https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3A_General_Biology_(Boundless)/45%3A_Population_and_Community_Ecology/45.06%3A_Innate_Animal_Behavior/45.6A%3A_Introduction_to_Animal_Behavior

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1-Less Relevant, 2- Mild Relevant, 3-Highly Relevant)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**1**	**2**	**-**	**3**	**2**
CO2	**2**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**1**	**1**	**3**	**1**
CO3	**2**	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**1**	**-**	**3**	**2**
CO4	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**1**	**2**	**1**	**3**	**1**

Program: Master of science **Subject / Branch:** Zoology

Year : 2022/23 **Semester:** IV

Course title:	Toxicology and Environmental Biology	**Course code :**	MZOO403DSC
Course type:	Discipline Specific Course	**Course credit :**	04

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
4	0	3	20	10	70	100

Course Objective:

1. To introduce students to the foundational principles of toxicology, its historical evolution, and the diverse range of toxic agents.
2. To enable students to grasp the critical concept of dose-response relationships and assess toxicity through parameters like LD50 and EC50.
3. To educate students on environmental pollution across various mediums and its consequences, preparing them for effective pollution management.
4. To equip students with the knowledge and tools to address pressing global environmental issues, such as climate change, invasive species, and environmental impact assessment, fostering informed and responsible environmental stewardship.

Course Outcomes: At the end of the course, students shall be able to

CO1	In this concept of toxicology students will understand brief history of toxicology classification of toxic agents and characteristics of exposure toxicants
CO2	In this concept of toxicology students will understand different dose response relationship in toxicology
CO3	In this concept of toxicology students will understand different types of environmental pollution
CO4	In this concept of toxicology students will understand different environmental change and environmental impact assessment

Content

Unit	Description in detail	Credit	Weightage
I	**Introduction to toxicology** Brief history of toxicology Introduction and classification of toxic agents Spectrum of undesired effects of toxicity Characteristic of exposure of toxicant	1	25 %
II	**Dose response relationship in toxicology** Dose–Response Relationships: LD_{50}, LC_{50}, IC_{50}, IC_{90}, IC_{99}, EC_{50}, EC_{90} and EC_{99} Evaluating the Dose–Response Relationship Variation in toxic responses Descriptive animal toxicity tests	1	25 %
III	**Environmental pollution** Air pollution Water pollution Soil pollution Noise pollution	1	25 %
IV	**Global environmental change and environmental impact Assessment** Greenhouse effect Approaches to deal with global warming Impact, prevention and mitigation of invasive species Environmental impact assessment	1	25%

Suggested Readings:

1) Walker C H, Hopkin S P, Sibly R N and Peakall D B (Eds.) 2006. Principles of ecotoxicology- 3 rd. edition, Taylor and Francis, NewYork, NY.
2) Landis W.G.and Yu M.H. 2003 Introduction to Environmental toxicology -3 rd edition, Lewis publishers, Florida.
3) Hodgson E. and Levi P. 2000. Text Book of Modern Toxicology, McGraw – Hill International edition. Singapore.
4) Agarwal A. and Gopal K. 2010 Principles of toxicology, ibdc publishers India.

Practical:

Toxicology and Environmental Biology

1) To study the toxic effect of irritant on breathing rate of fish.
2) Comparative analysis of water samples collected from polluted and non polluted water bodies.
3) Comparative analysis of soil samples collected from polluted and non polluted water bodies.
4) To study the effect of neem tree leaf extract on mosquito larvae
5) Study of effect of common carcinogens and teratogens on human body using charts and pictures.

Online Resources

https://www.atsdr.cdc.gov/training/toxmanual/pdf/module-1.pdf

http://www.chemsafetypro.com/Topics/CRA/Toxicology_Dose_Descriptors.html

https://www.nrdc.org/stories/water-pollution-everything-you-need-know

https://www.nationalgeographic.org/encyclopedia/air-pollution/

https://www.nationalgeographic.org/encyclopedia/greenhouse-effect/

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1-Less Relevant, 2- Mild Relevant, 3-Highly Relevant)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**1**	**1**
CO2	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**1**	**2**
CO3	**3**	**2**	**2**	**2**	**-**	**2**	**-**	**-**	**2**	**-**	**2**	**1**
CO4	**2**	**2**	**2**	**2**	**-**	**2**	**-**	**-**	**1**	**-**	**2**	**1**

Program: Master of science **Subject / Branch:** Zoology

Year : 2022/23 **Semester:** IV

Course title:	Entomology	**Course code :**	MZOO404DSC
Course type:	Discipline Specific Course	**Course credit :**	04

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
4	0	3	20	10	70	100

Course Objective:

1. To introduce students to the field of entomology, imparting fundamental knowledge of insect classification, external and internal morphology, and key physiological systems.
2. To enable students to understand the intricate processes of metamorphosis, gaseous exchange, excretion, and communication in insects, highlighting their ecological importance.
3. To equip students with the skills and knowledge needed to identify and manage insect pests in agriculture and households, emphasizing integrated pest management strategies.
4. To foster a comprehensive understanding of the vital role insects, play in ecosystems and agriculture while preparing students for careers in applied entomology and pest control.

Course Outcomes: At the end of the course, students shall be able to

CO1	In this concept of Entomology students will understand basic introduction and general characters & classification of insect also understand of external morphology of insect
CO2	In this concept of Entomology students will get understand of internal morphology of insect (Grasshopper)
CO3	In this concept of Entomology students will get understand of physiology of an insect
CO4	In this concept of Entomology students will get understand of applied entomology

Content

Unit	Description in detail	Credit	Weightage
I	**Introduction to entomology** Introduction to entomology General characters of insect Classification of class insects (up to order) External morphology of insect: Head, Thorax and Abdomen (Grasshopper)	1	25 %
II	**Internal morphology of an insect (Grasshopper)** Digestive system, circulatory system, respiratory system Nervous system and sense organs Reproductive system and excretory system Different types of receptors and related organs	1	25 %
III	**Physiology of an insect** Metamorphosis and molting in insect Gaseous exchange and thermoregulation in insect Excretion and water regulation in insect Communication in insect: light production, sound production and chemical communication	1	25 %
IV	**Applied entomology** Insect pest to crop, pulses and vegetable and their control Household pest and their control Methods to control insect pest Insect vectors and Integrated pest management	1	25%

References

1) Chapman R.F. 1998. The Insects: Structure and Function. Cambridge Univ. Press, Cambridge.
2) David B.V. and Ananthkrishnan T. N. 2004. General and Applied Entomology. TataMcGraw Hill, New Delhi.
3) Duntson P. A. 2004. The Insects: Structure, Function and Biodiversity. Kalyani Publ., New Delhi.
4) Mathur and Upadhyay A textbook of Entomology. Aman publication house, India.
5) Richards O. W. and Davies R. G. 1977. Imm's General Text Book of Entomology. 10th Ed. Chapman & Hall, London.
6) Saxena R.C. and Srivastava R. C. 2007. Entomology: At a Glance. Agrotech Publ. Academy, Jodhpur.

Practical:

Entomology

1) Study of classification of class insecta up to orders using museum specimens.
2) Mounting of mouth parts of mosquito and housefly.
3) Study of modification of antennae in different insects.
4) Study of modification of legs in different insects.
5) Study of different systems of insect using charts/pictures.
6) Study of insect pest of crop, pulses and vegetable and their control.

Online Resources

https://www.rvskvv.net/images/I-Year-II-Sem_Fundamentals_Entomology_b_20.04.2020.pdf

https://csauk.ac.in/wp-content/uploads/2021/08/PG.pdf

https://www.amnh.org/learn-teach/curriculum-collections/biodiversity-counts/arthropod-identification/arthropod-morphology/parts-of-an-insect-grasshopper

https://www.mlsu.ac.in/econtents/1208_Insect%20Anatomy%20and%20Physiology%20%E2%80%93%20I,II,III&IV.pdf

http://ecoursesonline.iasri.res.in/course/view.php?id=148

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1-Less Relevant, 2- Mild Relevant, 3-Highly Relevant)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**2**	**2**	**2**	**2**	**1**
CO2	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**1**	**2**	**1**	**2**	**1**
CO3	**3**	**-**	**1**	**-**	**-**	**-**	**-**	**2**	**1**	**-**	**2**	**1**
CO4	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**-**	**2**	**1**

Program: Master of science **Subject / Branch:** Zoology

Year : 2022/23 **Semester:** IV

Course title:	Wildlife Biology- 4	**Course code :**	MZOO406SE
Course type:	ELECTIVE	**Course credit :**	02

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
2	0	0	20	10	70	100

Course Objective:

1. To educate students about crucial wildlife conservation laws in India, promoting an understanding of their role in protecting biodiversity.
2. To introduce students to global conservation organizations like IUCN and international initiatives like CITES and TRAFFIC, fostering awareness of international conservation efforts.
3. To analyze real-life case studies of wildlife crime control, enabling students to comprehend the challenges and strategies employed in combatting illegal wildlife activities.
4. To equip students with the knowledge and awareness needed to contribute effectively to wildlife conservation and law enforcement efforts, preparing them for careers in this field.

Course Outcomes: At the end of the course, students shall be able to

CO1	In this concept of wildlife biology students will get understand of different type of act (Indian wildlife protection act, forest act, national biodiversity act).
CO2	Students will learn about importance of law and regulations in wildlife conservation
CO3	In this concept of wildlife biology students will get understand of different type of organization (IUCN, CITIES, TRAFFIC)
CO4	Students will learn about different type of Wildlife crime: case study

Content

Unit	Description in detail	Credit	Weightage
I	**Unit 1** Indian Wildlife Protection Act (1972) Forest Act (1927) National Biodiversity Act (2002) Importance of law and regulations in wildlife conservation	1	**50%**
II	**Unit 2** IUCN as a global conservation organization CITIES TRAFFIC Wildlife crime control: case studies	1	**50%**

References

1) Sinclair A. R., Fryxell J M and Caughly G. (2006) Wildlife Ecology, Conservation and Management. Blackwell Publishing, U.S.A.
2) Gopal R. (1992) Fundamentals of Wildlife Management. Justice Home, Allahabad, India.
3) Jairajpuri M. S. (1990) Collection and preservation of animals. Zoological Survey of India.
4) Magguran, A.E. (1996). Ecological diversity and its measurements. Princeton University.
5) Gadgil, M. (2002) A methodology mannual for scientific inventorying, monitoring and conservation of Biodiversity
6) Hickman C. P., et al. 2006 Integrated principals of Zoology, McGraw Hill Higher Education. 931pp. 14th edition

Online Resources

https://en.wikipedia.org/wiki/Wild_Life_(Protection)_Act,_1972

https://www.indiacode.nic.in/handle/123456789/2046?sam_handle=123456789/1362

https://www.encyclopedia.com/environment/energy-government-and-defense-magazines/wildlife-protection-policies-and-legislation

https://www.iucn.org

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1-Less Relevant, 2- Mild Relevant, 3-Highly Relevant)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**3**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**
CO2	**3**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**
CO3	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1**
CO4	**2**	**2**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**2**