MAHARAJA'S COLLEGE, ERNAKULAM

(Govt. Autonomous -Affiliated to MG University, Kottayam)

UNDERGRADUATE PROGRAMMES (HONOURS)

SYLLABUS

MCE-UGP (Honours)

(2024 Admission Onwards)

Faculty: Science

BoS: Zoology

Programme: BSc Zoology (Honours)

Maharaja's College, Ernakulam
(Govt. Autonomous)
Park Avenue Road, Marine Drive
Ernakulam– 682011, Kerala, India

Contents

Preface

The Post Graduate and Research Department of Zoology at Maharajas College is dedicated to advancing the study and research of zoology through innovative and comprehensive academic programs. Known for its excellence in teaching and research, the department continuously strives to stay at the forefront of scientific discovery and education. In alignment with these goals, the department has embraced the University Grants Commission's concept of a Four-Year Undergraduate Program, which envisions a paradigm shift from a teacher-centric to a student-centric higher education system in India.

The University Grants Commission has introduced the concept of a Four-Year Undergraduate Program, which aims to shift from a teacher-centric to a student-centric higher education system in India. This proposal has been endorsed for implementation by the Kerala Higher Education Council. Following the regulations of Mahatma Gandhi University, the Board of Studies of Zoology has developed a curriculum emphasizing skill-based education, with graduate attributes guiding the design of programs, courses, and supplementary activities. The framework allows students to exit with a BSc Degree in Zoology at the end of the third year. Continuing into the fourth year, students can choose between a BSc Honours in Zoology or a BSc Honours with Research in Zoology. This learning outcomes-based curriculum framework is designed to provide a solid foundation in the subject and help students develop the skills needed for further studies and research, as well as for diverse professional careers in a developing, knowledge-based society.

The curriculum framework aims to maintain globally competitive standards of achievement in Zoology and related courses, fostering scientific orientation, inquiry, problem-solving skills, and rational and critical thinking in students. It offers numerous opportunities across classical and applied Zoology fields. The curriculum blends theoretical knowledge with practical applications, ensuring students gain a deep understanding of core concepts and the skills to apply them in real-world scenarios. Through lectures, laboratory work, field trips, and research projects, students will develop hands-on experience and critical thinking, problem-solving, and analytical skills essential for success in Zoology. Additionally, the

curriculum includes skill enhancement courses, value-added courses, and multidisciplinary courses to complement core Zoology studies, enhancing the academic experience and preparing students for future challenges and opportunities. Field studies enhance laboratory research by providing real-world validation of experimental findings. Field courses and trips give students practical experience in zoological research and a deeper appreciation of the natural world.

Students pursuing a BSc Zoology (Honours) with Research must complete a 12-credit research project, fostering inquiry-based learning and establishing a strong foundation for future academic or professional pursuits. An internship during the summer vacation of the second year offers students real-world experience in their field of study, helping them develop and enhance skills such as communication, teamwork, problem-solving, time management, adaptability, and professional growth. The Board of Studies of Zoology proudly presents this newly designed curriculum for the Four-Year Undergraduate Program in Zoology, to be implemented in the coming academic year, with the goal of providing a comprehensive and enriching learning experience that prepares students for future challenges and opportunities. We extend our heartfelt thanks to Board of studies in Zoology, Mahatma Gandhi University and whose dedicated efforts were crucial in designing this syllabus. We are also deeply grateful to the external members of the Board of Studies in Zoology at Maharajas College, for their invaluable contributions.

Board of Studies in Zoology (UG)
Post Graduate and Research Department of Zoology
Maharaja's College, Ernakulam

BOARD OF STUDIES AND EXPERTS BOARD OF STUDIES

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External Expert (nominated by the Vice-Chancellor, MG University)

Dr. Jayakrishnan T.V, Associate Professor in Zoology, Govt. Brennen College, Thalassery

Curricular Structure of the MCE – UG (Honours) Programme

3 Year UG Degree – 6 Semesters

No.	Course Type	No. of Courses	Total Credits
1	Foundation: Ability Enhancement Courses (AEC)	4	12
2	Foundation: Multi – disciplinary Courses (MDC)	3	9
3	Foundation: Skill Enhancement Courses (SEC)	3	9
4	Foundation: Value Addition Courses (VAC)	3	9
5	Discipline Specific Courses: Major (DSC A/DSE)	17	68
6	Discipline Specific Courses: Minor (DSC B & C)	6	24
7	Internship		2
	Total	36	133

4 Year UG Degree (Honours) – 8 semesters

4 Year UG Degree (Honours with Research) – 8 Semesters

No.	Course Type	No. of Courses	Total Credits
1	Foundation: Ability Enhancement Courses (AEC)	4	12
2	Foundation: Multi – disciplinary Courses (MDC)	3	9
3	Foundation: Skill Enhancement Courses (SEC)	3	9
4	Foundation: Value Addition Courses (VAC)	3	9
5	Discipline Specific Courses: Major (DSC A/DSE)	17	68
6	Discipline Specific Courses: Minor (DSC B & C)	6	24
7	Discipline Capstone Courses: Major (DCC/DCE)	8	32
8	Research Project		12/8
9	Internship		2
	Total	44	177

Programme Outcomes (POs)

PO1	Critical Thinking and Analytical Reasoning
PO2	Scientific Reasoning and Problem Solving
PO3	Multidisciplinary/Interdisciplinary/Transdisciplinary Approach
PO4	Communication Skills
PO5	Leadership Skills
PO6	Social Consciousness and Responsibility
PO7	Equity, Inclusiveness and Sustainability
PO8	Moral and Ethical Reasoning
PO9	Networking and Collaborating
PO10	Lifelong Learning

Evaluation Scheme

Courses without practical

Components	**Marks (4 Credit)**	**Marks (3 Credit)**
Continuous Internal Assessment (CIA)	30	25
End Semester Examination	70	50
Total	100	75

Courses with practical

Components	Marks (4 Credit)		Marks (3 Credit)	
	Theory	**Practical**	**Theory**	**Practical**
Continuous Internal Assessment (CIA)	25	15	15	15
End Semester Examination	50	35	35	35
Total	75	50	50	50

Syllabus Index

Name of the Major: **Zoology**

Semester: 1

Course Code	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
MCE1DSCZGY100	Introduction to Zoology	DSC A	**4**	**5**	**3**	---	**2**	---
MCE1MDCZGY100	Ornamental Fish Farming and Aquarium Keeping	MDC	**3**	**4**	**2**	----	**2**	----

Semester: 2

Course Code	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
MCE2DSCZGY100	Environmental Biology	DSC A	**4**	**5**	**3**	**---**	**2**	**---**
MCE2MDCZGY100	Pet Care and Management	MDC	**3**	**4**	**2**	**---**	**2**	-----

Semester: 3

Course Code	Title of the Course		Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
						L	T	P	O
MCE3DSCZGY200	Protistan Diversity and Animal Diversity Non-Chordata- I		DSC A	**4**	**5**	**3**	**---**	**2**	**---**
MCE3DSCZGY201	Animal Diversity Non-Chordata- II		DSC A	**4**	**5**	**3**	**---**	**2**	**----**
MCE3DSEZGY200	Ethology	Any 1	DSE	**4**	**4**	**4**	**---**	**---**	**----**
MCE3DSEZGY201	Value Added Products of Animals								
MCE3DSCZGY202	Applied Zoology		DSC B	**4**	**5**	**3**	**---**	**2**	**---**
MCE3MDCZGY200	Human Diseases and Their Management		MDC	**3**	**3**	**3**	**---**	**---**	**---**
MCE3VACZGY200	Science of Happiness & Human Rights		VAC	**3**	**3**	**3**	**---**	**---**	**---**

Semester: 4

Course Code	Title of the Course		Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
						L	T	P	O
MCE4DSCZGY200	Animal Diversity Chordata-I		DSC A	**4**	**5**	**3**	**--**	**2**	**--**
MCE4DSCZGY201	Biological Chemistry		DSC A	**4**	**5**	**3**	**---**	**2**	**---**
MCE4DSEZGY200	General Toxicology	Any 1	DSE	**4**	**4**	**4**	**--**	**---**	**--**
MCE4DSEZGY201	Health, Nutrition and Wellness								
MCE4DSCZGY202	Functional Zoology		DSC B	**4**	**5**	**3**	**---**	**2**	**---**
MCE4SECZGY200	Emergency Life Support and First Aid		SEC	**3**	**3**	**3**	**--**	**---**	**--**
MCE4VACZGY200	Comprehensive Fitness		VAC	**3**	**3**	**3**	**--**	**---**	**--**
MCE4INTZGY200	Internship		INT	**2**					

Semester: 5

Course Code	Title of the Course		Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
						L	T	P	O
MCE5DSCZGY300	Animal Diversity Chordata -II		DSC	**4**	**5**	**3**	**---**	**2**	**---**
MCE5DSCZGY301	Cell Biology and Molecular Biology		DSC	**4**	**5**	**3**	**---**	**2**	**----**
MCE5DSCZGY302	Fundamentals of Genetics		DSC	**4**	**4**	**4**	**---**	**--**	**----**
MCE5DSEZGY300	Biotechnology - Principles and Practices		DSE	**4**	**4**	**4**	**---**	**---**	**---**
MCE5DSEZGY301	Wildlife Management	Any1	DSE	**4**	**4**	**4**	**---**	**---**	**---**
MCE5DSEZGY302	Climate Change and Disaster Risk Reduction								
MCE5SECZGY300	Food and Water Quality Management		SEC	**3**	**3**	**3**	**---**	**---**	**----**
MCE5SECZGY301	Aquarium Fabrication and Setting (for those who are opting Aquaculture as Minor)								

Semester: 6

Course Code	Title of the Course		Type of Course DSC/ MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
						L	T	P	O
MCE6DSCZGY300	Microbiology and Basic Immunology		DSC	**4**	**5**	**3**	**---**	**2**	**----**
MCE6DSCZGY301	Physiology and Endocrinology		DSC	**4**	**5**	**3**	**---**	**2**	**----**
MCE6DSEZGY300	Reproductive Biology and Teratology		DSE	**4**	**5**	**3**	**---**	**2**	**---**
MCE6DSEZGY301	Zoogeography and Evolutionary Biology	Any1	DSE	**4**	**4**	**4**	**---**	**---**	
MCE6DSEZGY302	Fundamentals of Parasitology								
MCE6SECZGY300	Responsible Tourism		SEC	**3**	**3**	**3**	**---**	**---**	**---**
MCE6SECZGY301	Artificial Fish Feed Preparation (for those who are opting Aquaculture as Minor)								
MCE6VACZGY300	Reproductive Health and Sex Education		VAC	**3**	**3**	**3**	**---**	**---**	**----**

Semester: 7

Course Code	Title of the Course		Type of Course DSC, DCC, MDC, SEC	Credit	Hours / week	Hour Distribution /week			
						L	T	P	O
MCE7DCCZGY400	Biophysics, Instrumentation and Diagnostic Imaging Techniques		DCC	**4**	**5**	**3**	**---**	**2**	**----**
MCE7DCCZGY401	Biostatistics and Research Methodology		DCC	**4**	**4**	**4**	**---**	**--**	**---**
MCE7DCCZGY402	Advanced Genetics		DCC	**4**	**4**	**4**	**---**	**--**	**---**
MCE7DCEZGY400	Economic Entomology	Any 1	DCE	**4**	**4**	**4**	**---**	**---**	**----**
MCE7DCEZGY401	Aquafarming								
MCE7DCEZGY402	Live Stock and Poultry Management		DCE	**4**	**4**	**4**	**---**	**---**	**----**
MCE7DCEZGY403	Solid Waste Management		DCE	**4**	**4**	**4**	**---**	**---**	**----**

Semester: 8

Course Code	Title of the Course		Type of Course DSC, DCC, MDC, SEC	Credit	Hours / week	Hour Distribution /week			
						L	T	P	O
MCE8DCCZGY400	Advanced Immunology		DCC	**4**	**5**	**3**	**---**	**2**	**---**
MCE8DCCZGY401	Animal Systematics		DCC	**4**	**5**	**3**	**---**	**2**	**----**
MCE8DCEZGY400	Pandemic Science	Any 1	DCE	**4**	**5**	**3**	**---**	**2**	**----**
MCE8DCEZGY401	Developmental Biology								
MCE8DCEZGY402	Aquatic Biology		DCE	**4**	**5**	**3**	**---**	**2**	**----**
MCE8DCEZGY403	Fishing and Fish Processing Technologies	Any 1							
MCE8DCEZGY404	Biological Specimen Preparation Techniques		DCE	**4**	**5**	**3**	**---**	**2**	**----**
MCE8DCEZGY405	Bioinformatics and Computational Biology	Any 1							
MCE8PRJZGY400	Project			**8/12**					

Semester-I

Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**INTRODUCTION TO ZOOLOGY**					
Type of Course	**DSC A**					
Course Code	**MCE1DSCZGY100**					
Course Level	**100**					
Course Summary	The course includes several marvelous facts about the animal world which can foster sense of interest¸ connection, empathy and caring towards the animals. They feel responsible and enthusiastic to learn more about the animal world.					
Semester	**I**	**Credits**			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	---	1	---	75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Identify the wonders of the animal world and the facts behind the phenomena.	U	2,3
2	Explain Coloration, Mimicry & Parental care.	U	2,3
3	Discover the research avenues & career opportunities in Zoology	U	2,3
4	Predict the Entrepreneurial Possibilities in the field of Zoology	E	1,2,3
5.	Prepare detailed report of field visits to environmentally important places¸ research institutions and career orientation centers	A	2,3

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Wonders of Animal world**	**15**	
	1.1	**Incredible Animal Architects** Introduction to Animal Societies	7	1
	1.2	Honeybees – Skilled Engineers of Nature Comb building in Honey bees		
	1.3	Architectural secret of Termite hills		
	1.4	Weaver Bird-Wonderful Architect		
	1.5	**Glowing Wonders** Bioluminescence – Mechanism Noctiluca – Sparkle of the sea Firefly- Stars on earth Octopus – Wild Glowing Wonder Angler fish – the glowing monster	8	1
	1.6	Story of Pearl, Types of Pearl, Pearl Formation, Process of Picking best Pearl		
2		**Coloration, Mimicry & parental care**	15	
	2.1	**Coloration & Mimicry** Fakers of Nature- Secret behind Coloration & Mimicry Beautiful Butterflies, Colorful Earthworms, Painted Starfish Blue beauty Frog, Lovely Chameleon, Handsome Peacock Magnificent Owl Butterfly Leaf insect – The Walking leaves	7	2
	2.2	P**arental care** Animal Parenting – Facts & examples Who will take care? Father or Mother. Mother – Velvet Spider - Epitome of sacrifice Father – Water bug - Model father Pregnant Father – Sea Horse Father Brooder – Male Darwin frog. Sophisticated parents – Python parenting Supermom – Humming Bird Aggressive Mother – Otter	8	
3		**Major Research Areas & Careers in Zoology**	15	
	3.1	**Exciting avenues for research** Bioinformatics, Molecular biology, Biostatistics, Wildlife Biology, Toxicology & Pharmacology, Forensic biology, Physiology, Genetics,	5	3

		Microbiology, Immunology, Developmental Biology, Ethology, Biotechnology, Environmental Biology, Animal Systematics, Marine biology, Fisheries, Cell biology, Entomology, Biochemistry, Parasitology, **brief description only**		
	3.2	**Attractive career opportunities** **General**- All general UPSC jobs especially IFS (Indian Forest Service), Kerala PSC (all general degree-based jobs), jobs in Kerala Forest and wildlife department (Range Forest Officer and Beat Forest officer), Scientists, Research assistants, Lab technicians, Animal house keepers in reputed research centers like ZSI, CSIR, ICAR, RGCB, KFRI, NCBS, TIFR, SACON, BARC, ICZN etc. Jobs in NGOs like WWF, ATREE, Wildlife SOS, Wildlife Trust of India, Center for Wildlife Studies, Nature Conservation Foundations etc. **Specific**- Entomologist in Vector control board and in research institutes like KFRI; Teaching; Biologist and Curator in Museum and Zoological Parks; Fisheries officer in Fisheries department, Junior scientific assistant in pollution control board, District Malaria Officer, forensic assistant in police department and health department; ecologist, conservation biologist and nature education officers in various wildlife sanctuaries and protected areas; jobs in Pharmaceutical companies. Embryologist, Cytological specimen preparation, Cytogeneticist in diagnostic labs and hospitals. Medical coding	5	4
	3.3	**Lucrative Entrepreneurial Possibilities** Products, byproducts & value-added products of: Apiculture, Sericulture, Dairy Farming, Poultry Farming, Pets and their management, Aqua culture (Edible and ornamental) and Vermiculture	5	
4		**Practical**	**30**	
	4.1	Identification of any 10 specimens coming under the following categories 1. Animal architects, 2. Glowing animals, 3. Animal mimicry, 4 Animal coloration, 5. Parental care.	8	5
	4.2	Search wonders of animal world and make short videos/reports/photos: 1. Animal architects, 1. Glowing animals, 3. Animal mimicry, 4 Animal coloration, 5. Parental care.	5	

	4.3	1. Field visit - Nature camp, butterfly garden, museum, pearl culture farm. (any 2) 2. Visit to any 2 research institutes 3. Visit and interact with any two entrepreneurs from different fields and submit the report 4. Career Orientation class by experts	17	
5.		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture¸ group interaction¸ seminar¸ presentations **Note:** Only a brief description of the focal topic is required. Teaching aids like photographs¸ models¸ videos¸short films¸ documentaries related to the topic may be used
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total = 25 marks** Quiz, Test Papers, seminar **Practical Total = 15 marks** Lab performance, record, field report, entrepreneur interaction report
	B. End Semester Examination **Theory Total = 50 marks, Duration 1.5 hrs** Short Essays - 5 out of 7 x4 =20 marks Short questions - 10 out of 12 x2 =20 marks Fill in the blanks -10x1=10 marks **Practicals Total = 35 marks; Duration- 2 hrs** **Record 10 marks,** **Examination 25 marks:** spotter identification - 16 marks Viva - 4 marks, research institute visit report- 5 marks

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19. Moore, R. C. Lalicker, C. G. and Fisher, A. G. (1952) Invertebrate Fossils, Mc. Graw Hill Book Co., New York.
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21. Young, J.Z. (1950) Life of Vertebrates. Clarendon Press Oxford.

SUGGESTED READING

1. Jolie, M. (1968) Chordate Morphology. East West Press.
2. Parragon Publishing India. (2023) Fascinating facts Animals.Parragon Publishing India.
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4. Young J.Z. (2006). The life of Vertebrates. Oxford University Press.

Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**ORNAMENTAL FISH FARMING AND AQUARIUM KEEPING**					
Type of course	**MDC**					
Course Code	**MCE1MDCZGY100**					
Course Level	**100**					
Course Summary	The course 'Ornamental fish breeding, culture and aquarium keeping' provides a comprehensive understanding of the varieties of ornamental fishes, management aspects of ornamental fish farming, fish transportation, breeding and rearing of ornamental fishes and construction and maintenance of aquarium.					
Semester	**I**	**Credits**			**3**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		2	--	1	--	60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Identify various commercially important freshwater ornamental fishes, aquarium accessories, aquarium fish diseases.	U, An, A	1
2	Understand and apply fish transportation techniques while transporting brooders and fish seeds.	U, A	1
3	Employ skills for breeding and rearing of egg-layers and live-bearers and aquarium setting.	A, S	1
4	Apply the knowledge in aquascaping, water quality management and feed administration.	A	10
Remember(K),Understand(U),Apply(A), Analyze(An),Evaluate(E), Create (C), Skill(S), Interest (I)and Appreciation(Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Ornamental fish farming- Management aspects**	**15**	
	1.1	Introduction to ornamental fish farming**.** Common freshwater ornamental fishes; Live bearers (Guppy, Platy, Molly, Sword tail), Egg layers (Varieties of Gold Fish, Gourami, *Betta*, Tetra, Angel Fish, *Puntius* sp.).	2	1
	1.2	Study of Two examples each of Indigenous, Endemic and Exotic ornamental fishes of Kerala	2	1
	1.3	**Food and feeding**: Nutritional requirements of fishes. Types of Feed: Dry feeds, Non -Dry feeds (Moist feeds, Wet or paste feeds), Feeds for colour enhancement. Live feed and live feed culture. Preparation and composition of formulated fish feeds. Feeding rate and management.	4	1, 5
	1.4	**Water quality management** (pH, hardness, salinity, oxygen, carbon dioxide, chlorine, ammonia, nitrites, temperature); Water filtration systems – biological, physical; types of filters. Aerators, Aquarium Plants.	3	5
	1.5	**Common diseases of aquarium fishes** Parasitic (protistan, helminthic, arthropodan), microbial (Bacterial, Fungal, Viral) (Any two from parasitic and microbial) and nutritional deficiency diseases.	3	3
	1.6	Conditioning, packing, transport and quarantine methods.	1	2
2		**Breeding and rearing of ornamental fishes & Construction and maintenance of aquarium**	**15**	
	2.1	Breeding of Live bearers (Guppy, Molly, Sword tail) and Egg layers (Gold Fish, Gourami, *Betta*).-any one from each group. Sex identification, brooder selection and conditioning, induced spawning, hatching and rearing of frys.	10	3
	2.2	Types of aquaria, Setting up of a freshwater aquarium. **ACTIVITY:** Visit ornamental fish farm & submit a report	5	3,4

3		**Practicals**	**30**	
	1	Identification of aquarium fishes-Egg layers and live bearers, both indigenous, exotic and endemic.		1,3, 4
	2	Identification of fish diseases - symptom, causative organism and control measures.		
	3	Study of aquarium accessories		
	4	Determination of pH of water sample		
	5	Demonstration of construction and setting up of an aquarium		
	6	Study of breeding behaviour of any one ornamental fish.		
	7	Identification of live fish feeds and culturing of any one.		
4		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, Demonstration, ICT Enabled learning, Experiential Learning Tutorial
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA):** **Theory Total - 15 Marks** Submission of report on ornamental fish farm visit, Test paper, Viva, Seminar **Practical Total - 15 Marks** Lab performance, record, Lab test
	B. End Semester Examination **Theory Total = 35 Marks; Duration - 1 hr** Short Essays 5 out of 7 x4=20 Marks Short questions 5 out of 7 x 2 =10 Marks Fill in the blanks - 5x1=5 Marks **Practicals Total = 35 Marks, Duration - 2 hrs** **Record - 10 Marks,** **Examination - 25 Marks:** Spotter identification 20 Marks, Determination of pH of two water samples - 5 Marks

REFERENCES

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Semester-II

Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**ENVIRONMENTAL BIOLOGY**					
Type of Course	**DSC A**					
Course Code	**MCE2DSCZGY100**					
Course Level	**100**					
Course Summary	This comprehensive course covers the fundamental principles of ecosystems, populations, and communities, emphasizing biodiversity & its threats. It explores biogeochemical cycles, renewable and non-renewable resources, and ecological interactions. The module on biodiversity delves into its types, significance, and threats, including climate change & habitat destruction. Conservation efforts, both international & national, are detailed, along with key environmental laws. It concludes with a focus on managing environmental issues, addressing solid waste, watershed management, carbon-related concepts, and eco-friendly initiatives.					
Semester	**II**	**Credits**			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	--	1	--	75
Pre- requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1.	Explain the dynamics of Ecosystem and renewable resources.	A	1,2, 7
2.	Describe the attributes of Population, community and animal interaction.	U	1,2, 7
3.	Distinguish concepts of biodiversity¸ threats to biodiversity and measures to conserve Biodiversity.	A	1,2,6,7
4.	Employ strategies to manage environmental issues.	A	1,2,6,7
5.	Administer experiments in Environmental Biology.	A	2¸6¸10
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E),Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Dynamics of Ecosystem**	**10**	
	1.1	Introduction to Environmental Biology; Scope and History.	1	1
	1.2	**Basic concept and structure of ecosystem**: Definition; Abiotic (Sunlight, temperature, soil, water, atmosphere) and Biotic components (Producers, consumers, decomposers)	2	1,2
	1.3	**Functions of ecosystem**: Productivity-Food chain-Food web- Energy flow-Laws of Thermodynamics	2	1
	1.4	**Types of Ecosystem**: **Terrestria**l (Forest-Grassland-Desert) and **Aquatic**- (Marine, Fresh water, Wetland); Biome; Ecological pyramids (number, biomass, energy)	2	1,2
	1.5	**Biogeochemical cycles:** Concept, gaseous (Carbon cycle, Nitrogen cycle) and sedimentary cycles (phosphorous cycle).	1	1,3
	1.6	**Renewable resources (**solar, wind, wave, hydroelectric, biomass and geothermal) **and Non-renewable resources** (mineral and metal ore, fossil fuels)	2	1,3
2		**Population and Community**	**8**	
	2.1	**Concept of population**: Population attributes-Population growth forms, Basic concepts of growth rates, density, natality, mortality, growth curves.	1	2,3
	2.2	**Animal interactions**: **Positive**- Commensalism-Mutualism-Proto-cooperation, **Negative**-Predation-Parasitism-Competition-Antibiosis.	3	2,3
	2.3	**Characteristics of a community**: Species diversity-richness, evenness, stratification, dominance, ecological indicators, Ecotone and Edge effect, Keystone species, Flagship species¸Umbrella species. Concepts of Ecological Niche and Guild, Ecological succession, community evolution- climax.	4	2,3
3		**Biodiversity Conservation and Disaster Management**	**27**	
	3.1	**Introduction to Biodiversity:** Types of biodiversity-Alpha, Beta and Gamma diversity.	7	1,2, 3

		Concept and importance of Biodiversity: Levels of Biodiversity-Species diversity, Genetic diversity, Microbial, Ecosystem diversity (in brief); Biodiversity indices (Shanon-Weiner index, Simpson's index); Basic sampling techniques (Quadrat and Transect methods). **Significance of Biodiversity** - Ecosystem productivity (Ecosystem services, Biological resources, Social benefits), Ecosystem stability; India as a mega-diversity nation, Biodiversity hotspots. **Threats to Biodiversity:** 1. Climate change and global warming (details of greenhouse effect and Ozone depletion to be included here), 2. Habitat destruction, 3.Pollution (air, water, noise and plastic pollution) - causes, effects and control measures in brief, Invasive species, Over-exploitation of natural resources.		
	3.2	**Conservation of Biodiversity** **Protected area concept:** Wildlife Sanctuary, National Park, Biosphere Reserve, Conservation Reserve, Community Reserve	1	3,4
	3.3	**International Efforts in Biodiversity Conservation**: WWF, Convention on Biological Diversity (CBD), International Union for the Conservation of Nature and Natural Resources (IUCN), United Nations Environment Program-World Conservation Monitoring Centre (UNEP-WCMC), Red Data Book, Green Data Book, Blue Data Book; IUCN's Post 2020 Global Biodiversity Framework (GBF) Strategy Initiative, UN's Sustainable Developmental Goal 15 of 2030 Agenda. Overview of G20 Summit 2023 in terms of Biodiversity Conservation and Sustainable development .	3	4
	3.4	**National level initiatives** National Biodiversity Strategy and Action Plan; People's Biodiversity Register. **Regional level initiatives**: The Chipko movement, Narmada Bachao Andolan, The Silent Valley Episode.	4	4
	3.5	**Environmental disasters:** Natural disasters (Earthquakes, Cyclones, Floods, Tsunamis and Landslides) and Man-made disasters-case studies (Global level- Chernobyl nuclear power plant explosion, National level - Bhopal gas tragedy and Regional level- Endosulfan issue). PRRP for disaster management.	5	2,3
	3.6	**Management oF Environmental Issues**	7	3,5

		Solid Waste Management; Watershed Management; Rainwater Harvesting; **International agreements:** Montreal Protocol, Kyoto Protocol, Inter-government Panel on Climate Change (IPCC), Overview of UN Climate Change Conferences (COP 2023 to be included); Ramsar Convention. Carbon Credit; Carbon Trading (Emission trading); Carbon Sequestration; Carbon Footprint; Ecological Footprint **Environmental Laws (Brief accounts only):** The Wildlife Protection Act, 1972; The Water (Prevention and Control of Pollution) Act, 1974; The Forest (Conservation) Act, 1980; The Air (Prevention and Control of Pollution) Act,1981; Indian Forest Act (Revised) 1982; The Environment Protection Act, 1986; The Biodiversity Act, 2002; National Green Tribunal Act, 2010; Environment (Protection) Amendment Rule, 2022.		
4		**Practicals**	**30**	
	1.	Estimation of Dissolved Oxygen.	2	4, 5
	2.	Estimation of Carbon-di-oxide	2	
	3.	Analyze the pH and texture (sandy/silty/clayey) of any 2 soil samples.	2	
	4.	Preparation of Temporary mount of any one plankton	2	
	5.	Counting of planktons using plankton counting chamber	2	
	6	Spotters:Plankton counting chamber, Secchi disc & Plankton net	2	
	7.	Individual visit to any polluted site and preparation of a detailed report (it should include observation and remedial measures)	8	
	8.	Present a report on the environmental challenges identified in your Locality and its mitigation measures.(group project of 5 members each)	8	
	9.	Identify five influential personalities (from India) who have contributed towards the conservation of the environment and comment on their contributions (eg. Vandana Shiva,Sundarlal Bahuguna, ,Daya Bhai, Sugathakumari, M.K.Prasad, Prof.Sitaraman, Sankaranarayana, Kallen Pokkudan)	2	
5		T**eacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, Field Visit to Ecologically significant areas
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA):** **Theory Total = 25 Marks** Quiz, Test Papers, Seminar **Practical Total = 15 Marks** Lab performance, record , field report, entrepreneur interaction report
	B. End Semester Examination: **Theory: Total =50 Marks, Duration 1.5 hrs** Short Essays 5 out of 7 x4=20 Marks Short questions-10 out of 12 x2 =20 Marks Fill in the blanks - 10x1 =10 Marks **Practical Total =35 Marks; Duration - 2 hrs** **Record** - 10 **Marks** **Examination - 25 Marks:** Spotter identification - 10 marks Viva - 5 marks, research institute visit report- 10 marks

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Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**PET CARE AND MANAGEMENT**					
Type of course	**MDC**					
Course Code	**MCE2MDCZGY100**					
Course Level	**100**					
Course Summary	Pet care and management course provides a sound introduction to caring for a wide variety of different pets including dogs, cats, birds and some other pets like rabbits, and rodents. This course covers the aspects like diets & nutrition, breeding health and hygiene, care of litters and young animals and more. Pet Care is designed as an introductory course for those seeking to work with animals in positions such as vet nurses, animal welfare and animal rescue.					
Semester	**II**	**Credits**			**3**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		2	**---**	**1**	**----**	**60**
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Describe the legal and safety measures in keeping pets	***K***	1
2	Explain different breeds of dog¸cat and bird, pet nutrition¸ grooming¸ reproductive biology & healthcare management.	***U***	2
3	Apply management techniques of pet care in starting and running a pet-related business, marketing, and customer service.	E	1
4	Identify different breeds of pets and pet diseases.	K	7
****Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)***			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Pet care sector -- Legal and safety measures**	**9**	
	1.1	**Introduction to Pet animals** – Relevance of Pet animals – for leisure, revenue. Common pet animals. Cat, dog, birds, rabbits, hamsters, guinea pigs.	2	1
	1.2	Career Opportunities Associated with pet Animals- Pet breeding & marketing & pet food business.	1	1, 2
	1.3	Laws (animal & bird act regulations) & licenses	2	6
	1.4	Animal charities & societies - Animal Welfare Board of India:(AWBI); 'National Institute of Animal Welfare' (NIAW); NGOs - Federation of Indian Animal Protection organisations (FIAPO); 'Blue Cross of India'- Chennai (BCI-Chennai) 'People for Ethical Treatment of Animals'- India (PETA'-India)	2	6
	1.5	Zoonotic diseases (rabies, capnocytophagosis, Swine flu, avian flu, toxoplasmosis and ecto-parasitic infections)	2	5
2		**Pet Cats, Dogs ,birds and their care**	**21**	
	2.1	Common cat breeds for Indian climate - Small cat breeds (Bombay cat, Siamese cat & Oriental Shorthair) Large cat breeds (Persian Cats, Bengal Cat, & British Shorthair)	2	1
	2.2	**General Habits, nutrition and feeding, breeding and management** of Pet cats. Newborn Kittens - Behaviour and grooming. Feed and nutrition.	3	2
	2.3	**Common diseases** of cats-their diagnosis, treatment and control. Care for a sick cat. Cattery design and management.	3	7
	2.4	**Common dog breeds** - Labrador, German Shepherd, Pug, Beagle, Indian Spitz & Doberman. Selection of dog breeds - Purebred and mix-breeds. Behaviour and Grooming. General habits, Feeding and nutrition. Detection of oestrus and Breeding of dogs. Desexing.	3	7
	2.5	**Common diseases** Microbial, parasitic, fungal and nutritional deficiency disorders. Clinical manifestations, diagnosis, treatment and control. Vaccination/ deworming schedules.	3	7

	2.6	**Pet Birds : Selection of Breeds** (eg. Canaries, Finches, Budgerigars, Small Parrots)	2	1,2
	2.7	**Sexing, Desexing, Containment (Aviaries –** selection, design, size, management). Feed and Feeding methods, Grooming (Wing trim, Beak Trim, Nail Trim), Hygiene	3	2
	2.8	**Common diseases -** diagnosis, treatment and control. Caring for the Sick Bird, Supportive therapy.	2	7
3		**Practicals**	**30**	
	1	Breed identification – dog,cat and bird.	6	3,4
	2	Identification of ecto & endoparasites of dog,cat and bird	3	
	3	Composition of balanced diet for the pets; dog, cat & bird.	3	
	4	Visit to near by Veterinary hospital & report submission on different pet diseases	6	
	5	Collaborate with veterinarians to organize joint workshops or informational sessions, combining medical advice with practical care tips.	6	
	6	Analyse incidence of different diseases on specific pets and submit the report (any two pets).	6	
4		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** 1. Lecture, Videos 2. Demonstrations: Conduct live demonstrations, either in person or through videos, showcasing proper grooming techniques, training methods, or other aspects of pet care.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA):** **Theory Total = 15 Marks** Test paper, Viva, Seminar **Practical Total = 15 Marks.** Lab performance, record, Report submission
	B. End Semester Examination **Theory Total = 35 Marks, Duration - 1 hr** Short Essays 5 out of 7 x4=20 Marks, Short questions - 2 out of 4 x5 =10 Marks; Fill in the blanks -5x1=5 Marks **Practicals Total = 25 Marks; Duration - 2 hrs** **Record - 10 Marks, Examination - 25 Marks:** Breed identification with reasons (2 breeds) - 8 Marks, Parasite identification - 10 Marks, Composition of balanced diet for dog, cat & bird - 7 Marks

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Semester-III

Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**PROTISTAN DIVERSITY AND ANIMAL DIVERSITY - NON CHORDATA- I**					
Type of Course	**DSC A**					
Course Code	**MCE3DSCZGY200**					
Course Level	**200**					
Course Summary	This course aims to provide a thorough understanding of various animal phyla, including Kingdom Protista, Phylum Orthonectida, Phylum Placozoa, Phylum Coelenterata, Phylum Ctenophora, Phylum Platyhelminthes, Phylum Aschelminthes and Phylum Annelida. The course structure focuses on the key features, classification, and special characteristics of representative examples within each phylum. Additionally, it explores topics such as economic importance, unique features, and adaptations. The course places a strong emphasis on practical knowledge in the area of invertebrate zoology, with a particular focus on developing students' hands-on skills, observational abilities, and collaborative work.					
Semester	**III**	**Credits**			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	**-**	**1**	**----**	**75**
Pre- requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Classify the Kingdom Protista, Phylum - Orthonectida, Placozoa, Coelenterata, Ctenophora, Platyhelminthes, Aschelminthes and Annelida.	**U**	**1**
2	Compare salient features of different phyla from Orthonectida to Annelida.	**U**	**1**
3	Describe the canal systems in Sponges¸ Parasitic Protists¸ Life cycle of *Plasmodium*¸ Coral and coral reefs and its conservation¸ Polymorphism in Coelenterates¸ Pathogenic nematodes in man.	**U**	**1**
4	Distinguish different parasitic/pathogenic Protists¸ Platyhelminthes, Nematodes and Annelids	**U**	**2**

	Practical		
1	Identification of specimens from Protista¸ Porifera¸ Cnidaria¸Platyhelminthes¸ Nematoda & Annelida	**U**	**1**

2	Apply culture techniques of protists and prepare temporary whole mounts of specimens	**A**	**1, 2**
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E),Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Kingdom Protista**	**15**	
	1.1	Kingdoms of classification: Two-kingdom, Three Kingdom, Five kingdom and Eight kingdom classifications, Levels of animal organization. (Mention only)	1	1
	1.2	**Animal -like protists** 1. Phylum Rhizopoda Eg.: *Amoeba* 2. Phylum Actinopoda Eg.: *Actinophrys* 3. Phylum Foraminifera Eg.: *Elphidium* 4. Phylum Ciliophora Eg.: *Balantidium* 5. Phylum Opalinata Eg.: *Opalina* 6. Phylum Kinetoplasta Eg.: *Trypanosoma* 7. Phylum Metamonada Eg.: *Giardia* 8. Phylum Choanoflagellata Eg.: *Proterospongia* 9. Phylum Parabasalia Eg.: *Trychonympha* 10. Phylum Sporozoa Eg.: *Toxoplasma* **Plant -like protists** 11. Phylum Euglenophyta Eg. : *Euglena* 12. Phylum Cryptophyta Eg. : *Cryptomonas* 13. Phylum Bacillariophyta Eg.: Diatoms 14. Phylum Chlorophyta Eg.: *Volvox* 15. Phylum Rhodophyta Eg. : Red Algae 16. Phylum Dinoflagellata Eg. :*Noctiluca* **Fungus -like protists** 17. Phylum Mycetozoa Eg.: Slime moulds 18. Phylum Microsporidia Eg.: *Nosema* (Brief description only)	7	1
	1.3	**Type: - *Paramecium* –** Morphology (Mention - cyclosis, respiration, osmoregulation and excretion), asexual reproduction (Binary fission) and sexual reproduction (Conjugation). **General topics**: 1. Parasitic Protists (*Entamoeba* and *Leishmania*) 2. Lifecycle of *Plasmodium*	7	1

2		**Kingdom Animalia** **Classification, Phylum Porifera and Cnidaria**	**15**	

	2.1	**Basis of classification** Germ layers: diploblastic, and triploblastic Symmetry – Asymmetry, Spherical, Radial, Biradial and Bilateral Coelom – Acoelomates, Pseudocoelomates and Eucoelomates -Schizocoelom, Enterocoelom, Protostomia and Deuterostomia Metamerism Outline classification of Kingdom Animalia Three branches – Mesozoa, Parazoa and Eumetazoa **Mesozoa**: **Phylum Orthonectida** - Eg. *Rhopalura* **Parazoa**: **Phylum Placozoa** – Eg. *Trycoplax adherens*	5	1
	2.2	**Phylum Porifera** – Classification up to classes. Salient features of phylum and classes. Class I – Calcarea Eg. *Sycon* Class II – Hexactinellida Eg. *Euplectella* Class III – Demospongia Eg. *Cliona* **General topic:** 1. Canal system in Sponges.	4	1, 2
	2.3	**Eumetazoa** **Phylum Cnidaria** Classification up to classes. Salient features of phylum and classes. Class I- Hydrozoa Eg. *Obelia* (Mention metagenesis) Class II- Scyphozoa Eg. *Rhizostoma* Class III- Anthozoa Eg. *Metridium* **General topics**: 1. Coral and coral reefs and its conservation. 2. Polymorphism in Coelenterates	5	1, 3
	2.4	**Phylum Ctenophora** - Salient features Eg. *Pleurobrachia*	1	1
3		**Phylum Platyhelminthes, Nematoda and Annelida**	**15**	
	3.1	**Phylum Platyhelminthes –** Classification up to classes. Salient features of phylum and classes. Class I- Turbellaria Eg. *Planaria* Class II- Trematoda Eg. *Fasciola hepatica* Class III- Cestoda Eg. *Taenia solium* **General topics**: 1. Life history of *Fasciola hepatica*. 2. Platyhelminth parasites of Man and Dog (*Schistosoma*, *Taenia solium*, *Echinococcus*)	5	1, 4

	3.2	**Phylum Nematoda -** Classification up to classes. Salient features of phylum and classes. Class- Phasmidia Eg. *Enterobius*, *Ascaris* Class -Aphasmidia Eg. *Trichinella* **General topics**: Pathogenic nematodes in man. (*Wuchereria bancrofti*, *Ancylostoma duodenale*, *Enterobius vermicularis*, *Ascaris lumbricoides*)	5	1, 5
	3.3	Classification up to classes. Salient features of phylum and classes. Class I- Archiannelida Eg. *Polygordius* Class II -Polychaeta Eg. *Chaetopterus* Class III- Oligochaeta Eg. *Megascolex.* Class IV- Hirudinea Eg. *Hirudinaria* **General topic:** 1. Ecological and parasitic Adaptations with reference to the above examples.	5	1
4		**Practicals**	**30**	
		1. General identification and classification (Phylum, Class, Genus and Species) a) Protista (any 6) b) Porifera- 1 c) Cnidaria - 3 d) Platyhelminthes- 2 e) Nematoda – 1 f) Annelida – 2	10	1
		2. Identification of any four economically important parasitic protists (Slides/ photographs may be used)	2	1
		3. Identification of Protistans from pond water (any 2).	4	2
		4. Mounting of earthworm setae.	2	3
		5. Study of sections (Any Two) a. T.S. of *Hydra* b. T.S. of *Ascaris* c. T.S. of *Fasciola* d. T.S. of Earthworm	4	1
		6. Identification of larval stages. (Any two, Slides or photographs may be used) (miracidium, sporocyst, redia, cercaria, metacercaria)	4	1
		ACTIVITY 1. Poster making as a group project on parasitic protists infesting humans and presentation by a group representative	4	4
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, Tutorial, ICT enabled learning, Group activity, Assignment, Seminar
Assessment Types	**MODE OF ASSESSMENT THEORY** **A. Continuous Comprehensive Assessment (CCA):** **Theory Total = 25 Marks** Quiz, Test Papers, Seminar **Practical Total = 15 Marks** Lab performance, record, other assignments
	B. End Semester Examination **Theory Total = 50 Marks; Duration 1.5 hrs** Short Essays - 5 out of 7 x4 =20 Marks; Short questions - 10 out of 12 x2 = 20 Marks Fill in the blanks -10x1 = 10 Marks **Practical Total = 35 Marks, Duration - 2 hrs** **Record - 10 Marks, Examination - 25 Marks:** Spotter identifications: 1. Identification & classification - 6 Marks 2. Identification of economically important parasitic protist - 4 Marks 3. Identification, sketch and labeling of section (any one) - 6 Marks 4. Identify and write notes on larval stage - 4 Marks **5.** Mounting of setae - 5 Marks

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Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**ANIMAL DIVERSITY- NON-CHORDATA II**					
Type of Course	**DSC A**					
Course Code	**MCE3DSCZGY201**					
Course Level	**200**					
Course Summary	This course aims to provide a thorough understanding of various animal phyla, including Phylum Onychophora, Phylum Arthropoda, Phylum Mollusca, Phylum Echinodermata, Hemichordata, and Minor Phyla.					
Semester	**III**	**Credits**			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	--	1	--	75
Pre- requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Differentiate salient features of Phylum Onychophora, Arthropoda, Mollusca, Echinodermata, Hemichordata, and Minor Phyla.	An	1,2
2	Describe different systems of Prawn, pearl culture, edible molluscs, the economic importance of insects, water vascular systems, and larval forms of Echinodermata.	U, S	1,2
3.	Dissect the prawn and cockroach nervous systems and mount the prawn appendages, mouth parts of the cockroach, plant bug, and mosquito.	A, S	1,2
4.	Sketch invertebrates scientifically.	A, S	1,2
5	Classify species belonging to the minor phyla and phylum Arthropoda, Mollusca, and Echinodermata.	An, S	1,2
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E),Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Phylum Onychophora and Phylum Arthropoda**	**15**	
	1..1	**Phylum Onychophora** Salient features of the phylum Eg. *Peripatus* (Mention its affinities).	1	1, 5
	1.2	**Phylum Arthropoda** Classification up to classes. Salient features of phylum and classes. (Brief mention only) **1. Sub Phylum - Trilobitomorpha** Class -Trilobita (mention the salient features). Eg. *Triarthrus* **2. Subphylum –Chelicerata** Class 1 Merostomata (Xiphosura) (Eg. *Limulus*- Living fossil) Class 2.Arachnida (Eg., *Palamnaeus*- Scorpion) Class 3 Pycnogonida (Eg. *Pycnogonum* – Sea spider) **3. Subphylum- Crustacea** Class 1 Branchiopoda Eg. *Daphnia* Class 2 Ostracoda Eg. *Cypris* -seed shrimp Class 3 Copepoda Eg. *Cyclops* Class 4 Remipedia Eg. *Speleonectes* (eyeless crustacean seen in caves) Class 5.Branchiura Eg.,*Argulus* (common fish louse) Class 6 Cirripedia Eg. *Sacculina* Class 7 Malacostraca Eg. *Squilla* (spot tail mantis shrimp) **4. Subphylum- Uniramia** Class 1 Chilopoda Eg. *Scolopendra* – (Centipede) Class 2 Symphyla Eg. *Scutigerella* – (garden centipedes or pseudocentipedes) Class 3 Diplopoda Eg. *Spirostreptus*- (Millipede) Class 4 Pauropoda Eg. *Pauropus* Class 5 Hexapoda (Insecta) Eg. *Bombyx mori* – (silk moth)	14	
2		**Type study & General topic**	**15**	
		Type: Prawn – *Fenneropenaeus* sp. **General Topic:** Economic importance of insects		2
3		**Phylum Mollusca and Echinodermata**	**15**	

	3.1	**Phylum Mollusca** Classification up to classes. Salient features of phylum and classes. (Brief mention only) Class I- Aplacophora Eg. *Neomenia* Class II- Monoplacophora Eg. *Neopilina* Class III Amphineura Eg. *Chiton* Class IV Gastropoda Eg. *Aplysia* Class V Scaphopoda Eg. *Dentalium* Class VI Pelecypoda (Bivalvia) Eg. *Pinctada* Class VII Cephalopoda Eg. *Sepia* **General Topics** 1. Pearl culture 2. Edible molluscs	7	1, 2
	3.2	**Phylum Echinodermata** Classification up to classes. Salient features of phylum and classes. Class I- Asteroidea Eg. *Astropecten* Class II- Ophiuroidea Eg. *Ophiothrix* Class III- Echinoidea Eg. *Echinus* Class IV- Holothuroidea Eg. *Holothuria* Class V – Crinoidea Eg.*Antedon* **General Topics** 1. Water vascular system in Echinodermata	6	
	3.3	**Phylum Hemichordata** Salient features and affinities Eg. Balanoglossus	1	1,5
	3.4	**Minor Phyla** Salient features of 1. Phylum Chaetognatha Eg. *Sagitta* 2. Phylum Sipunculida Eg. *Sipunculus*	1	
4		**Practicals**	**30**	
	1	**Scientific Drawing:** Make scientific drawings of 5 locally available invertebrate specimens belonging to different phyla.	5	4
	2	General identification and classification (Phylum, Class, Genus and Species) a). Arthropoda - 6 b). Mollusca - 4 c). Echinodermata – 3 d) Minor Phyla – 2	2	5
	3	**Dissections** 1. Prawn - Nervous system 2. Cockroach - Nervous system	8	3
	4	**Mounting:-** 1. Prawn appendages. 2. Mouth parts - Cockroach/ Plant bug/ Mosquito. (Any Two)	6	3

	5	**Taxonomic identification with key** Identification of insects up to the level of order (Any Three).	3	5
	6	**Larval identification** (Any Two). (Nauplius, Zoea, metazoea, Mysis)	1	2
	7	**Group activity on identification and classification of any five arthropods from college campus. (Group of 3 to 5)** Geotagged photo submission in the form of print out	5	5
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, Tutorial, ICT enabled learning, Individual/Group activity, Assignment, Seminar
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA):** **Theory Total = 25 Marks** Quiz, Test Papers, Seminar **Practical Total = 15 Marks** Lab performance, record, Submission of group activity reports
	B. End Semester Examination **Theory Total = 50 Marks; Duration 1.5 hrs** Short Essays 5 out of 7 x4=20 Marks; Short questions 10 out of 12 x2 = 20 Marks Fill in the blanks - 10 x1 =10 Marks **Practical Total = 35 Marks, Duration - 2 hrs** **Record - 10 Marks, Examination - 25 Marks:** Dissection - 15 Marks, Mounting/scientific drawing – 5 Marks Spotter identification/taxonomic identification – 5 Marks

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Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**ETHOLOGY**					
Type of Course	**DSE**					
Course Code	**MCE3DSEZGY200**					
Course Level	**200**					
Course Summary	This course is designed to unravel the intricate connections between animal behavior and cognitive processes and the fascinating dynamics of how organisms learn, evolve, and exhibit behavioral plasticity in response to their environment.					
Semester	**III**	**Credits**			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	---	---	---	60
Pre- requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain the basics and advances in ethology.	U	1,2,6
2	Describe the role of neural plasticity in learning, memory and behavior.	U	1,2,3, 10
3	Analyze the different patterns & mechanisms of animal behavior.	An	1,2,4, 10
4	Distinguish the nature and characteristics of social behaviour.	U	1,2,3
5	Interpret different animal communications.	A	1,2,8, 10
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E),Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Introduction to Ethology**	**3**	
	1.1	Historical background and Scope of ethology, Branches of Ethology, Significance of ethology during animal conservation., animal welfare and human society, Ethogram. Contributions of Pavlov, Frisch and Lorenz		1
2		**Learning, Memory and Neural mechanisms**	17	
	2.1	**Neurobiology and Neuroplasticity** Structure of brain-overview. Describe briefly Hypothalamus, Hippocampus and Amygdala; Learning centers in brain- Broca's areas, Wernicke's area and angular gyrus; Motor areas. Physiological changes during learning. Neural Mechanisms of Behavior	6	2
	2.2	**Motivation & Learning** Innate and learned behavior, motivation- learning model- Lorenz's Psycho-Hydraulic Model of Motivation Types of learning: Habituation, Sensitization, Associative learning – Classical Conditioning, Operant Conditioning, Taste Aversion, Cognitive learning- Latent learning, Trial and error learning, Insight learning, Imitation, learning set learning, Imprinting, Instinct	9	2
	2.3	**Memory** Short term & long term memory., Consolidation of memory. Role of sleep in memory consolidation.	2	2
3		**Patterns & Mechanisms of Animal Behaviour**	**22**	
	3.1	**Reproductive behavior & Parental care** Reproductive strategies, Types of Mating systems, Sexual selection, Courtship behavior in invertebrates (Scorpion) & vertebrates (Stickle back fish), Parental care & investment. Influence of hormones on sexual behavior, maternal behavior and parental behavior.	7	1,3
	3.2	**Complex behavior** Orientation, Navigation, Migration (birds), Homing instinct, Hibernation, Aestivation, Biological rhythms – Circadian, Circannual, lunar periodicity, tidal rhythm, Biological clock, Physiological concepts of wakefulness and sleep. Physiological basis for emotionality and stress	9	1, 3

	3.3	**Defensive behavior and biomimicry** Camouflage, Cryptic coloration, Disruptive coloration, Aposematic coloration, Mimicry – Batesian, Mullerian and Aggressive Mimicry, Biomimicry.	6	1, 3
4		**Social Behavior**	**18**	
	4.1	Socio – biology (brief account), Cost and benefits of group living, Group selection, Kin selection, Altruism, Reciprocal altruism, Alarm call	4	4
	4.2	**Social organization** Territoriality- territory marking in animals, Aggressive behavior, Foraging behavior, Aggregation – schooling in fish. Social organization in insects (ants, honeybees), Mammals (Primates) Activity –Behavioral study/ behavioral conditioning of any one organism based on observation	6	4
	4.3	**Animal Communication** Components of Communication, Types of Communication – Visual, Auditory, Olfactory, Tactile, Chemical – Pheromones, Types of pheromones, Pheromonal communication in ants and mammals. Bee Dance in honeybees.	8	5
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** ICT Enabled Learning, Experiential learning, Tutorial, Lecturing,
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total = 30marks** Quiz, Test Papers, Seminar, Activity Report (on behavioral study)
	B. End Semester Examination **Theory Total = 70 marks, Duration 2 hrs** Short Essays 8 out of 18 x 4 = 32 Marks; Short questions - 14 out of 16 x 2 = 28 Marks Fill in the blanks - 10x1 =10 Marks

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Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**VALUE ADDED PRODUCTS OF ANIMALS**					
Type of Course	**DSE**					
Course Code	**MCE3DSEZGY201**					
Course Level	**200**					
Course Summary	Makes students aware of processes to prevent the risk of spoilage of raw produce, gives an idea about a variety of convenient, ready to prepare and ready to eat products which can satisfy the need of the present-day consumers at reasonable price, enable those who are interested to process during period of excess production and reduced selling of fresh perishable livestock produce, for value addition to less perishable products, store them, and sell them later in greater quantities. Promote employment and entrepreneurship development.					
Semester	**III**	**Credits**			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	**--**	**--**		**60**
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Describe products and value-added products of bee keeping.	U, S	1,2
2	Explain Fishery products, by-products and value-added products.	A, S	1,2
3	Explain Meat and Poultry Products	A, S	2,9.10
4	Describe testing and grading of raw milk, preparation of cultured milks and milk products.	U, S	1,2,9, 10
5	Deduce employment and entrepreneurship opportunities in value-added animal products.	An, S	1,2,9, 10
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Course description	Hrs	CO
1	**Products and value added products of bee keeping**	**15**	
	Honey – bee wax, bee venom – Honey Production, chemical composition – Economic importance of Honey bee wax. Value added products of honey- Fermented honey (mead), honey paste for dressing wounds, honey jelly, honey caramels, creamed honey, comb honey, honey beer, honey fruit syrup, honey with fruits and nuts and honey gums their manufacture,		1,5
2	**Fishery products, by-products and value added products**	15	
	Fish protein concentrate, fish oils- fishliver oil and body oil, squalene from shark liver oil, fish gelatin, fish glue, fish maws and isinglass, fish wafers, fish silage, fish skin leather, shark cartilage, fertilizer from fish waste, chitin and chitosan, surimi, roe, ambergris, ready to cook and ready to eat products - Additives and classes of additives.		2,5
3	**Meat & Poultry Products**	15	
	Meat Products: Canned meat, Frozen meat, Cooked and Refrigerated meat, Dried and preserved meat, Cured meat, Prepared meat products, Production methods for Intermediate moisture and dried meat products, Different kinds of goat meat products -Curried goat, Goat Sausage, Goat Hamburger. Organ products for food and pharmaceuticals. Poultry Products: Poultry meat processing operations in detail along with equipment used – Packaging of poultry products, refrigerated storage of poultry meat, by products – eggs, egg products, Whole egg powder, Egg yolk products, their manufacture, packaging and storage.		3,5
4	**Milk Products**	15	
	Testing and grading of raw milk. Pasteurized, standardized, toned, double toned, sterilized, homogenized, reconstituted, recombined and flavoured milks. Preparation of cultured milks, cultures and their management, yoghurt, Dahi, Lassi and Srikhand. Milk products such as Cream, Butter, Peda, Paneer, Burfi, Ghee, Khoa, Cheese, rasagolla mix, condensed, evaporated, dried milk and baby food, Ice cream and Kulfi, butter milk, lactose and casein.		4,5

	ACTIVITY: 1. Assignment and submission of various preparations. 2. Survey or refer sources and list out other value-added products of animals. 3. Organizing of food fest. 4. Exhibition of value added products (any 2)		
5	**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction):** Lectures, demonstrations using videos
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total = 30marks** Quiz, Test Papers, seminar, report submission of activity
	B. End Semester Examination **Theory Total = 70 marks, Duration - 2 hrs** Short Essays 8 out of 10 x4=32 marks; Short questions 14 out of 16 x2 =28 marks Fill in the blanks -10x1 =10 marks

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Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**APPLIED ZOOLOGY**					
Type of Course	**DSC B**					
Course Code	**MCE3DSCZGY202**					
Course Level	**200**					
Course Summary	To understand experiential learning on the methodology of Poultry Farming, Dairy Farming, Aquaculture, Vermiculture And Entomology					
Course Code	**MCE3DSCZGY202**					
Semester	**III**	**Credits**			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	---	1	---	75
Pre- requisite, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Distinguish different breeds of cattle, poultry, duck, quail, and cultivable fish and shellfish species.	An, S	1,2, 3. 10
2	Explain common diseases of cattle, poultry, and fish.	A, S	1,2, 3,10
3	Identify economically important insects, castes of honeybees, bee products, pollen basket and cocoon.	R, S	1,2, 3,10
4	Explain different aquaculture methods as well as the management of dairy, quail, ducks, and poultry.	An, S	1,2, 3,10
5	Explain milk, milk by-products, Biogas production and test the purity of milk.	An, S	1,2, 3,10
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Poultry and Dairy Farming**	**15**	
	1.1	**Poultry Farming** Introduction, Poultry breeds in India, Broilers and layers, Poultry Housing and Equipment, Poultry feed and its composition, Importance of egg production, Nutritive value of eggs and meat, Diseases and their management.	5	1, 3, 4
	1.2	Husbandry of quail - Breeds in India, Advantages of quail rearing - Housing, feeding and management of quail.	2	1, 4
	1.3	Husbandry of ducks - Breeds in India, Advantages of duck rearing - Housing, feeding and management of ducks	2	1, 4
	1.4	**Dairy Farming** Importance, Scope and management of farm animals. Breeds of cattle, housing system, nutrition requirements. Importance of artificial insemination	3	1, 4
	1.5	Milk, milk by-products. Biogas production.	1	5
	1.6	Common Cattle diseases: Anthrax, Foot and Mouth disease, Rinderpest	2	3
2		**Economically Important Insects**	**15**	
	2.1	Useful Insects: Honey bee, silk worm, Black soldier fly. Apiculture	9	3
	2.2	Pests of paddy - *Leptocorisa acuta* (Rice bug)]; Pests of coconut - *Oryctes rhinoceros* (Rhinoceros beetle), Pests of stored products - *Sitophilus oryzae* (Rice weevil).	3	3
	2.3	Vectors of public health importance – Mosquitoes- elephantiasis, malaria, chikun guinea, dengue, zika & Housefly – typhoid, dysentery	3	3
3		**Aquaculture**	**15**	
	3.1	Introduction & scope, Advantages and salient features, Types of aquaculture, Biotic and abiotic factors affecting aquaculture.	4	4
	3.2	Pond culture, Brief Description of common cultural fishes of Kerala, Composite fish culture. Integrated Fish Culture, Induced breeding in fishes, Mussel culture, Prawn culture. Important Fish Diseases. Fish preservation and processing.	8	4, 2
	3.3	Aquarium management: Setting up of an Aquarium.	3	4

4		**Practicals**	**30**	
	4.1	Poultry breeds (picture identification)	6	1
	4.2	Cattle breeds (picture identification), Purity analysis of milk	8	1
	4.3	Study of Pests of paddy *Leptocorisa acuta* (Rice bug), Pests of coconut *Oryctes rhinoceros* (Rhinoceros beetle) Pests of stored products [*Sitophilus oryzae* (Rice weevil) through damaged plant parts /photographs. Identification different species and castes of honey bees and bee products. Identification of pollen basket using picture, photograph. Identification of Silk worm moth, cocoon. Identification of black soldier fly.	8	3
	4.4	General Identification, scientific names and common names of the following a. cultivable fish species (Catla, Rohu, Mrigal, Etroplus, Tilapia) and b. shellfish species (Any 3: *Fenneropenaeus indicus / F.monodon / Macrobrachium*, *Perna viridis / P. indicus*)	8	1
		ACTIVITY - Visit to any 2 units (Poultry, Dairy, Apiculture or Aquaculture) and submit report		4
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Tutorial, Videos, Visit to any 2 units (Poultry, Dairy, Vermiculture or Aquaculture).
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA):** **Theory Total = 25 Marks** Quiz, Test Papers, Seminar **Practical Total 15 Marks** Lab performance, record, Activity Reports
	B. End Semester Examination **Theory Total = 50 Marks; Duration 1.5 hrs** Short Essays 5 out of 7 x4=20 Marks; Short questions 10 out of 12 x2 =20 Marks Fill in the blanks 10x1 =10 Marks **Practical Total = 35 Marks, Duration - 2 hrs** **Record - 10 Marks, Examination - 25 Marks:** Spotter Identification - 16 Marks Field Study Report – 4 Marks, Viva - 5 Marks

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Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**HUMAN DISEASES & THEIR MANAGEMENT**					
Type of Course	**MDC**					
Course Code	**MCE3MDCZGY200**					
Course Level	**200**					
Course Summary	Familiarizing various causative organisms and factors for human diseases, how and what preventive and therapeutic measures can be adopted against these diseases, the need to keep away/manage communicable diseases and life style diseases, thereby creating a healthy society, the need for maintaining vectors below damage threshold levels.					
Semester	**III**	**Credits**			**3**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	---	---	---	45
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Explain the aetiology, symptoms, diagnosis, treatment, and preventive measures of common airborne, waterborne, foodborne, and microbial infectious diseases.	U	1,2, 3
2	Distinguish infectious zoonotic diseases and diseases spread by mosquito vectors.	U	1,2, 3
3	Differentiate the aetiology, symptoms, diagnosis, treatment, and preventive measures of disorders of the central nervous system, immune system, and blood vascular system, as well as genetic, lifestyle, and nutritional deficiency diseases.	An	1,2, 3
4	Explain the causes and types of cancer, the characteristics of cancer cells, and theories of carcinogenesis.	U	1,2, 3
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT Content for Classroom transaction (Units)

EVALUATION AND ASSESSMENT

Module	Units	Course description	Hrs	CO No.
1		**Infectious diseases**	**15**	
	1.1	Introduction, health: - Need for being healthy. Classification of diseases: - infectious and non - infectious	5	1, 2
	1.2	Infectious diseases:-Description of disease, etiology, symptoms, diagnosis, treatment and preventive measures required for 2 disease each from a category. Air borne (Covid 19, measles), water borne (typhoid, hepatitis A), food borne (Botulism, shigellosis), Microbial —bacterial (TB, whooping cough), viral, (Covid 19, chickenpox) fungal (Candidiasis, Aspergillosis), protozoan (Malaria, leishmaniasis), helminthic (Schistosomiasis, ascariasis) Mosquito the terrible vectors – Dengue, Zika, chikunguinea. Bats- Nipah Zoonotic diseases- plague, rabies	10	
2		**Non infectious diseases - 1**	**15**	
	2.1	Non infectious diseases ---Description of disease, etiology, symptoms, diagnosis, treatment and preventive measures required for 2 diseases each from a category. 1. Genetic disorders (autism, sickle cell anaemia, haemophilia) Life style diseases (Diabetes, obesity). 2. Nutritional Deficiency diseases- Kwashiorkar, Night Blindness, Hypovitaminosis, Pernicious Anaemia.	15	3, 4
3		**Non infectious diseases - 2**	**15**	
	3.1	Non infectious diseases 3. Disorders of blood vascular system (Atherosclerosis, myocardial infarction), disorders of immune system:-Immune deficiency disorders (AIDS, SCID), Autoimmune disorders (Rheumatoid arthritis, SLE), Allergy. Disorders of central nervous system (Parkinson's disease, Alzheimer's disease)	8	3, 4
	3.2	4. Cancer: causes, types, characteristics of cancer cells, theories of carcinogenesis	7	
4		**Teacher Specific module**		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, Presentation of report of the activity.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment** **Theory Total = 25 Marks** Quiz, Test Papers, Seminar
	B. End Semester Examination **Theory Total = 50 Marks, Duration 1.5 hrs** Short Essays 5 out of 7 x4 =20 Marks Short questions 10 out of 12 x 2 =20 Marks Fill in the blanks 10 x1 =10 Marks

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Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**SCIENCE OF HAPPINESS & HUMAN RIGHTS**					
Type of Course	**VAC**					
Course Code	**MCE3VACZGY200**					
Course Level	**200**					
Course Summary	Helps the students to synthesize the insights developed by Human Development experts, Psychologists, Anthropologists towards the experience of happiness, to illustrate various factors that determine the subjective experience of happiness in a cross-cultural context, to achieve a life-saving skill to cope with the stress. To develop the real sense of Human rights – its concepts & manifestations					
Semester	**III**	**Credits**			**3**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	--	---	---	45
Pre- requisites, ifany						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Identify the factors contributing to happiness in the personal, familial and community life of an individual.	U	1,2,6
2	Describe different theories of Happiness.	U	1,2
3	Distinguish potential sources and consequences of stress.	An	1,5
4	Integrate individual approaches of Managing stress.	C	1,5
5	Explain the fundamental concepts of human rights, the human rights provisions stipulated in the Indian Constitution, and the UN's involvement in these areas.	A	6,7,8, 10
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E),Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1.		**Science of Happiness**	**15**	
	1.1	Human Ecology and Happiness. Definitions/Factors of Happiness: Environmental and Social. Physical, emotional and psychological well-being for happiness Physiological and hormonal basis of happiness Perspectives of happiness-Hedonic (Subjective Well-being) Eudaimonic (Psychological well-being). Happiness pie-chart" of Lyubomirsky.	5	1
	1.2	Theories of Happiness: - Need/ goal satisfaction theory, Process/ activity theory, Genetic/ personality theories. Idea of Self and other, Hierarchy and stages of happiness. New ways of thinking and rewiring the brains and be happy: 1. Be authentic 2. Change your perspective 3. Grow positive feelings 4. Cultivate mindfulness 5. Develop and foster healthy relationships 6. Create meaning Happiness: Cross-cultural Contexts: Culture and Happiness, Interpersonal Relationship: Comparative Perspective, Towards Self-Actualization. Local and Global Perspective of Happiness, Measuring happiness: Key indicators, Happiness Index, India in Global Happiness Indices	10	2
2		**Stress management**	**15**	
	2.1	Coping with Stress- A life-saving skill: Stress can be bad and good as well. Potential sources of stress - Environmental factors, organizational factors, personal factors.	3	3,4
	2.2	Consequences of stress- Physiological –headache, high blood pressure, heart disease; Psychological- anxiety, depression, decrease in job satisfaction; Behavioural- changes in productivity, absenteeism, sleeping disorders, changes in eating habits etc.	5	
	2.3	**Individual approaches of Managing stress-** a) implementing time management techniques - ✓ making daily lists of activities to be accomplished; ✓ prioritizing activities by importance and urgency; ✓ scheduling activities according to the priorities set; and	7	

		✓knowing your daily cycle and handling the most demanding parts of your job during the high part of your cycle when you are most alert and productive; b) increasing physical exercise - such as aerobics, walking, jogging, swimming, and riding a bicycle; c) relaxation training- meditation, hypnosis, biofeedback; d) expanding social support network –have friends, family and colleagues as an outlet of stress.		
3		**Human Rights**	**15**	
	3.1	An Introduction to Human Rights, Meaning, concept and development –History of Human Rights-Different Generations of Human Rights- Universality of Human Rights- Basic International Human Rights Documents - UDHR, ICCPR, ICESCR. -Value dimensions of Human Rights	5	5
	3.2	**Human Rights and United Nations** Human Rights co-ordination within UN system- Role of UN secretariat- The Economic and Social Council- The Commission Human Rights-The Security Council and Human rights- The Committee on the Elimination of Racial Discrimination- The Committee on the Elimination of Discrimination Against Women- the Committee on Economic, Social and Cultural Rights- The Human Rights Committee- Critical Appraisal of UN Human Rights Regime.	5	
	3.3	**Human Rights National Perspective** Human Rights in Indian Constitution – Fundamental Rights- The Constitutional Context of Human Rights- directive Principles of State Policy and Human Rights- Human Rights of Women-children –minorities- Prisoners- Science Technology and Human Rights- National Human Rights Commission- State Human Rights Commission- Human Rights Awareness in Education.	5	
		ACTIVITY - Any two 1. Workshops/ Sessions for the actualization of innate creative potential-(Music, Drawing, Calligraphy, Dramatics) 2. Hands-on Happiness: Gardening, Cleaning, Cooking, etc. 3. Extending help and social service by visiting old age homes/hospitals/slum areas or any other disadvantaged groups. 4. Community surveys on the facilities promoting positive mental health practices such as Yoga and Meditation Centres, Recreation clubs, and Parks for youth and senior citizens		

		5. Survey on various factors that determine the subjective experience of happiness in various populations and its reporting, distributing questionnaires. 6. Collection of newspaper reports on Global Human rights violations. **(Any two)**		
4		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lectures, presentations, videos
Assessment types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total =25 Marks** Quiz, Test Papers, Seminar, Activity
	B. End Semester Examination **Theory Total = 50 marks, Duration - 1.5 hrs.** Short Essays 5 out of 7 x4=20 Marks Short questions 10 out of 12 x2 =20 Marks Fill in the blanks 10x1 =10 Marks

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Semester-IV

Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**ANIMAL DIVERSITY - CHORDATA I**					
Type of Course	**DSC A**					
Course Code	**MCE4DSCZGY200**					
Course Level	**200**					
Course Summary	The course gives an overall idea of the classification of chordates and highlights the differences between different classes of chordates up to Class Reptilia. It also sheds light on the evolutionary significance of certain animals, which form the connecting links between two groups. It also helps in the identification of poisonous and non-poisonous snakes. The course enables skill development in understanding the diversity, systematic position, and economic importance of chordates.					
Semester	**IV**	**Credits**			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	----	1	---	75
Pre- requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Classify Chordata up to class and Class amphibia and Reptilia up to order.	An	2
2	Examine the general characters of protochordates, agnatha, pisces, amphibia, and reptilia.	A	2
3	Describe fish migration, scales, parental care, and accessory respiratory organs.	U	2
4	Describe the different organ systems of frogs and the key characteristics of both poisonous and non-poisonous snakes.	U	2
5	Demonstrate expertise in the laboratory in mounting scales and identifying specimens.	A, S	2
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Classification of Chordata**	**13**	
	1.1	**Introduction** General Characters and outline **classification** of Chordata up to class	2	1,2
	1.2	**Protochordates**: General characters and Classification	1	1,2
	1.3	**Sub phylum: Urochordata** Class I Larvacea Eg. *Oikopleura* (mention paedogenesis and Oikopleuran house) Class II Ascidiacea Eg: *Ascidia* (Mention Retrogressive Metamorphosis) Class III Thaliacea Eg: *Doliolum*	4	1,2
	1.4	**Sub phylum: Cephalochordata** Example - *Amphioxus* (Structure and affinities)	3	1,2
	1.5	**Sub phylum: Vertebrata** General characters and Classification **Division 1– Agnatha** Class I Ostracodermi Eg: *Cephalaspis* Class II Cyclostomata Eg: *Petromyzon* **Division 2 – Gnathostomata**	3	1,2
2		**Superclass Pisces**	**13**	
	2.1	Super class Pisces General Characters and Classification	1	1,2
	2.2	**Class: Chondrichthyes** - General Characters Sub class – Elasmobranchii Eg: Shark Sub class - Holocephali Eg: *Chimaera*	2	1,2
	2.3	**Class: Osteichthyes** - General Characters Sub class – Choanichthyes Order 1 Crossopterigii (Coelocanths) Eg: *Latimeria* (Evolutionary Significance) Order 2 Dipnoi Eg: *Lepidosiren* Sub class: - Actinopterygii Super order 1. Chondrostei Eg: *Acipencer* Super order 2. Holostei Eg: *Amia* Super order 3. Teleostei Eg: Sardine	4	1,2
	2.4	**General topics** 1. Accessory respiratory organs in fishes. 2. Parental care in fishes. 3. Scales in fishes. 4. Migration in fishes	6	3

3		**Super class: Tetrapoda**	19	
	3.1	General characters	1	2
	3.2	**Class Amphibia** – General characters, Classification up to Orders. Mention the extinct orders. Order I Anura Eg: *Hyla* Order II Urodela Eg: *Ambystoma* (mention axolotl larva and Paedomorphosis /neoteny) Order III Apoda Eg: *Ichthyophis.* Mention Nasikabatrachus sahyadransis	3	1,2
	3.3	Class Amphibia - **Type Frog** (*Euphlyctis hexadactylus*	10	4
	3.4	**Class Reptilia** - General characters, Classification up to Orders Sub class I: Anapsida Order Chelonia Eg: *Chelone* Sub class II: Parapsida Eg: *Ichthyosaurus* Sub class III: Diapsida Order I Rhynchocephalia Eg: *Sphenodon* Order II Squamata Eg: *Chamaeleon* Order III. Crocodilia Eg:*Crocodylus* Sub class IV: Synapsida Eg: *Cynognathus*	2	1,2
	3.5	General topics 1. Identification of venomous and non- venomous snakes 2. Common venomous and non- venomous snakes of Kerala 3. Biting mechanism of snakes	3	4
4		**Practicals**	**30**	
	1	**Scientific Drawing** Make scientific drawing of 3 locally available vertebrate specimens belonging to different Classes	3	5
	2	**Dissections** Frog: Photographs/diagrams/one dissected & preserved specimen each/models /virtual Dissections may be used for study 1. Frog Viscera 2. Frog Digestive System 3. Frog Arterial System 4. Frog 9 th & 1st Spinal nerve 5. Frog Sciatic Plexus 6. Frog Brain	6	
	3	Mounting of placoid scales; study of cycloid and ctenoid scales	4	
	4	**Osteology** Frog vertebrae - typical, atlas, 8th and 9th Pectoral and pelvic girdles of Frog Turtle/Tortoise - plastron and carapace	4	

	5	**Study of sections.** *Amphioxus* T. S. through pharynx/T.S. through intestine	1	
	6	**Identification:** **A**,**General identification;** Identify, classify and describe the following animals by their scientific names. Protochordata-1, Pisces-5, Amphibia-5, Reptilia- 5 **B. Taxonomic identification with key:** i) Identification of fishes up to the level of order (any 4 different orders). ii) Identification of snakes up to family (any 2 venomous and 2 nonvenomous snakes). **C.** Identification of different types of caudal fins	4 4 1	
	7	**Group activity**- Report presentation of homestead /campus biodiversity of Amphibia and Reptilia/ fish diversity of the locality	3	
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, Videos, PPT, Field trips, Zoo Visit, Fish landing center visit
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total=25 marks** Quiz, Test Papers, seminar **Practical Total =15 marks** Lab performance, record, submission of group activity
	B. End Semester Examination **Theory Total = 50 marks, Duration 1.5 hrs** Short Essays 5 out of 7 x4=20 marks Short questions 10 out of 12 x2 =20 marks Fill in the blanks 10 x 1=10 marks **Practical Total = 35 marks, Duration - 2 hrs** **Record 10 marks, Examination 25 marks:** Dissection – 15 marks Mounting/ scientific drawing/section – 5 marks Spotter identification/ osteology/taxonomic identification – 5 marks

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Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**BIOLOGICAL CHEMISTRY**					
Type of Course	**DSC A**					
Course Code	**MCE4DSCZGY201**					
Course Level	**200**					
Course Summary	This course provides a comprehensive exploration of bioenergetics, enzymology, biomolecules and metabolism. Students will have a deep understanding of the chemical foundations of life.					
Semester	**IV**	**Credits**			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	--	1	--	75
Pre-requisites if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain how energy is released into high-energy compounds capable of driving biochemical reactions.	U	1
2	Describe the role of enzymes in catalyzing reactions.	U	2
3	Illustrate the structure and function of the chemical building blocks of life -carbohydrates, proteins, lipids, and nucleic acids	U	2
4	Explain the primary metabolic pathways that power cells and metabolic disorders.	U	2,3
5	Prepare standard solutions and test the presence or absence of biomolecules in various samples.	A, S	1,2
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description (Theory)	Hrs	CO No.
1		**Biomolecules**	**17**	
	1.1	**Carbohydrates:** Biological function. Classification- Monosaccharides- Fischer's and Haworth's structure of Glucose, Fructose, Galactose, Mannose. Oligosaccharides – Maltose, Lactose and Sucrose. Polysaccharides- Glycogen, Chitin, Hyaluronic acid. Enantiomers, Anomers, and Epimers.	5	3
	1.2	**Proteins:** Biological function. Amino acids- Basic structure. Zwitterions. Isoelectric point. Essential and non-essential amino acids. Ketogenic and Glucogenic amino acids (examples). Levels of organization of proteins - primary (Insulin), secondary (Collagen), tertiary (Myoglobin) and quaternary structure (Haemoglobin). Mention Ramachandran plot. Chaperons.	4	3
	1.3	**Lipids:** Biological function. Basic structure- Triglycerides. Fats, oils and waxes. Saturated and unsaturated fatty acids, Cis and trans fatty acids. Reactions- Saponification, Rancidity. Generation of free radicals and role of antioxidants. Cholesterol and its importance. Physiological functions of Sphingolipids and Phospholipids.	5	3
	1.4	**Nucleic acids:** Biological function. Basic structure- Purines and Pyrimidines, Nucleosides and nucleotides. RNA (m-RNA, t-RNA, r-RNA) and DNA (A, B and Z model).	3	3
2		**Enzymology**	9	
	2.1	**Enzyme Chemistry** Chemical nature of enzymes. Holoenzyme, Apoenzyme, Non-proteinaceous enzymes: ribozymes, DNA enzymes, Abzymes. Coenzyme, Cofactor. Classification (I.U.B. system).	2	2
	2.2	**Enzyme Kinetics** Mode of action of enzymes- lowering of Activation energy, Michaelis-Menten Curve. Km and its significance. Factors affecting enzyme-catalyzed reaction.	4	2

	2.3	**Enzyme Inhibition** Reversible inhibition (Mention competitive, uncompetitive and noncompetitive) (eg: methanol inhibition of ADH), irreversible inhibition (eg: Iodoacetate inhibition of SDH), and feedback enzyme inhibition (eg: citrate inhibition of glycolysis). Isoenzymes (eg: LDH) and Allosteric enzymes (eg: PFK-1).	3	2
3.		**Bioenergetics** & **Metabolism** (structural details not expected)	**19**	
	3.1	Free energy changes, coupled reactions, redox reactions. High energy compounds.	2	1
	3.2	Overview of Metabolic pathways- Anabolic and Catabolic pathways **Carbohydrate** - Cellular respiration – Glycolysis - aerobic and anaerobic (alcohol and lactic acid fermentation), Krebs cycle, Oxidative phosphorylation. Glycogen metabolism- Glycogenesis, Glycogenolysis. Gluconeogenesis, HMP shunt	7	4
	3.3	**Amino acid** - Transamination, Deamination, Urea cycle	2	4
	3.4	**Lipid** - Fatty acid activation, Carnitine Shuttle, and Beta Oxidation of fatty acids.	5	4
	3.5	**Metabolic disorders**- Diabetes, Keto acidosis, Lactose intolerance, Hyperlipidemia, Atherosclerosis.	3	4
4		**Practicals**	**30**	
		Calculation of Molarity and normality of solutions. Preparation of standard solutions.	6	5
		Study of the structure of Carbohydrates – Glucose and Fructose using Ball and stick model	2	3
		Study of the structure of Nucleic acids- DNA, RNA and Protein using software tools	6	3
		Qualitative analysis of Carbohydrates, Proteins and lipids	6	5
		Qualitative analysis of Urease	4	5
		Saponification test	6	5
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lectures and presentations Case studies, Visual aids- charts, animations etc. Interactive lectures, group discussions, Laboratory simulations, hands-on activities, Technology Integrating Laboratory Sessions
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total =25 marks** Quiz, Test Papers, seminar **Practical Total = 15 marks** Lab performance, record, Test paper
	B. End Semester Examination **Theory Total = 50 marks, Duration 1.5 hrs** Short Essays 5 out of 7 x4=20 marks Short questions 10 out of 12 x2 =20 marks Fill in the blanks 10x1 =10 marks **Practical Total = 35 Marks, Duration - 2 hrs** **Record 10 marks, Examination 25 marks:** Qualitative analysis- Carbohydrates, Proteins &lipids– 15 marks; Qualitative analysis urease – 4 marks Spotter identification – 6 marks

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3. https://biochem.oregonstate.edu/undergraduate/educational-resources
4. https://wou.edu/chemistry/courses/online-chemistry-textbooks/ch450-and-ch451-biochemistry-defining-life-at-the-molecular-level/ch450-biochemistry-i-student-and-teacher-resources/
5. https://www.abpischools.org.uk/topics/chemistry-of-life/the-importance-of-chemistry-in-biology/
6. https://home.csulb.edu/~cohlberg/songbook.html

Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**GENERAL TOXICOLOGY**					
Type of Course	**DSE**					
Course Code	**MCE4DSEZGY200**					
Course Level	**200**					
Course Summary	Provides an overview of the principles and practices of toxicology, focusing on the adverse effects of chemicals on living organisms. Students will explore the fundamental concepts of toxicology, including the mechanisms of toxicity, routes of exposure, dose-response relationships, risk assessment, and regulatory aspects.					
Semester	**IV**	**Credits**			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	--	--	--	60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1.	Distinguish different toxicants, their impacts on human health and environment and the principles of toxicity evaluation	E	1,2,6, 8, 10
2	Describe the toxicants of biological origin and various food additives & their impacts.	U	1,2,10
3	Analyze the toxicity of various products used in day today life.	A	1,2, 6
4	Identify the branches of Applied Toxicology	U	1,2,10
5	Identify the occupational hazards, occupational diseases and their control measures	U	1,2,6, 10
Remember (K), Understand (U), Apply (A), Analyze (An), Evaluate (E),Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Basic Concept of Toxicology**	**18**	
	1.1	Introduction of toxicology, history of toxicology, definition of toxicology, definition of poison, definition of toxicity and classification of toxicants-occurrence/source. Mode of action of toxic agents.	9	1
	1.2	**Evaluation of toxicity** Principles, Acute, sub-acute and chronic assays LD50, LC50, NOEL. Maintenance and general handling of animals for toxicological laboratory.	3	1
	1.3	Toxicants of biological origin:- aflatoxin, botulinum toxin	3	2
	1.4	Food additives	3	2
2		**Xenobiotics**	**17**	
	2.1	Introduction, Important of xenobiotics concerned to Human health, absorption of xenobiotics, distribution of xenobiotics, accumulation of xenobiotics, elimination, biotransformation and excretion.	3	3
	2.2	Adverse effects of xenobiotics through Biological Magnification and Biotransformation, mechanism of Xenobiotic Translocation, Membrane permeability and mechanism of chemical transfer	8	3
	2.3	**Pesticides and Heavy Metal Toxicity** Pesticides and their toxicological effects. Classification of Pesticides, Insecticides, Mode of action of Insecticide. Heavy Metal Toxicity: Introduction, dispersion, general principal of metal toxicity, sources, toxic metals and their toxicity. Arsenic, Aluminium, Cadmium (ItaiItai disaster), Chromium Lead, Mercury, Manganese, Zinc and Nickel	6	2,3
3		**Applied Toxicology**	**13**	
	3.1	**Cosmetic toxicology**- Toxicity of shampoos, conditioners, bleachers, dyes, allergic and respiratory disorders.	2	4
	3.2	**Wildlife toxicology**- Susceptibility of wildlife to chemicals, Acute ecological hazards, Toxicology of chemicals in birds and mammals, Integrated approach to wildlife toxicology	3	4
	3.3	**Medical toxicology**- acute drug poisoning, adverse drug effects, drug abuse, chemicals and hazardous materials	2	4

	3.4	**Toxicology of chemical warfare agents**- Chemical weapons, classification of chemical warfare agents, mustard gas, lewisite, nerve agents, hydrogen cyanide, management of chemical warfare agents	4	1,4
	3.5	**Veterinary toxicology**- Common toxicity in dogs, cats, horses and poultry, by herbicides, house hold chemicals, heavy metals, mycotoxins, blue green algae and toxic plants .	2	1
4		**Occupational toxicology**	**12**	
	4.1	Occupational hazards- Physical hazards, Chemical hazards, Biological hazards, Mechanical hazards, Psychosocial hazards	4	5
	4.2	Occupational diseases- Pneumoconiosis, silicosis, asbestosis, anthracosis, byssinosis, bagassosis, Farmers' lung Occupational Cancer- Skin cancer, Lung cancer, Bladder cancer, Leukaemia	4	
	4.3	Prevention of occupational diseases- Medical measures, Engineering measures, Legislative measures, Occupational health in India	4	
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, Report on activities, Videos, Group discussions and presentation
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total =30 marks** Quiz, Test Papers, seminar, report submission of activity
	B. End Semester Examination **Theory Total = 70 marks, Duration 2 hrs** Short Essays 8 out of 10 x 4=32 marks Short questions 14 out of 16 x2 =28 marks Fill in the blanks 10 x1 =10 marks

REFERENCES

1. Bryan Ballantyne, Timothy C. Marrs, Tore L. M. Syversen 2009, General and applied toxicology Wiley-Blackwell, Oxford
2. Clinical and Experimental Toxicology of organophosphates and carmabates: Bryan Ballantyne and C. Marrs.
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Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**HEALTH, NUTRITION AND WELLNESS.**					
Type of Course	**DSE**					
Course Code	**MCE4DSEZGY201**					
Course Level	**200**					
Course Summary	This course explores the fundamental principles of nutrition, emphasizing the role of a balanced diet in promoting health and wellness. Topics include macronutrients, micronutrients, dietary guidelines, and their impact on various aspects of physical and mental well-being. Additionally, the course delves into lifestyle factors, such as exercise and stress management, contributing to overall health.					
Semester	**IV**	**Credits**			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	--	--	--	60
Pre- requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain the fundamental concepts of nutrition and their role in maintaining health and well-being.	U	1,6
2	Employ healthy dietary practices to prevent disease.	A, S	2,6
3	Describe healthy lifestyle choices.	A	1,10
4	Explain how exercise, diet, and nutrition affect health.	A	1,3
5	Create dietary plans for different age groups.	C, S	1,2,6
Remember (K), Understand (U), Apply (A), Analyze (An), Evaluate (E),Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Introduction to Nutrition and Health**	**15**	
	1.1	Overview of nutrition. Basic nutrients, Macronutrients, sources and functions (Carbohydrates, Proteins & Fats), Micronutrients (vitamins, minerals-Ca, Fe, I, Na & K) their functions and sources. vitamin toxicity (brief account only). **ACTIVITY -** Observe and interpret the nutritional information on the labels of food packets /tin, Assignment on Common myths and facts related to nutrition.	9	1
	1.2	Dietary antioxidants. Importance of dietary fibers and water in the diet. Balanced diet and its importance. Basal Metabolic Rate and BMI.	3	1,3,5
	1.3	Common nutrition-related diseases and their prevention. (Obesity, Protein Energy Malnutrition-Kwashiorkor and Marasmus, Vitamin deficiency disorders etc.)	3	2
2		**Health and well being**	**15**	
	2.1	Health- concept and dimensions. Benefits of regular physical activity.	2	4
	2.2	Stress management and relaxation techniques. Importance of quality sleep for mental and emotional health, sleep deprivation. Sleep hygiene practices for improved sleep quality	3	3
	2.3	Types of exercises and their benefits – Aerobic and anerobic. Brief account on yoga and its health benefits **ACTIVITY** - Short videos - Practice 3 yoga asanas or zumba or any other physical activity	10	4
3		**Nutritional needs during different Life stages and Healthy dietary practices**	**16**	
	3.1	**Nutritional needs during different Life stages** Nutrition for different stages – Childhood, adolescence and adulthood.	4	5
	3.2	Special nutritional requirements during Pregnancy each trimester and lactation, The importance of breastfeeding. Composition and benefits of breast milk.	4	5

	3.3	**Healthy dietary practices** The role of nutrition in prevention and management of cardiac problems. The role of nutrition in prevention and management of diabetes Dietary strategies for addressing obesity Dietary management of hypertension and lactose intolerance	4	2
	3.4	Overview of different dietary practices: Gluten-free, Vegan and Keto diet	2	2
	3.5	Food adulteration: Impact on health, addressing concerns. Fast food culture and health implications)	2	2
4		**Geriatric Nutrition**	**14**	
	4.1	Overview of ageing (changes in metabolism, digestion, and absorption in aged people) and the changes in nutritional requirements. The impact of common chronic conditions (eg., Diabetes, Hypertension) on dietary requirements	6	5
	4.2	Common nutritional issues in the elderly population. Importance of adequate hydration & practical approaches to ensure adequate hydration. **ACTIVITY** - Meal Planning for adolescence or pregnancy or geriatrics	8	5
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, Report on activities, Videos Group discussions and presentation
Assessment Types	**MODE OF ASSESSMENT** A. **Continuous Comprehensive Assessment (CCA)** **Theory Total =30marks** Quiz, Test Papers, seminar, report submission of activity
	B. End Semester Examination **Theory Total = 70 marks, Duration 2 hrs** Short Essays 8 out of 10 x 4=32 marks Short questions 14 out of 16 x 2 =28 marks Fill in the blanks 10 x1 =10 marks

REFERENCES

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2. National Institute of Nutrition, (2005): Dietary Guidelines for Indians – A Manual, Hyderabad
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Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**FUNCTIONAL ZOOLOGY**					
Type of Course	**DSC B**					
Course Code	**MCE4DSCZGY202**					
Course Level	**200**					
Course Summary	To impart deep knowledge in physiology, endocrinology and immunology					
Semester	**IV**	**Credits**			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	--	1	--	75
Pre-requisite, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domain*	PO No
1	Explain the physiology of nutrition, respiration, circulation, excretion, and disorders.	A	1,2,3, 10
2	Describe Muscle and Neuro physiology and neural disorders.	A	1,2,3, 10
3	Explain Endocrine system and Hormonal disorders	U	1,2,3, 10
4	Distinguish types of immunity, lymphoid organs, antigen-antibody reactions, auto-immune diseases, immunodeficiency diseases, hypersensitivity, and vaccines.	An	1,2,3, 10
5	Test human blood groups, leukocytes, tonicity, lymphoid organs, estimate haemoglobin, monitor blood pressure, heart rate, and opercular movement in fish.	An, S	1,2, 3, 10
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Physiology**	**16**	
	1.1	Nutrition: Introduction & Types, Nutritional requirements, nutritional disorders	1	1
	1.2	Respiration: Transport of respiratory gases, Respiratory disturbances- Hypoxia, Hypercapnia, Physiological effect of smoking, carbon monoxide poisoning	3	1
	1.3	Circulation: Composition and function of blood, Mechanism of blood clotting, ECG, Blood pressure, Arteriosclerosis, Haemophilia	3	1
	1.4	Excretion: Structure of nephron, Urine formation and concentration, Kidney stone, dialysis	3	1
	1.5	Neuro physiology: Structure of neuron, Nerve impulse production and propagation, synapse and synaptic transmission, Neurotransmitters, EEG, Neural disorder: Parkinson's & Alzheimer's diseases	3	2
	1.6	Muscle Physiology: Types of muscles, Structure of striated muscle, Mechanism of muscle contraction, Cori cycle, Muscle fatigue, Oxygen debt, Rigor mortis	3	2
2		**Endocrinology**	**15**	
	2.1	Endocrinology: Introduction to Endocrine system, Mechanism of hormone action, Endocrine glands, Hormonal disorders (brief account only).	15	3
3.		**Immunology**	**14**	
	3.1	Introduction to immunology, types of immunity (innate & acquired immunity, Humoral & Cell mediated)	2	4
	3.2	Structure of immunoglobulins, Classes of immunoglobulins, Types of antigen.	3	4
	3.3	Lymphoid organs, T cells, B cells and other cells of immune system.	2	4
	3.4	Antigen-Antibody reactions (Precipitation test, agglutination test, WIDAL, VDRL, ELISA), monoclonal antibodies	3	4
	3.5	Auto immune diseases (Rheumatoid arthritis), Immune deficiency diseases (AIDS), Hypersensitivity	2	4
	3.6	Vaccines (BCG, DPT, Polio, recombinant vaccines, DNA & mRNA vaccine)	2	4
4		**Practicals**	**30**	

	1	Preparation of blood smear and identification of leukocytes	8	5
	2	Identification of human blood groups	3	5
	3	Study of lymphoid organs	3	5
	4	Demonstration of effect of tonicity on RBC	3	5
	5	Estimation of haemoglobin (Demonstration)	5	5
	6	Effect of temperature on opercular movement of fish	4	5
	7	Instruments-(Principle and Use)-Sphygmomanometer, Stethoscope (Students are expected to learn how to monitor blood pressure and heart rate)	4	5
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Tutorial, Videos
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA):** **Theory Total = 25 Marks** Quiz, Test Papers, seminar **Practical Total = 15 Marks** Lab performance, record, Other assignments
	B. End Semester Examination **Theory Total = 50 Marks; Duration 1.5 hrs** Short Essays 5 out of 7 x4=20 Marks; Short questions 10 out of 12 x2 =20 Marks Fill in the blanks 10 x1 =10 Marks **Practical Total = 35 Marks, Duration - 2 hrs** **Record - 10 Marks, Examination - 25 Marks:** Spotter Identification: 1. Identification – lymphoid organs, instruments -6 marks 2. Practicals 2/4/5/6 -4 marks 3. Blood smear preparation and identification of leucocytes -15 marks

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Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**EMERGENCY LIFE SUPPORT AND FIRST AID**					
Type of course	**SEC**					
Course Code	**MCE4SECZGY200**					
Course Level	**200**					
Course Summary	Equips the learner with life-saving techniques and knowledge about the fundamentals of first aid and safety protocols to respond confidently to emergencies					
Semester	**IV**	**Credits**			**3**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	--	--	--	45
Pre- requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Apply the basics of first aid and crisis management.	A,S	1,2, 3
2	Demonstrate CPR	A,S	1,2, 5, 6
3	Apply first aid for fractures, sprains, wounds, and drowning.	A,S	1,2, 3, 6
4	Employ tailored treatments for various types of burns, bites, and stings.	A,S	1,2, 3, 6
5	Demonstrate basic life support care and safety measures.	A,S	1,2, 3, 8
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E),Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**First Aid Essentials**	**8**	
	1.1	**First aid -** Definition, Importance of first aid, Rules of first aid, contents of an ideal first aid kit.	4	1
	1.2	**Crisis management** Dealing with an emergency- crisis management and emotional support including effective communication with casualities and bystanders, responses in casualities- AVPU (Alert, Voice, Pain, Unresponsive). Stroke symptom management-FAST(Face, Arms, Speech, Time)	4	1
2		**First aids for frequently encountered emergency situations**	**20**	
	2.1	Initial care for falls, fractures, dislocations, sprains, and strains, including immobilization techniques.	5	3
	2.2	**Different Types of wounds** Small cuts and abrasions, Head injury¸ nosebleed, bleeding gums, bleeding from varicose veins.	4	3
	2.3	**Burns** Types, danger of burns, first aid in dry burns and scalds, electrical burns, chemical burns, sunburn, heatstroke.	4	4
	2.4	**Bites, Stings and Poisoning** Snake bite, bed bug/ spider/ animal bite, wasp/ bee/ fire-ant/scorpion sting and poisoning- poisoning by swallowing, gases, injections, skin absorption.	5	4
	2.5	**Drowning –** Rescue from water¸ First aid measures- Position(supine) Observe¸ alert medical service	2	3
3		**Basic Life Support care & Safety Education**	**17**	
	3.1	**Cardiopulmonary Resuscitation** Airway, Breathing and Circulation (ABC), Cardiopulmonary Resuscitation (CPR) in adults, children and infants, automated external defibrillators (AED).	4	2, 5
	3.2	**Choking Relief Techniques** Techniques in adults and children, recovery position.	5	5

	3.3	**Safety education: Fundamental principles** Accident prevention, hazard identification, risk assessment, and mitigation strategies, Safety at home and different workplaces like laboratories, construction sites, healthcare facilities, schools. Safety in sports.	4	5
	3.4	**Safety management** An overview on safety technologies, including sensors, alarms, personal protective equipment (PPE), and software tools for risk assessment and management.	4	5
		ACTIVITY: (Anyone) **1.** Preparation of First aid kit 2. Role play (group) on given hypothetical situations/ Pamphlet preparation on emergency care & distribution in community. 3. Survey on safety management, its assessment and evaluation, if required conduct of awareness sessions in the area of concern in the survey (group) 4. Demonstration class on CPR/ recovery position & reporting **(Anyone)**		
4		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, Participatory learning, Experiential learning, ICT enabled discussion. Tutorial, Focus group discussions,
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total = 25 Marks** Quiz, Test Papers, activity
	B. End Semester Examination **Theory Total = 50 marks, Duration - 1.5 hrs** Short Essays 5 out of 7 x4=20 marks, Short questions 10 out of 12 x2 =20 marks, Fill in the blanks 10x1 =10 marks

REFERENCES

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Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**COMPREHENSIVE FITNESS**					
Type of Course	**VAC**					
Course Code	**MCE4VACZGY200**					
Course Level	**200**					
Course Summary	This course is designed to foster an overall well-being through an integrated approach that combines mental resilience, physical vitality, and the enriching practice of yoga. It explores the interconnected dimensions of health, promoting balance and harmony in both mind and body.					
Semester	**IV**	**Credits**			**3**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	--	--	--	45
Pre- requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Explain the factors affecting health and wellness.	U	1,2,3,4,6
2	Describe different types of fitness exercises.	U	1,3,6
3	Describe the effect of exercise on the body's systems.	A	1,2,3
4	Explain the importance of mental health.	A	1,2,3,6, 10
5	Analyze the holistic role of yoga.	An	1,2,3, 4,5
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E),Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Fitness exercises & Physiology**	**19**	
	1.1	Definition. Differentiate health and wellness. Importance of health and wellness education. Five dimensions of health. Local, demographic, societal issues and factors affecting health and wellness. Role of diet, exercise & sleep.	4	1
	1.2	**Exercise & health** Definition. Health benefits- overview, Recovery, Regeneration	3	3
	1.3	**Fitness exercises** Moderate exercises for body fitness, right postures of sitting & standing, stretching, walking, aerobic & flexibility exercises.	6	2
	1.4	**Effect of exercise on the body systems** Effect on the blood vascular system, effect on the muscular system, effect on respiration & metabolism, effect on the endocrine system, effect on the skeletal system, body's adaptations.	6	3
2		**Mental Health**	**14**	
	2.1	**Psychological well being** Importance of mental health. Stress, anxiety, and depression. Factors affecting mental health. Mental health promotion activities/sessions. Counselling, Agencies supporting Mental health	6	4
	2.2	**Substance abuse** Substance abuse (Synthetic Drugs, tobacco products, Alcohol), de-addiction, counselling and rehabilitation.	8	4
3		**Concept of Yoga**	**12**	
	3.1	**Yoga and its types** Origin. Breathing- Exercise- Meditation Types. Asanas — Differences between Asanas and Physical exercises.	6	5

	3.2	**Yoga for holistic wellness** Yogic concept of health, wellness and illness, holistic health and importance in management of diseases & stress and its management. **ACTIVITY**: (Any one) 1. Local, demographic, societal issues and factors affecting health and wellness- Focus group discussion & report submission 2. Drug awareness campaigns and its outcome assessment (local level survey & reporting) 3. Group presentation of the different asanas and reporting with geotagged photos of students doing Asanas	6	5
4		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, Participatory learning,, ICT Enabled Learning, Experiential Learning
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total =25 Marks** Quiz, Test Papers, Activity
	B. End Semester Examination **Theory Total = 50 marks, Duration - 1.5 hrs.** Short Essays 5 out of 7 x4=20 Marks Short questions 10 out of 12 x2 =20 Marks Fill in the blanks 10x1 =10 Marks

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Semester-V

Programme	**BSc (Honours) ZOOLOGY**					
Course	**ANIMAL DIVERSITY CHORDATA - II**					
Type of Course	**DSC**					
Course Code	**MCE5DSCZGY300**					
Course Level	**300**					
Course Summary	The course is designed to understand the characteristics and basic classification of Aves and Mammals along with an attempt to provide an insight on the concepts of comparative anatomy					
Semester	**V**	**Credits**			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	--	1	--	75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No.
1	Describe the classification and general characters of Aves and mammals.	U	1,2
2	Compare different systems of Euphlyctis, Pigeon, and Rabbit.	A	1,2
3	Identify the avian and mammalian fauna and their peculiarities.	U, I	1,2,3
4	Explain flight adaptations in birds, endemic birds of the Western Ghats, and aquatic mammals.	U	2
5	Dissect the pecten and hyoid of a bird.	A, I	2

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT
Content for Classroom transaction (Units)

Module	Units	Course description Theory (45 Hrs)	Hrs	CO. No.
1		**Class Aves**	**16**	
	1.1	General characters - Aves **Subclass Archaeornithes** Eg.: *Archaeopteryx* **Subclass Neornithes.** Super order Paleognathae: eg: *Struthio* Super order Neognathae: Brahminy Kite	3	1,3
	1.2	**Type: Pigeon** (*Columba livia*) External characters, Skeletal System (Skull may be excluded), Respiratory System, Digestive system, Circulatory system, Excretory system, Reproductive system, Nervous system and sense organs	10	2
	1.3	**General Topics**. Flight adaptations in Birds. Endemic birds of Western Ghats with special reference to Kerala (Nilgiri - Wood Pigeon, Malabar Grey Hornbill, Malabar Barbet, Malabar Parakeet, Malabar Wood shrike, White-bellied Tree pie, Nilgiri Flower pecker, Crimson-backed Sunbird, Broad-tailed Grass bird, Flame-throated Bulbul, Grey-headed Bulbul, Rufous Babbler, Wynand Laughing thrush, White-bellied Blue Flycatcher, Nilgiri Flycatcher, Malabar Starling , Black-and-orange Flycatcher, Palani Laughing thrush White-bellied Blue Robin) (brief mention only)	3	4
2		**Class Mammalia**	**15**	
	2.1	General characters and Classification of Mammals. (Modified version of McKenna and Bells Classification - Updated in 2005 with contributions from Don E. Wilson and DeeAnn M Reeder) **Subclass Prototheria** - Order Tachyglossa. Eg: Echidna Order Platypoda. Eg: Platypus **Subclass Theria.** Infra class- Metatheria Eg: *Macropus* Infra class - Eutheria Order Rodentia. Eg :*Funambulus* Order Chiroptera. Eg : *Pteropus* Order Soricomorpha Eg : Mole Order Afrosoricida. Eg : Tenrec	5	1,3

		Order Erinaceomorpha. Eg : Hedgehog Order Primates Eg : Lion tailed Macaque Order Artiodactyla. Eg . Camel Order Perissodactyla Eg. Rhinoceros Order Cetacea. Eg. *Delphinus* Order Hyracoidea. Eg. Procavia Order Sirenia. Eg .Dugong Order Proboscidea. Eg : Elephas Order Tubulidentata. Eg : Aardvark Order Carnivora. Eg: *Panthera tigris* Order Lagomorpha. Eg : Rabbit Order Xenarthra. Eg: Armadillo Order Scandentia. Eg: Tree shrews Order Macroscelidea. Eg : Elephant Shrews Order Pholidota. Eg: Pangolin		
	2.2	**Type: Rabbit** External Characters, Integumentary system and Glands, Axial and Appendicular Skeleton (Skull bones may be avoided), Digestive System (Mention Dentition and Secondary digestion), Respiratory System, Circulatory system, Urinogenital system, Nervous system and sense organs	8	2
	2.3	**General Topic** Adaptations of aquatic mammals with representative examples from Sirenia and Cetacea	2	4
3		**Comparative Anatomy of Selected Vertebrates**	**14**	
	3.1	**Type Specimens (***Euphlyctis*, Pigeon and Rabbit - Brief study only) Integumentary System, Locomotor organs, Skeletal System: Axial Skeleton (skull excluded), Appendicular skeleton, Digestive System, Circulatory System, Respiratory system, Sense organs, Urinogenital system	14	2
4		**Practical**	**30**	
	1	Dissection of pecten and hyoid of a bird	6	5
	2	Study of specimens (5 Birds and 5 Mammals)	3	3
	3	Prepare and write in the record, the list of the common names and scientific names of smallest/ biggest/tallest/ heaviest/ other peculiarities/ animals of different states /national animal etc. from all classes of animals.	1	3
	4	Study of Skeletal Structures: Bird- Heterocoelous vertebra, Synsacrum, pygostyle, keel and sternum	8	2

		Mammals: Skull with special reference to dentition (Diastema/Carnassial teeth), vertebrae, pectoral girdle, pelvic girdle		
	5	Study of arterial system of bird and mammal using pictures	6	2
	6	Study of different parts of Heart and Kidney of rabbit from photograph/picture	4	2
		ACTIVITY 1. Digital photo book / Printed Album of local Avian and Mammalian Fauna 2. Prepare a list of common names, Malayalam names and scientific names of mammals of Kerala. 3. Field visit to Zoo/Protected Area (2 fields) and report submission	2	3
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Verbal Teaching, Video Classes, Documentaries, Seminars, Album making,
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total = 25 marks** Quiz, Test Paper, seminar **Practical Total = 15 marks** Lab performance, record, submission of activity report
	B. End Semester Examination **Theory Total = 50 marks, Duration 1.5 hrs** Short Essays 5 out of 7 x4=20 marks; Short questions 10 out of 12 x2 =20 marks Fill in the blanks 10x1 =10 marks **Practical Total = 35 marks** **Record - 10 marks, Examination - 25 marks:** Minor Dissection – 8 Marks, osteology – 4 marks; Spotter identification - 4 marks, Taxonomic identification – 6 marks Identify the labelled parts and write notes on -3 marks

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4. The Book of Indian Animals by S H Prater BNHS Oxford University Press.
5. William S. Hoar, General and Comparative Physiology

Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**CELL BIOLOGY AND MOLECULAR BIOLOGY**					
Type of Course	**DSC**					
Course Code	**MCE5DSCZGY301**					
Course Level	**300**					
Course Summary	Encompasses the study of cells at the molecular level, exploring topics such as cellular diversity, cell structure, membrane dynamics, cell cycle, DNA structure and replication, prokaryotic gene expression and regulation, and basics of cancer biology. The course emphasizes the practical applications of cellular and molecular biology.					
Semester	**V**	**Credits**			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	--	1	--	75
Pre- requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Explain cell theory, cell structure, cellular diversity, cell communication, and the structure and functions of the cell organelles, nucleus, and plasma membrane.	**U**	1, 2
2	Compare the stages of mitosis and meiosis.	**A**	1, 2
3	Describe the types, diagnosis, and treatment of cancer.	**A**	1,2,3
4	Explain the nature of genetic material, the principles of prokaryotic gene expression, and its regulatory mechanisms.	**A**	1,2,3
5	Prepare blood and buccal smear to identify blood cells and the Barr body and extract DNA.	**C**	1,2,3
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Overview of cells and cellular dynamics**	**16**	
	1.1	Diversity of cells: Brief history, Cell theory	1	1
	1.2	Prokaryotes - Bacteria in detail and Mycoplasma Eukaryotic cell (Brief account) Difference between Prokaryotes and Eukaryotes Virus, Virions and Viroids, Prions	2	1
	1.3	Origin of Eukaryotic cell - Endosymbiotic theory Structure and functions of: Cytoskeleton, Endoplasmic reticulum, Ribosomes (Prokaryotic and Eukaryotic), Golgi complex , Lysosomes, Mitochondria	4	1
	1.4	Interphase nucleus, nuclear membrane, pore complex, nucleolus (in detail), Chromatin	3	1
	1.5	Cell cycle - Interphase, Mitosis, meiosis. Difference between Mitosis and Meiosis Cancer - types, diagnosis and treatment (only brief account)	6	2,3
2		**Plasma membrane**	**14**	
	2.1	Structure of plasma membrane (Sandwich model, Unit membrane and Fluid mosaic model)	2	1
	2.2	Modifications of plasma membrane - Cell junctions - Tight junctions, Desmosomes, Gap junctions. Cell coat and Cell recognition - Basic principles of cell communications	4	1
	2.3	Cell signaling - Types of signaling and signaling molecules - hormones, nitric oxide, neurotransmitters, vitamins A and D derivatives, cytokines. Cell signaling pathways - (cAMP and RTK)	6	1
	2.4	Functions of Plasma membrane: Transport - Diffusion, facilitated diffusion, Osmosis, Passive transport, Active transport, bulk transport, role of cell membrane in cell communication.	2	1
3		**Nature of Genetic material and Expression of Gene**	**15**	
	3.1	Structure and types of DNA and RNA.	2	4
	3.2	Modern concept of gene (Cistron, muton, recon)., Brief account of the following -- Split genes (introns	3	4

		and exons), Junk genes, Pseudogenes, Overlapping genes, Transposons		
	3.3	**Prokaryotic Gene expression and regulation:** Central Dogma of molecular biology and characteristics of genetic code DNA replication (theta and rolling circle) Gene Expression: Transcription, Translation and Reverse transcription. Prokaryotic Gene regulation: (inducible and repressible systems) Operon concept - Lac operon and Tryptophan operon.	10	4
4		**Practicals**	**30**	
		Cell Biology	20	
	1	Squash preparation of onion root tip for mitotic stages.		2
	2	Squash preparation of grasshopper testes for meiotic stages (Demonstration).		2
	3	Identification of cell organelles (using models, pictures).		1
	4	Identification of Barr body from human buccal epithelium.		5
	5	Preparation of human blood smear and identification of leukocyte.		5
		Molecular Biology	10	
	1	Study and interpretation of electron micrographs/ photograph of DNA, DNA replication, RNA different types.		4
	2	Study of Polytene chromosomes from *Chironomus/Drosophila* larvae (Demonstration).		4
	3	Extraction of DNA from plant/ tissue samples.		5
		ACTIVITY 1. Prepare posters on cellular diversity 2. Make models of DNA and RNA		
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lectures, Flipped classroom, Participative Learning, Interactive Sessions, Seminars, Discussions, Practical based learning, Research-based Learning, Technology-embedded Learning, Peer teaching
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total = 25 marks** Quiz, Test Papers, seminar **Practical Total = 15 marks** Lab performance, record, Poster/Model
	B. End Semester Examination **Theory Total = 50 marks, Duration 1.5 hrs** Short Essays 5 out of 7 x4 =20 marks; Short questions 10 out of 12 x2 =20 marks Fill in the blanks 10x1 =10 marks **Practical Total = 35 marks, Duration - 2 hrs** **Record - 10 marks, Examination - 25 marks:** Squash preparation of onion root tip for mitotic stages/ Preparation of human blood smear and identification of leukocyte. – 15 marks Barr body from human buccal epithelium/Extraction of DNA- 4 marks Spotter identification from Cell Biology – 3 marks Spotter identification from Molecular Biology – 3 marks

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Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**FUNDAMENTALS OF GENETICS**					
Type of Course	**DSC**					
Course Code	**MCE5DSCZGY302**					
Course Level	**300**					
Course Summary	This course covers the foundational aspects of genetics, offering a comprehensive understanding of inheritance, molecular mechanisms, genetic variation, and their practical applications.					
Semester	**V**	**Credits**			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	--	--	---	60
Pre- requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1.	Discuss Mendelian principles of inheritance and gene interactions; apply these to predict the outcome of genetic crosses	U, A, An	1,2
2.	Understand and analyze genetic recombination, linkage and sex determination, and solve problems related to these phenomena.	U, An	1, 2
3.	Evaluate the mechanism of mutation and generate awareness about the impact of various chemicals and drugs used in day-to-day life	E, A	2, 6
4.	Comprehend the organization of genetic material	U, An	2
5.	Familiarize with genetic diseases and analyze their pattern of inheritance	U	1, 6
*Remember (K), Understand (U), Apply (A), Analyze (An), Evaluate (E),Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Principles of Transmission Genetics**	22	
	1.1	**Mendelian inheritance and Chromosome Theory:** Mendel's Experiments- Monohybrid cross, dihybrid cross, test cross, back cross, reciprocal cross (Genetic problems to be included). Principles of inheritance, Chromosome theory of heredity. **ACTIVITY** Problems on Genetics	8	1
	1.2	**Extension of Mendelism:** Interaction of genes: (Brief account with one example each) **I**ncomplete dominance, Co-dominance, Complementary, Supplementary, Dominant and Recessive epistasis, Polygenes, pleiotropism, Modifying genes, Lethal genes. Multiple allelism - ABO Blood group system, Rh group and its inheritance in human, Erythroblastosis fetalis. Pseudo autosomal genes, sex-limited, sex-influenced, sex-linked genes and holandric genes. Mitochondrial inheritance (Brief account only).	10	1
	1.3	**Linkage and Recombination:** Linkage and recombination of genes based on Morgan's work in Drosophila (Complete and incomplete linkage). Recombination mapping using two point test cross.	4	2
2		**Sex determination**	**10**	
	2.1	**Basics of sex determination:** Chromosome theory of sex determination (sex chromosomes and autosomes), Chromosomal mechanism (XX-XO, XX-XY, ZW-ZZ). Genic balance theory	3	2
	2.2	Sex determination in Honey bees, Drosophila (Intersex) and Man. Role of SRY genes and gonad development. Hormonal influence & Environmental influence on sex determination.	4	2
	2.3	Barr bodies, Dosage compensation and Lyon hypothesis, gynandromorphs, sex mosaics, Hermaphroditism- Freemartin.	3	2
3		**Mutations**	10	
	3.1	**Types of Mutations**: Germinal & Somatic, Spontaneous & Induced mutations. Chromosomal mutation - structural and numerical aberrations.	3	3

	3.2	Molecular basis of gene mutation – tautomerism, addition, deletion, substitution, frame shift mutation.	3	3
	3.3	Factors affecting mutation, mutagens and their mode of action. Detection of mutation - CIB method	4	3
4		**Cytogenetics and Genetic disorders**	**18**	
	4.1	Nucleus & Chromosome structure: Chromatin (euchromatin, heterochromatin), Chromosome – structure, types, different levels of organization (Nucleosomes, Solenoid, Chromosome loop), Giant chromosomes (Polytene and Lampbrush chromosomes), Karyotyping - Normal human chromosome complement.	5	4
	4.2	Human chromosomal anomalies: Autosomal (Down syndrome, Edward's syndrome and Cri du chat syndrome). Sex chromosomal anomalies (Klinefelter syndrome, and Turners syndrome), Single gene disorders - Sickle cell anemia, cystic fibrosis¸Tay Sachs disease. **ACTIVITY:** Study of syndromes and karyotypes using photograph	5	5
	4.3	Inborn errors of metabolism: Genetic basis of Phenyl ketonuria, Alkaptonuria, Albinism.	3	5
	4.4	Multifactorial disorders - Cleft lip and cleft palate.	1	5
	4.5	Pedigree Analysis (Brief account only) – Pedigree symbols and construction of Pedigree.	2	5
	4.6	Human Genome Project (Brief account only), Genetic counselling- Eugenics and Euthenics.	2	5
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)**
AssessmentTypes	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment** **Theory Total = 30 marks** Quiz, Test Papers, seminar, Activity
	B. End Semester Examination **Theory Total = 70 marks, Duration 2 hrs** Short Essays 8 out of 10 x4=32 marks Short questions 14 out of 16 x2 =28 marks Fill in the blanks 10x1 =10 marks

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1. Benjamin, L. (2004). Gene VIII. Oxford University Press.
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11. Vijayakumaran, N. K. (2017). Cell Biology, Genetics and Molecular Biology. Academica, Trivandrum.

Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**BIOTECHNOLOGY: PRINCIPLES & PRACTICES**					
Type of Course	**DSE**					
Course Code	**MCE5DSEZGY300**					
Course Level	**300**					
Course Summary	This course encourages the students to master the fundamental principles underpinning genetic engineering and provides insight into the transformative applications shaping the forefront of modern science and industry.					
Semester	**V**	**Credits**			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	--	--	--	60
Pre- requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain the principles and techniques of rDNA Technology	U, S	1, 2, 9, 10
2	Describe techniques in cell culture & genetic engineering.	U	1, 2, 3,10
3	Analyze the biotechnological applications in various fields	An	1, 2, 3, 6,7, 8
4	Describe biosafety concerns in biotechnology	U	1, 2, 4, 5, 6, 8
5	Explain the provisions for the protection of intellectual property.	U, Ap	1, 5, 7, 8, 10
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E),Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Fundamentals of Recombinant DNA Technology**	**20**	
	1.1	**Introduction to Biotechnology** Historical background, Prospects of biotechnology	2	1
	1.2	**Tools & Techniques** Enzymes- restriction enzymes, ligases, polymerases. Vectors- Plasmids, Bacteriophage-derived vectors, artificial chromosomes. Techniques- DNA Extraction (Brief account of RNA & plasmid extraction), Electrophoresis- Agarose Gel, PAGE. PCR-Principle & application. Hybridization of nucleic acid- Southern and Northern blotting. DNA sequencing-Sanger sequencing, Next Generation Sequencing (NGS) (Brief account only) Brief account of protein/proteome; identification/sequencing - (using a flowchart/schematic representation only)	10	1
	1.3	**rDNA technology** Gene isolation, integration of the desired gene into Vector, Insertion of rDNA into host cell. Screening methods of recombinants. Gene transfer - Transformation, Transduction, Transfection, Retro-virus, Gene gun, Microinjection, Electroporation, Ultrasonication. Genomic and cDNA library. **(Brief description only)**	8	1
2		**Cell culture and Genetic Engineering**	13	
	2.1	**Cell culture** Animal cell culture-Media-Natural & Synthetic media (one example each) Stem cell- type & uses	3	2
	2.2	**Genetic Engineering** Organismal cloning by nuclear transfer, transgenic technology: development of transgenic animals- Transgenic mice- knock-in, knock - out models, Transgenic *C.elegans*. Cell line transfections. Gene silencing - RNA interference, gene editing - **CRISPR Cas** (brief account only).	10	2

3		**Biotechnology & Human welfare**	17	
	3.1	**Medical Biotechnology & Forensics** Gene therapy (SCID). Stem cell therapy - regenerative medicine, Personalized medicine. Development of Pharmaceuticals- biopharmaceuticals of immune system –(interferons, IL) Hormones (insulin, somatostatin), Antibiotics, monoclonal antibodies, vaccines. DNA finger printing and its applications. **ACTIVITY** Case studies and report submission and presentation of: any criminal case, disputed paternity etc. based on DNA fingerprinting, from Newspapers [any one]	7	3
	3.2	**Agricultural & Environmental Biotechnology** Agriculture: Transgenic plants -Pest resistant (Bt-cotton), herbicide resistant, disease resistant varieties. Microbial pesticides. Qualitative improvement of livestock-Milk production in cows Environment: Bioremediation of soil & water contaminated with oil spills, heavy metals and detergents. Bio-fertilizers: Algal and fungal biofertilizers (VAM), Bioleaching. Development of Biodegradable polymers-PHB.	6	3
	3.3	**Fermentation Biotechnology: Principles and applications** Enzymes - Amylase¸ Invertase¸ Zymase¸ General overview of synthesis of vitamins, food and beverages Single Cell Proteins.	4	3
4		**A. Biosafety concerns B. Intellectual Property Protection**	10	
	4.1	**A. Biosafety concerns** Levels of Biosafety. Risks associated with Genetically Modified Organisms (terminators seeds, impact on biodiversity, transferring transgenes from food to intestinal microbes, toxins/allergens in foods). Biological warfare & biopiracy. Ethics in Cloning	5	4

	4.2	**B. Intellectual Property Protection** Intellectual Property Rights (IPR)- Patents, Indian Patent law (overview).Copyright-TRIPS agreement, Trade secret, trademark, Plant breeder's right, Geographical indication (GI)	5	5
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, ICT Enabled Learning, Experiential learning, Participatory learning. Tutorial.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total = 30 marks** Quiz, Test Papers, seminar, Case study report submission & presentation
	B. End Semester Examination **Theory Total = 70 marks, Duration 2 hrs.** Short Essays 8 out of 10 x4=32 marks Short questions 14 out of 16 x2=28 marks Fill in the blanks 10x1=10 marks

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Programme	**BSc (Honours) Zoology**					
Course Name	**Wildlife Management**					
Type of Course	**DSE**					
Course Code	**MCE5DSEZGY301**					
Course Level	**300**					
Course Summary	To convey basic information in Forests, Wildlife, Man wildlife conflict and Wildlife Conservation.					
Semester	**V**	**Credits**			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	--	--	--	60
Prerequisite, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain biodiversity hotspots, forest ecosystems, and species richness-diversity indices.	U	1,2,10
2	Describe primate biology, ecology, and behaviour; animal barriers; and wildlife, with special reference to mammals, birds, and reptiles.	U	1,2,6
3	Describe the consequences of the man-wildlife conflict.	A	1,2,6,7
4	Explain the threats faced by wildlife, protected areas; research institutes, and types of wildlife conservation.	A	1,2,10
5	Summarise the advances in wildlife conservation.	U	1,2,3,6, 7,10
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Forest ecosystems**	**14**	
	1.1	Introduction to Forest ecosystems. Structure and functioning, forest succession. Keystone species, flagship species, Umbrella species	5	1
	1.2	Types of Forests - classification, distribution, composition and structure. Estimation of volume of individual tree and forest stands. Species richness-diversity indices (Shannon Weiner; Simpson).	5	1
	1.3	Biodiversity hotspots with special reference to Western Ghats.	4	1
2		**Introduction to wildlife & Man wildlife conflict**	**18**	
	2.1	Wild life - with special reference to Mammals, Birds and reptiles in international, national and local perspective	4	2
	2.2	Introduction to Biology, ecology and behaviour of Primates (Bonnet Macaque), Carnivora (Tiger, Leopard) and Elephants.	7	2
	2.3	Man wildlife conflict- Case studies-(one each) Elephant, Monkey (Bonnet Macaque), Large carnivores (Tiger/leopard) & Wild boar.	6	3
	2.4	Animal barriers: Mechanical and electrical.	1	2
		ACTIVITY: Compilation of newspaper reports and seminar presentation of Wildlife/ Man- Wildlife conflict.		
3		**Wildlife Conservation**	**15**	
	3.1	Threats faced by wildlife. Conservation of wildlife- Ex-situ conservation and in-situ conservation. Management of Protected Areas.	6	4
	3.2	National Park, Sanctuaries, Tiger reserves, Biosphere Reserves, Community reserves. Ramsar Sites. Protected areas of Kerala	4	4
	3.3	Research institutes of Wildlife in India. Special projects for wildlife conservation- Project Tiger, Project Elephant, Crocodile Conservation Initiative. Wildlife (Protection) Act, 1972 and 2022 amendments. CITES, TRAFFIC. IUCN red list categories, Red Data Book.	5	4

4		**Advances in Wildlife Conservation**	**13**	
	4.1	Remote sensing (RS): Introduction, definition, brief history, fundamental principle of RS, Stages of RS, Classification of RS: Active and Passive RS- based on source of energy and wavelength; Aerial and space remote sensing, Merits and limitations of RS. Recent developments.	10	5
	4.2	GIS; GPS; Radio collaring.	3	5
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Tutorial, Videos.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total =30 marks** Quiz, Test Paper, seminar, Compilation of newspaper reports and seminar presentation
	B. End Semester Examination **Theory Total =70 marks, Duration 2 hrs** Short Essays 8 out of 10 x 4=32 marks Short questions 14 out of 16 x2 =28 marks Fill in the blanks 10x1 =10 marks

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Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**CLIMATE CHANGE AND DISASTER RISK REDUCTION**					
Type of Course	**DSE**					
Course Code	**MCE5DSEZGY302**					
Course Level	**300**					
Course Summary	The course on Climate Change and Disaster Management is designed to provide a comprehensive understanding of the interplay between climate change and the increasing frequency and intensity of natural disasters. Students will explore the scientific foundations of climate change, its impact on the environment, and the resulting challenges in disaster management. The course integrates theoretical knowledge with practical applications to equip participants with the skills necessary for effective mitigation, adaptation, and response strategies.					
Semester	**V**	**Credits**			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	--	--	--	60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Develop a comprehensive understanding of climate change and disasters, including the causes and consequences.	A	1,2,6, 10
2	Administer strategies in risk assessments and disaster mitigation preparedness and adaptation.	A	1,2,6
3	Infer Carbon trading, Carbon credit; Carbon footprint; Carbon Sequestration,Green & Energy audit	U	2,6
4	Understand the Policies/treaties to combat Climate change and the challenges and issues of climate change.	U	3,6, 10
5	Evaluate the impact of disasters and climate change	E	1,2, 6
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Climate Change & Disasters**	**10**	
	1.1	**Fundamentals of Climate change** : Introduction, Climate change over geological history. Causes & effect of climate change	2	1
	1.2	**Current status** - Greenhouse gases and global warming, acid rain, Ozone layer depletion	3	2
	1.3	**Climatic and meteorological disasters:** Extreme temperature (El Nino & La Nina), drought, fog, wildfire (forest fire and land fire), Cyclone & storms, floods, landslides, earthquake and tsunami	5	1, 2
2		**Disaster Risk Reduction (DRR)**	**20**	
	2.1	**Basic concepts and terminologies:** Hazard, Risk, vulnerability, Disaster, Mitigation, DRR and its evolution, Disaster Risk Management (DRM), Emergency, Response, Relief; Resilience, Reconstruction, Recovery	4	2
	2.2	**Disaster Risk Mitigation** Disaster management journey and paradigm shift; Approaches in disaster management–Engineering centric, Community Based Disaster Preparedness (CBDP), Indent management, Ecosystem-based Disaster Risk Reduction (ecoDRR). Land Use Planning and Development Regulations, Disaster Safe Designs and Constructions - Structural and Non Structural measures of mitigation International and national policy frameworks and guidelines.	5	2
	2.3	**Disaster Risk Management** Tools and Methods in Disaster Risk Management: Hazard, risk and vulnerability analysis; Legislations, Codes & Standards, Risk sensitive land use planning, Safety auditing, Role of Strategic Environmental Assessment (SEA)/ Environmental Impact Assessment (EIA), Situation analysis, Incident response system, Post-Disaster Needs Assessments (PDNA), Environmental economics & DRR, Recovery framework. DM Planning for Government at national/ sub-national, Ministry/ departments, organization/establishments and at local levels.	5	1,2

	2.4	**Applications of science and technology for DRR & Climate Change Adaptation (CCA)** Geo-informatics in Disaster Management (RS, GIS, GPS and RS) Disaster Communication System (Early Warning and Its Dissemination), S&T Institutions for Disaster Management in India.	3	2
	2.5	**Disaster Preparedness** Crisis management, Early warning and communication, Emergency response, Local preparedness, Relief management-Shelter, "water, sanitation and hygiene" (Watsan), environmental health, trauma care; Role of agencies, technology and coordination; Issues of green relief, sustainable recovery, built back better; Climate Change Adaptation - Disaster Risk Reduction (CCA-DRR) and sustainability integration into post-disaster/post-conflict development, International response.	3	2
3		**Adaptation strategies**	**15**	
	3.1	Natural Resource Management-Disaster Risk Management (NRM-DRM) integration, ecosystem-based adaptation and eco DRR; Role of Green growth, sustainable NRM – IWRM (Natural Resource Management - Integrated Water Resources Management), Watershed, River basin, Integrated Coastal Zone Management Plan: (ICZM), Socioeconomic resilience, Capacity building,	5	2
	3.2	Carbon trading, carbon credit; Carbon footprint; Carbon Sequestration. Carbon neutral, alternate sources of energy, ecological footprint, Polluter pays principle, 3'R Principle, Green auditing **ACTIVITY** 1. Energy audit of your house/college 2. Survey in your locality regarding measures adopted for energy utilisation, rain water harvesting etc. and conducting awareness programs	4	1
		Policies/treaties to combat Climate change: **International** - Montreal protocol, Kyoto Protocol, Earth summit, Paris Agreement 2005, IPCC, & UNFCCC **National** - Disaster Management Act, 2005, NAPCC - National Action Plan on Climate Change Role of government, NGOs, and communities.		

	3.3	**Methods of risk assessment in the Kerala context:** GIS and remote sensing applications for risk mapping Role of local government in disaster management Case studies on policy implementation Early warning systems and their implementation Community-based disaster preparedness Infrastructure planning for disaster resilience Analyzing successful disaster management cases in Kerala Data analytics for predicting and managing disasters **ACTIVITY** 1. Case studies; Field work at areas with history of natural disasters in Kerala – Report submission and Presentation. 2. Visit to disaster prone areas & report.	6	4
4		**Challenges, issues & impact of Climate change**	**15**	
	4.1	Issues in Urban, Rural and Industrial disaster risks management with respect to climate change. Resilient agriculture, Disaster Resilient - Infrastructure, Industry, Livelihoods, Schools, Hospitals.. Issues of special needs - gender, aged, children, disabled, psycho-social	6	4
	4.2	Impact of climate change in India/Kerala: Extreme Heat, changing rainfall patterns, increased droughts, depletion of ground water, melting of glaciers, rise of sea level, faunal decline	5	1, 2
	4.3	Impact on Agriculture & Food Security, Energy Security, Water Security. Health, Migration & Conflict	4	1, 2
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lecture, Case studies, guest speakers .
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total =30 marks** Quiz, Test Paper, Evaluation of report on the basis of activities
	B. End Semester Examination **Theory Total =70 marks, Duration 2 hrs** Short Essays 8 out of 10 x 4=32 marks Short questions 14 out of 16 x2 =28 marks Fill in the blanks 10x1 =10 marks

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SUGGESTED READINGS

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Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**FOOD AND WATER QUALITY MANAGEMENT**					
Type of course	**SEC**					
Course Code	**MCE5SECZGY300**					
Course Level	**300**					
Course Summary	Aimed at ensuring the safety & quality of both food & water. Discusses issues like food adulteration and the indiscriminate use of food additives. Delves into the identification & management of spoilage bacteria, along with methods for monitoring & assessing microbial quality. It also explores the regulatory frameworks at both national& international levels that oversee food & water quality, highlighting the responsible agencies entrusted with enforcing these regulations.					
Semester	**V**	**Credits**			**3**	Total Hours
Course details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	--	--	--	45
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No.
1	Identify various food adulterants & additives and their health implications	U	1
2	Describe the causes and consequences of quality deterioration of food and water	U	3
3	Apply skills in food and water quality analysis	S	6, 10
4	Explain the laws and regulations pertaining to food safety and consumer protection and quality management systems operating at national and international levels.	U	1
5	Analyse the chemical & microbial quality of different categories of food & water	An, S	2, 6
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Food adulterants and food additives**	**16**	
	1.1	**Food adulteration** Definition; types-intentional, incidental. Poisonous substances, cheap substitutes, metallic and packaging hazard. Common adulterants and detection methods. General impact on human health.	3	1
	1.2	**Food additives** Definition, classification: Preservatives, colourants, flavour enhancers, anti-oxidants, artificial sweeteners and stabilizers, thickening agents, leavening agents, emulsifiers, anti-caking agents and humectants. Food additives generally recognized as safe (GRAS); toxicology and safety evaluation of food additives.	4	1
	1.3	**Food laws & regulations:** Food Safety and Standards Act 2006, Role of Food Safety and Standard Authority of India (FSSAI). FSS Regulations 2011: Regulations on Contaminants, toxins and residues, FSS Regulations on Food products standards and food additives, FSS Regulations on Packaging and Labeling, Regulations on Approval of non-specified food and food ingredients, 2017. Consumer protection act 2019.	4	4
	1.4	**Quality management**: Introduction**,** Scope, significance & objectives of quality management systems. Good Manufacturing Practices. Hazard Analysis and Critical Control Point (HACCP). Management and certification systems: Role of FDA, FAO, Codex Alimentarius Commission, ISO 2000, FSSC 22000, Agmark, BIS, QCI, NABCB.	5	4

2		**Food and water quality analysis**	**14**	
	2.1	**Food Spoilage:** Introduction, definition, types of spoilage - Physical, chemical and microbial. Chemical spoilage - Oxidation of fat, Physical spoilage - Browning of fruits and vegetables.	2	5
	2.2	**Microbial spoilage of food** Factors affecting microbial spoilage of food. Contamination and spoilage of fish and shell fishes, dairy products, fruits and vegetables, meat and meat products. Control measures.	4	5
	2.3	**Analysis of spoiled foods** Microbiological analysis of spoiled foods: isolation, total plate count and biochemical tests for the identification of spoilage bacteria (Brief account)	2	3
	2.4	**Physico-chemical parameters of water** Turbidity, colour, odour, taste, conductivity, pH, acidity, alkalinity, TDS, total hardness, nitrate, phosphate, residual chlorine.	2	2
	2.5	**Microbiological quality of water** Etiology of water borne diseases (Eg:Typhoid and Cholera). Microbial water quality analysis - most probable number, total coliforms, faecal coliforms, *E.coli*. BIS specifications for drinking water.	4	2,3
3		**Hands on training**	**15**	
	3.1	Detection of adulterants in honey (jaggery, sugar syrup), in milk – tests for urea and starch, in chilli powder, turmeric powder and coriander powder	5	1
	3.2	Detection of castor oil, cotton seed oil and argemone oil in edible oils and detection of adulteration in ghee	3	1
	3.3	Determination of alkalinity, hardness and residual chlorine in water, Microbial analysis of water	6	3
	3.4	Sensory/organoleptic evaluation of fish	1	5
4		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lectures, ICT enabled classes, Group discussions, seminar presentations, case studies and activities.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total = 25 marks** Quiz, Test Paper, Tests on hands on training
	B. End Semester Examination **Theory Total = 50 marks, Duration 1.5 hrs** Short Essays 5 out of 7 x 4 = 20 marks Short questions 10 out of 12 x2 =20 marks Fill in the blanks 10x1 =10 marks

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Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**AQUARIUM FABRICATION AND SETTING**					
Type of Course	**SEC (for those who are opting Aquaculture as Minor)**					
Course Code	**MCE5SECZGY301**					
Course Level	**300**					
Course Summary	Aquarium Keeping and Aquarium Fish Breeding is one of the most popular and enticing hobbies in the world today. It is in fact a multi-billion dollar industry and needs trained expertise. India, with its rich resources of endemic and unique specimens is slated to become a major player in the field. The country needs trained personnel and expertise in order to utilize its rich potential of resources. The course is aimed at imparting skill in the preparation of varieties of aquaria using the latest materials and techniques available					
Semester	**V**	**Credits**			**3**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	--	--	--	45
Pre- requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Illustrate the design and construction of home and public aqua-ria	U	1
2	Illustrate the setting and maintenance of aquariums in addition to water quality management.	U	1
3	Management of home as well as commercial aquariums.	Ap	2
4	Develops skills to handle different aquarium equipments.	Ap	1
5	Manage and Maintain Aquascaping and Decorations in an Aquarium	Ap	1

Remember (K), Understand (U), Apply (A), Analyze (An), Evaluate (E),Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Introduction to Aquaria**	**10**	
	1.1	Definition of aquarium, scope and history	2	1
	1.2	Fabrication of home aquarium **ACTIVITY:** Construction of a Freshwater Aquarium	3	1
	1.3	Design and construction of public fresh water and marine aquaria.	3	1
	1.4	Types of materials used in aquarium fabrication- Suitability, Advantages and Disadvantages	2	1
2		**Aquarium Accessories**	**10**	
	2.1	Aeration of water and Types of Aerators	2	2
	2.2	Different kinds of Filters and Lighting	2	2
	2.3	Thermostat for aquaria	2	2
	2.4	Hand nets and other equipments	2	2
	2.5	Aquarium gravels, pebbles, hood and aquarium plants	2	2
3		**Aquarium Setting, Maintenance and Trade**	**25**	
	3.1	Site selection for Aquaria	2	2
	3.2	Setting up of fresh water aquarium **ACTIVITY:** Set up a Freshwater Home Aquarium	3	2,5
	3.3	Setting up of marine aquarium	3	2
	3.4	Aquascaping- Different styles and Types	2	2
	3.5	Water quality parameters, Cleaning of aquarium, Filtration of Aquarium water: – different types of Filters and Filtration. **ACTIVITY** 1. Measurement of water Quality parameters 2. Setting up of a Biofilter and Recirculating System	5	2
	3.6	Nutritional requirements of aquarium fishes, Artificial and Live Feeds for Aquarium Fishes, **ACTIVITY:** Hatching of Artemia cysts	5	3
	3.7	Present Status of aquarium trade in India and the World.	5	4
4		**Teacher specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** lecturing with ICT, Activities, Transactions
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total = 25 marks** Quiz, Test Paper, Tests on hands on training
	B. End Semester Examination **Theory Total = 50 marks, Duration 1.5 hrs** Short Essays 5 out of 7 x 4 = 20 marks Short questions 10 out of 12 x2 =20 marks Fill in the blanks 10x1 =10 marks

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6. Sundararaj, V. and J.M. Sathish, 2005. Tropical Marine Aquarium. Yegam Publications, Chennai, 144 pp.
7. Greg Jennings, 2006. 500 Freshwater aquarium fish: a visual reference to the most popular species hardcover, Firefly Books, Limited, 528 Pages.
8. Matthew L. Wittenrich, 2007. The Complete Illustrated Breeder's Guide to Marine Aquarium Fishes - Microcosm/TFH (ca), 304 Pages.
9. Vincent Hargreaves, 2007. Complete Book of the Freshwater Aquarium: A Comprehensive Reference Guide to
10. More Than 600 Freshwater Fish And Plants, Plus How to Set Up And Maintain an Aquarium, Thunder Bay Press, 304 Pages.

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1. Jayashree K. V., Tharadevi C. S., and Arumugam N., (2015) Home Aquarium and Ornamental Fish Culture, Saras Publication, Tamil Nadu, India .
2. Training Manual on Freshwater Ornamental Fish Breeding and Aquascaping Techniques (2019), Haridas, H. et al, ICAR-Central Island Agricultural Research Institute, Port Blair, India.
3. The Simple Guide to Freshwater Aquariums" by David E. Boruchowitz.

Semester-VI

Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**MICROBIOLOGY AND BASIC IMMUNOLOGY**					
Type of Course	**DSC**					
Course Code	**MCE6DSCZGY300**					
Course Level	**300**					
Course Summary	Equips with a solid understanding of the microscopic world and the body's defence mechanisms, laying the groundwork for various professional paths in the biological sciences. Covers the study of microorganisms. explores their structure, function, classification, & role in various processes. Basic immunology delves into the body's defense mechanisms, examining components like antibodies, antigens, & immune responses.					
Semester	**VI**	**Credits**			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	--	1	--	75
Pre- requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Classify major groups of microbes.	U	1
2	Apply skills to isolate, cultivate, and identify microorganisms.	A, S	2
3	Describe the viral replication, viral cultivation, and morphology of bacteria and viruses.	U	1
4	Explain the etiology, symptoms, causative organism, modes of transmission and treatment of specific infections.	A	2
5	Explain the basic concepts of immunology.	A	2
Remember(K), Understand(U),Apply(A),Analyse(An),Evaluate(E), Create (C), Skill S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT
Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Introduction and Methods in Microbiology**	**16**	
	1.1	Scope of microbiology-Mention the relevance of Beneficial and harmful microbes.	1	1
	1.2	A brief description of different types of microbes - Bacteria and Archaea, Fungi, Viruses. Outline classification of microbes.	2	1
	1.3	Microbiome –Principles of microbial ecology and interactions within microbial communities. Human microbiomes, Environmental microbiomes. Microbiome research and its applications.	2	1
	1.4	Sterilization methods and disinfection. Culture media, Culture methods, Culture preservation technique. Staining techniques-Gram staining, Capsule staining	6	2
	1.5	Bacterial nutritional requirements. Microbial growth - Growth curve, Measurement of microbial growth- Direct method (viable count) & indirect method (turbidometry). synchronous growth, batch culture, continuous culture.	5	2
2		**A. Microbial Morphology and viral cultivation & B. Infections and Diseases**	**18**	
	2.1	**A. Microbial Morphology, Viral Replication and viral cultivation** Bacteria- Size, Shape and arrangement, Ultra structure of bacteria, spheroplast, protoplast. Virus: morphology - size, structure & shape. Bacteriophages - T4 Phages & life cycle (Lytic & Lysogenic cycle). Virions¸viroids, prions. Viral cultivation - Chick embryo and cell culture methods.	8	3
	2.2	**B. Infections and Diseases** Host pathogen interactions. Types of infections- Primary, Secondary and nosocomial infections. Contagious diseases- epidemic, endemic and pandemic Routes of infection-inhalation, ingestion, skin (Direct inoculation), iatrogenic and congenital. Modes of transmission-food, water, air, vectors and carriers. STDs (HIV), Emerging diseases (Corona Virus eg: SARS - Cov-2, Zika Virus), Re-emerging infections (Tuberculosis), Zoonoses (Rabies, Avian Influenza)	10	4

3		**Basic Immunology**	**11**	
	3.1	Cells of the Immune system- (B Cells, T cells, Macrophages, Dendritic cells, Natural Killer cells), Organs of Immune system. Mention Toll-like receptors	3	5
	3.2	Types of Immunity (Innate and Acquired, Passive and Active, Humoral and Cell Mediated)	3	5
	3.3	Antigens. Factors that influence immunogenicity. Haptens, Adjuvants, Epitopes (T cell and B cell Epitopes), Vaccines, Immunoglobulins - structure (basic only), classes and functions of immunoglobulins. Mention Hypersensitivity.	5	5
4		**Practicals**	30	
	1	Microbiology lab techniques: Autoclave, Incubator, Oven, Laminar airflow¸ cotton plugging, sterilization Disinfection.	4	2
	2	Preparation of culture media.Nutrient agar, Nutrient broth	2	2
	3	Culture methods: Streak plating, pour plating	4	2
	4	Viable plate count. (Demonstration)	4	2
	5	Gram Staining, Capsule staining, Fungal Staining	5	2
	6	Hanging drop experiment for motility.	2	2
	7	Identification of Bacterial species – IMViC	4	2
	8	Standard plate count SPC (Demonstration only)	2	2
	9	Antibiotic sensitivity test. (Demonstration)	2	2
	10	Blood typing-ABO	1	5
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure(Mode of transaction)** Lecture, Tutorial , Videos , Practicals
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total = 25 marks:** Quiz, Test Papers, seminar **Practical Total = 15 marks:** Lab performance, record, Lab Test
	B. End Semester Examination **Theory Total = 50 marks, Duration 1.5 hrs** Short Essays 5 out of 7 x4=20 marks, Short questions 10 out of 12 x2 =20 marks Fill in the blanks 10x1 =10 marks **Practical Total = 35 marks, Duration - 2 hrs** **Record 10 marks, Examination 25 marks:** Gram staining – 10 marks, Hanging drop method, Blood grouping, streak plating/pour plating (any 2)– 10 marks spotter identification – 5 mark**s**

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1. **Virtual textbook:** Inglis, T. J., Fu, B., & Kwok-Chan, L. (1995). Teaching microbiology with hypertext: first steps towards a virtual textbook. Medical Education, 29(6), 393-396.
2. **You Tube Channel** Birth of microbiology - :https://youtu.be/uKLrhp4Kw2A?si=D75ytk7SNoLYdgBA
3. **Virtual labs:**

   a) Virtual amrita laboratories-

   1. https://vlab.amrita.edu/?sub=3&brch=73

   2. https://vlab.amrita.edu/index.php?sub=3&brch=76

   b) McGraw-Hill Virtual Lab: online simulations covering microbiology experiments.

   https://www.mheducation.ca/higher-education/learning-solutions/virtual-labs

4. **Interactive websites** :BioMan Biozone, PhET Interactive simulations
5. **Educational platforms**: Swayam, coursera and edX Platforms offering microbiology courses from reputable universities.
6. **Podcasts:** "This week in microbiology (TWiM) podcasts discussing recent developments in the field of microbiology

Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**PHYSIOLOGY & ENDOCRINOLOGY**					
Type of course	**DSC**					
Course Code	**MCE6DSCZGY301**					
Course Level	**300**					
Course Summary	Provides an enthralling exploration of human physiology. Learn the mysteries of nutrition, the ways in which food nourishes our bodies, and the multifaceted mechanism of respiration - the inhalation of oxygen that maintains life. Unravel the enigmatic realm of excretion, where the removal of waste preserves the equilibrium of our systems. Uncover the mysteries of movement and feeling by venturing into the realm of muscle and neuron physiology. Know about the secret capabilities of hormones in the endocrine system and how these chemical messengers regulate our physical selves.					
Semester	**VI**	**Credits**			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	---	1	---	75
Pre- requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Describe the structure, functions, and mechanisms of human systems such as the cardiovascular, endocrine, respiratory, and nervous systems.	An	1,2
2	Analyse the physiological underpinnings, mechanisms, and impacts of prevalent health issues such as diabetes, nutritional disorders, cardiovascular ailments, neural disorders, kidney disorders, endocrine disorders, and respiratory disorders.	A	1,2
3	Explain homeostasis and feedback mechanisms, renal physiology, and basic aspects of nutritional science.	An	1,2
4	Investigate the intricate interactions between the nervous system and muscles, the mechanisms governing muscle contractions, and the impact of neuromuscular complexities on human movement and physiological function.	C	1,2

5	Demonstrate skills in analyzing physiological data and evaluating bodily functions.	A, S	2,10
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	**1**	**Cardiopulmonary Physiology**	**12**	
	1.1	Overview of circulatory system, Cardiac cycle and cardiac output, Haemostasis: Pathways of blood coagulation	3	1
	1.2	Cardiovascular diseases: Atherosclerosis, Myocardial infarction, stroke. ECG (brief) Cardiopulmonary resuscitation (CPR)	2	2
	1.3	Overview of respiratory system, Mechanism of breathing: Inspiration and Expiration, Gas exchange in the alveoli, Oxygen and Carbon Dioxide transport, Oxygen-Hemoglobin dissociation curve; Factors affecting the curve.	3	1
	1.4	Neural and chemical control of respiration, Respiratory problems (Hypoxia, Asphyxia, Hypercapnia, Oxygen toxicity, CO poisoning). Respiration in unusual environments (High Altitude, Diving, foetal).	2	1,2
	1.5	Importance of lung capacity and respiratory efficiency. Breathing exercises: Diaphragmatic Breathing, Pursed lip breathing, and lung expansion techniques, Physical activities and practices to enhance respiratory fitness (very brief account)	2	1
2		**A. Nutritional Science &** **B. Neuromuscular Physiology**	**17**	
	2.1	**A. Nutritional Science** Introduction to nutrition, balanced diet, RDA, antioxidants, importance of dietary fibre and water.	2	3
		Disorders: Ulcer, Bulimia nervosa, anorexia nervosa, irritable bowel syndrome. obesity. BMI .		

	2.2	Digestion, absorption, and assimilation of carbohydrates, proteins, and lipids	4	3
		B. Neuromuscular Physiology Types of neurons, mechanism of nerve impulse conduction, neuromuscular junction, synaptic transmission, types of neurotransmitters Neural disorders: Dyslexia, Parkinson's, Dementia, Alzheimer's, Schizophrenia	5	4
		Ultrastructure of striated muscle, mechanism of muscle contraction: Sliding filament theory, role of ATP in muscle contraction. Electrophysiology of muscle contraction, Muscle twitch, summation, fatigue, treppe, tetanus. Cori cycle, Rigor mortis.	6	4
3		**A. Renal Physiology & B. Endocrinology**	**16**	
	3.1	**A. Renal Physiology** Structure of nephron, mechanisms of urine formation: glomerular ultrafiltration, tubular re-absorption, tubular secretion, countercurrent exchange	3	3
	3.2	Kidney disorders: glomerular nephritis, pyelonephritis, kidney stones, dialysis, kidney transplantation (brief account)	3	2
	3.3	Role of kidney in homoeostasis	1	3
	3.4	**B. Endocrinology** Hormone - classification and mechanism of action	1	1
	3.5	Major endocrine glands, their secretions, functions, and disorders (Hypothalamus, pituitary, pineal gland, thyroid, parathyroid, islets of Langerhans, adrenal gland, gonads)	7	1
	3.6	Homoeostasis and feedback mechanisms	1	1
4		**Practical**	**30**	
	1	Estimation of the RBC count of blood.		5
	2	Estimation of the WBC Count of blood.		5
	3	Estimation of hemoglobin content.		5
	4	Determination of bleeding time.		5
	5	Determination of clotting time.		5
	6	Determination of erythrocyte sedimentation rate (ESR).		5
	7	Determination of heart rate, pulse rate and blood pressure using sphygmomanometer		5
	8	Analyze the effect of different concentrations of NaCl solution on RBC..		5
	9	Study of endocrine glands		5

5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **l**ecturing with ICT
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total =25 marks** Quiz-, Test Papers, seminar **Practical Total = 15 marks** Lab performance, record , Lab Test
	B. End Semester Examination **Theory Total = 50 marks, Duration 1.5 hrs** Short Essays 5 out of 7 x4=20 marks; Short questions- 10 out of 12 x2 =20 marks Fill in the blanks 10x1 =10 marks **Practical Total = 35 marks - Duration - 2 hrs** **Record 10 marks,** **Examination 25 marks:** Estimation of RBC/WBC count – 15 marks Estimation of Haemoglobin content/ ESR – 6 marks Spotter identification – 4 marks

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3. Morton, D. A., Foreman, K. B., & Albertine, K. H. (2018). Big Picture: Gross Anatomy, Medical Course & Step 1 Review [Access Medicine].
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Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**REPRODUCTIVE BIOLOGY AND TERATOLOGY**					
Type of Course	**DSE**					
Course Code	**MCE6DSEZGY300**					
Course Level	**300**					
Course Summary	This Course aims to give an idea about the development process, defects in development and the techniques applied in reproductive biology to rectify the developmental defects which can be an added milestone to the fertility related medicinal filed.					
Semester	**VI**	**Credits**			**4**	Total Hours
Course details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	--	1	---	75
Pre-requisites if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain the basic concepts and theories in Reproductive biology.	U	1
2	Describe the different developmental stages in animals.	U	3
3	Analyse various techniques in prenatal diagnostics and assisted reproduction.	An, A	3
4	Differentiate the concepts of Experimental embryology	U	1
5	Compare teratogens, their effects and other common developmental defects.	An	2

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description (Theory)	Hrs	CO No.
1		**Reproductive Biology**	**22**	
	1.1	Introduction to Reproductive biology, Definition, Theories of development- Preformation theory, Theory of Epigenesis, Recapitulation theory, Germplasm theory, Mosaic theory and Regulative theory	2	1
	1.2	Patterns of development – Oviparity, Ovo-viviparity and Viviparity	1	1
	1.3	Gonads - anatomy of testis and ovary, spermatogenesis, oogenesis, gonadal hormones and their functions. Hormonal control of human reproduction - Female reproductive cycles (Oestrous cycle, Menstrual cycle). Structure of mammalian sperm and egg, Pregnancy, Types of placenta, parturition and lactation.	7	1
	1.4	**Early Embryonic development** **Egg types:** Classification of eggs based on the amount, distribution and position of yolk. Mosaic and regulative, cleidoic and non-cleidoic eggs. Polarity and symmetry of egg. **Fertilization:** Mechanism of fertilization- (Encounter of spermatozoa and Ova, Approach of the Spermatozoon to the Egg, Acrosome Reaction and Contact of Sperm and Ovum, capacitation of sperm, Activation of Ovum, Migration of Pronuclei and Amphimixis), Significance of fertilization, Polyspermy. Parthenogenesis- Different types and significance.	5	2
	1.5	**Developmental patterns with special reference to frog and chick** **Blastulation:** Morula, blastula formation, types of blastula with examples. **Fate maps:** Concept of fate maps, construction of fate maps (artificial and natural), structure of a typical chordate fate map. Significance of fate map. **Gastrulation:** Major events in gastrulation. Morphogenetic cell movements. Influence of yolk on gastrulation. Concept of germ layers and derivatives.	7	2

2		**Prenatal diagnostic techniques Assisted Reproductive Techniques**	10	
	2.1	Invasive techniques: Amniocentesis, Chorionic villi sampling, Alfa fetoprotein test, cordocentesis, Foetoscopy, fetal tissue biopsy, Maternal serum beta-HCG. Non-invasive techniques: Ultra sound scanning, MRI, Cell free fetal DNA	4	3
	2.2	Assisted Reproductive Techniques**:** *In vitro* fertilization (IVF) and Embryo transfer (ET), ZIFT, GIFT, ICSI TET in detail	6	3
3		**Experimental embryology & Teratology**	13	
	3.1	Spemann's constriction experiments, Organizers and embryonic induction. Embryo transfer technology, cloning.	5	4
	3.2	**Significance of model organisms** (*Caenorhabditis elegans, Danio rerio and Mus musculus)* in embryological studies (brief account).	2	4
	3.3	**Teratology:** Teratogenesis, Teratogenic agents [Physical (Radiations), Chemical (Environmental toxins and drugs), Biological (infectious agents)], Teratogenic mechanisms- Genetic mutations, cellular processes and physiological disruptions).	3	5
	3.4	**Developmental defects**: Prenatal death (miscarriage and still birth). Intrauterine Growth Retardation (IUGR).	3	5
4		**Practical**	30	
	1	Calculation of gonado-somatic index of fish.	4	3
	2	Male and female reproductive organs in a teleost fish	3	2
	3	Study of placenta – pig and man.	2	2
	4	Study of permanent slides of blastula of frog and chick	3	2
	5	Study of permanent slides of gastrula of frog and chick	3	2
	6	Study of permanent slides of 18 hour, 24 hour, 33 hour and 48 hour chick embryo.	4	2
	7	Candling of eggs	1	3
	8	Study of chick development using live eggs – Vital staining-Window method (Demonstration)	3	2,3
	9	Blastoderm mounting and age determination of chick embryo (18hr/ 24hr/ 33 hr/ 48 hr/ 72 hr) using vital stains.	7	2,3
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, Tutorial (Videos , Practicals)
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total =25 marks:** Quiz-, Test Papers, seminar **Practical Total = 15 marks:** Lab performance, record, Lab Test
	B. End Semester Examination **Theory Total = 50 marks, Duration 1.5 hrs** Short Essays 5 out of 7 x4=20 marks, Short questions- 10 out of 12 x2 =20 marks, Fill in the blanks - 10x1 =10 marks **Practical Total = 35 Marks, Duration - 2 hrs** **Record - 10 marks, Examination - 25 marks:** Dissection and display – 15 marks Calculation of Gonadosomatic index/candling of eggs-6 marks Spotter identification – 4 marks

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4. Dutta 2007 Obstetrics, Church Livingston 17 Ed
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Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**ZOOGEOGRAPHY AND EVOLUTIONARY BIOLOGY**					
Type of Course	**DSE**					
Course Code	**MCE6DSEZGY301**					
Course Level	**300**					
Course Summary	Uncover the mysteries of evolution, unravel the geographical distribution of species, and journey through the fossilized record of Earth's evolutionary tapestry.					
Semester	**VI**	**Credits**			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	---		----	60
Pre- requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Explain the origin of earth and life.	U	1,2,7,10
2	Discuss the patterns and factors affecting the distribution of animals on earth.	U	1, 2,3
3	Describe the concept of evolution.	U	2,3, 10
4	Extrapolate evolutionary mechanisms.	A	1, 2, 10
5	Analyse the central role of fossils in evolution.	An	1,2, 3
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E),Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Zoogeography**	**20**	
	1.1	**Introduction to Zoogeography** Historical Biogeography Origin of oceans and continents, Plate tectonics – continental drift theory, rift valley, African great rift and its consequences- *(recent trends)*	4	1
	1.2	**Dispersal & Migration** Types and means of animal distribution, Factors affecting animal distribution.; Types of animal distribution,; Insular fauna – oceanic islands and continental islands with examples	8	2
	1.3	**Zoogeographic realms** Different Zoogeographical realms-Palearctic, Nearctic, Neotropical, Ethiopian, Oriental, Australian- with their sub regions - their boundaries, physical characteristics, climatic conditions, vegetation and fauna. Wallacea and its fauna; Zealandia **ACTIVITY:** Locating on the world map, zoogeographical realms and the animals endemic	6	2
	1.4	**Biogeography of India** Topographic features and Zoogeography, Western Ghats and its fauna and conservation measures	2	2
2		**Theories and genetic basis of organic evolution**	**14**	
	2.1	**Evolution of life- origin & theories** Brief account of Origin of Earth, Theory of origin life - biochemical origin- by Oparin and Haldane. Urey Miller experiment Lamarckism - Critical analysis of Lamarck's propositions Weisman's germplasm theory, Mutation theory Darwinism-Critical analysis of Darwinism Neo Darwinism Synthetic Theory of Evolution(brief account only) Neutral theory of molecular evolution by Kimura	9	1,3

	2.2	**Genetic basis of organic evolution** Genetic basis of variation, population genetics Hardy Weinberg law-gene pool, gene frequency, gene flow. Factors affecting gene frequencies	5	3
3		**Mechanism of evolution**	**17**	
	3.1	**Isolating Mechanisms** Types of isolating mechanisms-Geographic isolation (mention examples) and Reproductive isolation. Role of isolating mechanisms in evolution	3	4
	3.2	**Species and Speciation** Species concept, subdivisions of species- sibling species, deme, cline, semi species, sub-species. Speciation: Types of speciation, Phyletic speciation (autogenous and allogenous transformations), True speciation, Instantaneous and gradual speciation, allopatric and sympatric speciation.	8	4
	3.3	**Nature of Evolution** Microevolution, Macroevolution Mega evolution, Adaptive radiation – process, causes, types (Darwin's finches, adaptive radiation in placental mammals). Punctuated equilibrium vs Gradualism Homologous and analogous structures	6	4
4		**Palaeontology**	**9**	
	4.1	**Fossils & Fossilization** Definition and scope of Palaeontology Types of Fossilization, Types of fossils, microfossils, Index fossils, trace fossils and living fossils, Transitional fossils Dating of fossils	4	5
	4.2	**Trends in Evolution** Convergent evolution. Co-evolution. Mass extinction. Geological Time Scale: Major events in different stages with special reference to connecting links and fossils in human evolution (brief reference to African origin on modern man- Mitochondrial Eve and Y chromosomal Adam).	5	5
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, Tutorial, ICT Enabled Learning. Experiential learning.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total =30 marks** Quiz, Test Papers, Seminar, Activity
	B. End Semester Examination **Theory Total = 70 marks, Duration 2 hrs** Short Essays 8 out of 10 x 4 =32 marks Short questions- 14 out of 16 x2 =28 marks Fill in the blanks -10x1 =10 marks

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Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**FUNDAMENTALS OF PARASITOLOGY**					
Type of Course	**DSE**					
Course Code	**MCE6DSEZGY302**					
Course Level	**300**					
Course Summary	A broad and multi-disciplinary approach to the complex and dynamic relationships between parasites and their hosts. This course offers an overview of the biological and epidemiological bases of important parasitic diseases and an understanding of the impact of parasitic diseases on endemic communities.					
Semester	**VI**	**Credits**			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	---	--	---	60
Pre--requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Explain the fundamentals of host-parasite interactions, adaptations, and parasitism.	U	1,2
2	Describe the morphology, life cycle, pathogenicity, preventative measures, and control strategies of parasitic protists, nematodes, Platyhelminthes, and arthropods.	A	2
3	Identify parasitic vertebrates.	U	2
4	Demonstrate techniques used in molecular diagnosis and clinical parasitology.		
5	Determine career options in parasite research and the medical sciences.	A	2
Remember (K), Understand (U), Apply (A), Analyze (An), Evaluate (E),Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Parasites – An introduction**	**8**	
	1.1	Parasites, parasitoids, host, zoonosis, Origin and evolution of parasites, Basic concept of Parasitism, Symbiosis, Phoresy, commensalisms and mutualism, Host-parasite interactions, and adaptations.		1
2		**Parasitic Protists and Parasitic Platyhelminthes**	19	
	1.2	**Parasitic Protists** Study of morphology, life cycle, pathogenicity, prophylaxis and control measures of *Entamoeba histolytica, Giardia intestinalis, Leishmania donovani, Toxoplasma gondii*	10	2
	2.2	**Parasitic Platyhelminthes** Study of morphology, life cycle, pathogenicity, prophylaxis and control measures of *Fasciolopsis buski, Diphyllobothrium latum, Hymenolepis nana* ACTIVITY: Isolation, observation and documentation of trematode larval stages.	9	
3		**Parasitic Nematodes, arthropods and vertebrates**	18	
	3.1.	**Parasitic Nematodes** Study of morphology, life cycle, pathogenicity, prophylaxis and control measures of *Ascaris lumbricoides, Ancylostoma duodenale, Brugia malayi, Trichinella spiralis* Nematode plant interaction; Gall formation	10	2,3
	3.2.	**Parasitic Arthropods** Biology, importance and control of Ticks (Soft tick *Ornithodoros*, Hard tick *Ixodes*), Mites (*Sarcoptes*), Lice (*Pediculus*).Flea (*Xenopsylla*), Bug (*Cimex*), Parasitoid (Wasps)	5	
	3.3	**Parasitic Vertebrates** Cookicutter Shark, Hood Mocking bird and Vampire bat and their parasitic behavior and effect on host	3	
4		**Molecular diagnosis & clinical parasitology**	**15**	

	4.1	General concept of molecular diagnosis for parasitic infection Advantages and disadvantages of moleculardiagnosis Fundamental techniques used in molecular diagnosis of endoparasites Immunoassay or serological techniques for laboratory diagnosis of endoparasites on the basis of marker molecules (*Giardia intestinalis*, E. *coli*, *Entamoeba Histolytica, Leishmania donovani).* Malarial parasite using ELISA, RIA, Counter Current Immunoelectrophoresis (CCI), Complement Fixation Test (CFT), PCR, DNA, RNA probe		4
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, Tutorial, ICT Enabled Learning. Experiential learning.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total = 30 marks** Quiz, Test Papers, Seminar/Activity report
	B. End Semester Examination **Theory Total = 50 marks, Duration 1.5 hrs** Short Essays 8 out of 10 x4=32 marks Short questions- 14 out of 16 x2 = 28 marks Fill in the blanks 10x1 =10 marks

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Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**RESPONSIBLE TOURISM**					
Type of Course	**SEC**					
Course Code	**MCE6SECZGY300**					
Course Level	**300**					
Course Summary	Responsibility drives sustainability. Responsible Tourism is about making better places for people to live in and better places for people to visit. This course explores the principles and practices essential for responsible tourism including sustainable tourism focusing the inclusiveness of the local people, eliminating poverty, generating job opportunities, preserving cultural heritage and conserving natural resources.					
Semester	**VI**	**Credits**			**3**	Total Hours
CourseDetails	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	--	---	--	45
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Identify and describe the core concept of tourism and its impact on the environment.	**R**	1,3
2	Manage the key factors of responsible tourism and implement strategies to make the tourism sector profitable.	**C**	1,2,3,5, 6
3	Facilitate destination management and responsible tourist behaviour.	**A**	1,2,3,5, 6
4.	Integrate policies to promote responsible tourism.	**An**	1,2,3,6
5.	Choose instruments to implement responsible tourism.	**E**	1,2,3,4
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E),Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Introduction to Responsible Tourism(RT) & Responsible Tourism Practices**	**15**	
	1.1	**Introduction** Tourism - Positive & Negative impacts . Types of Tourism	2	1
	1.2	Why Responsible Tourism? Principles & Practices of RT. Benefits- Ecosystem benefits, Tourism industry¸ tourist & host communities of the locality.	3	3
	1.3	Pillars of Responsible Tourism and their roles– environmental, social, economic, cultural.	3	2
	1.4	**Responsible Tourism Practices** Green & Sustainable Tourism Practices - Environment conservation; culture & heritage preservation; Inclusiveness of local community¸ minimize waste production¸ recycle & reuse of waste water¸ Reduce carbon footprint.	7	3
2		**Responsible Tourism Management**	14	
	2.1	Concept of Destination Management-Responsible action to address the social, economic and environmental issues affecting the sustainability that arise in destinations. Destination Management organizations (DMO) –Vision¸ Functions¸ Responsibilities.	4	3
	2.2	Tourist management strategies. Responsible Tourist Guidelines- Responsible behavior including responsible travelling, respecting different cultures, visiting heritage sites with a clear understanding of rules and regulations, and making purchase or usage decisions without generating waste	4	2
	2.3	Implementation of Green tourism in hospitality management	2	2
	2.4	Responsible & Sustainable tourism spots in Kerala: Thenmala¸ Wayanad¸ Thekkady¸ Aymanam¸ Maravanthuruthu.	4	2
3		**A. Policies to promote Responsible Tourism & B. Instruments for RT**	16	
	3.1	**A. Policies to promote Responsible Tourism** National strategies for: Sustainable tourism¸ Ecotourism¸ National Tourism Policy¸ Swadesh Darsan Scheme Policies for States,	4	4

		Kerala Tourism Policy		
	3.2	Strategies for RT promotion: Environmental Sustainability, Biodiversity, Economic Sustainability, Socio-Cultural Sustainability; Criteria for accreditation of Sustainable Tourism: Environmental impact Social policy Capacity Building and Governance.	6	3
	3.3	**Instruments for RT:** Monitoring the Sustainability indicators. Identifying the limits of tourism: Geographic, Economic. Voluntary & Supporting Instruments: Voluntary - Guidelines and codes of conduct; Reporting and auditing; Voluntary certification Supporting - Infrastructure provision and management; Capacity building Implementation instruments for successful RT: Selection of location¸ Land use¸ balance between environmental protection and conservation. **ACTIVITY:** 1. Pick up two responsible tourism practices and present them before the class. 2. Conduct a survey on the award winners in the Responsible Tourism sector locally for the past 2 years and prepare the case study report. 3. Identify an unpopular tourist spot and formulate strategies to revive and turn it to successful 4. Conduct any one field trip to tourist destinations and prepare report on its functioning. **Information to be collected during field trip:** Visit to a hospitality enterprise (hotel, restaurant, travel agency etc) and discussion with the managers and employers about the sustainability innovations, products and technologies used by the company (e.g. renewable energy sources, bio energy, growing own fruits and vegetables, use of natural construction materials or organic household detergents and waste management). (**Minimum 4 days for all the 4**)	6	2, 5
4		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, group interaction, seminar presentations
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous and comprehensive assessment (CCA)** **Theory Total =25 marks** Case study report & Presentation, Test Papers, Field study reports
	B. End Semester Examination **Theory Total = 50 marks, Duration 1.5 hrs** Short Essays 5 out of 7 x4 = 20 marks Short questions-10 out of 12 x2 =20 marks Fill in the blanks -10x1 =10 marks

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Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**ARTIFICIAL FISH FEED PREPARATION**					
Type of Course	**SEC (**for those who are opting Aquaculture as Minor **)**					
Course Code	**MCE6SECZGY301**					
Course Level	**300**					
Course Summary	This course mainly focus on introduction to feed requirements of Fish, Raw materials for artificial fish feed, Feed Formulation Techniques, Types of feeds and measurement of calorific value, Feed Manufacturing equipments, additives and supplements.					
Semester	**VI**	**Credits**			**3**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	---	---	---	45
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Understanding aquaculture Feed and its significance.	UC	1,2
2	Identifying nutritional needs of various fish species	A	1,2
3	Exploring primary ingredients for fish feed	An	1.2
4	Understanding essential nutrients for fish growth and health. Acquire skills of various manufacturing process like extrusion, grinding pelleting etc, Evaluating the nutritional balance of the various artificial feeds.	U, E	1,2
5	Understanding the role of probiotics and prebiotics in fish nutrition. Understanding the purpose and types of additives.	U, E	1,2
6	Develop fundamental skills in the preparation of artificial feeds	A,S	2,10
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Introduction to Feed Requirements of Fish**	**12**	
	1.1	Nutritional needs of various fish species , Basics of fish feed composition	3	1
	1.2	Economic significance feed usage in Aquaculture, environmental considerations regarding fish feed in aquaculture.	3	1
	1.3	Feed Conversion Ratio (FCR), Food Efficiency Ratio(FER)	3	1
	1.4	Factors affecting digestibility, immunostimulants, growth promoters, preservatives.	3	1
2		**Raw Materials for Artificial Fish Feed Preparation and Feed Formulation Techniques**	**15**	
	2.1	Raw materials of plant origin , raw materials of animal origin , non conventional materials **ACTIVITY:** Identification of Feed Ingredients of Plant and Animal Origin	3	2
	2.2	Protein and amino acid requirement, carbohydrate and lipid requirement, Essential fatty acids, Non protein nitrogen sources.Vitamin and mineral requirements, vitamin C for fish and shell fishes	3	2
	2.3	Principles of feed formulation – Pearson's square method, Linear programming, Proximate analysis **ACTIVITY**: Prepare different feed formulation with two ingredients using Pearson's square .	3	3
	2.4	Types of feeds - Wet feeds, dry feeds , moist feeds Larval feeds Minced diets, microparticulate diets, spray dried diets, microbound diets, micro coated diets and microencapsulated diets	3	3
	2.5	Measurement of calorific value – Component analysis, Wet oxidation, Bomb Calorimetry.	3	3
3		**Types of Feeds, Feed Manufacturing Equipments**	**18**	
	3.1	Different forms of feed-fodders, mash, pellets, floating and sinking feeds. Feed formulation - methods, square method. Dry Feed manufacturing processes, Extrusion, Palletization, Different size and grades of fish/shrimp feeds - starter, grower and finisher feeds	4	4,5

	3.2	Micro-bound feed, micro-encapsulated feed. Storage and transportation of feeds. Quality problems - toxins, pests, rancidity	4	4,5
	3.3	Equipments used in feed preparation: Oven, dryers, pelletizer, feed press, die plate, extruder, grinders, mixers, coolers, elevators, crumbler, feed mills **ACTIVITY: V**isit a feed manufacturing unit and submit a brief report	4	4
	3.4	Additives: definitions, types – binders, anti-oxidants, pigments, anabolic agents, antimicrobials and health supplements Role of additives in immune health and stress reduction.	3	4
	3.5	Enzymes, probiotics, pre biotics. Importance of emulsifiers and stabilizers.	3	5
4		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and learning Approach	**Classroom Procedure (Mode of transaction)** lecturing with ICT Activities, Transactions
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous and comprehensive assessment (CCA)** **Theory Total =25 marks:** Quiz, Test Papers, assignment, seminar, Field study report
	B. End Semester Examination **Theory Total 50 marks, Duration 1.5 hrs** Short Essays 5 out of 7 x4=20 marks, Short questions- 10 out of 12 x2 =20 marks, Fill in the blanks 10x1 =10 marks

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Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**REPRODUCTIVE HEALTH AND SEX EDUCATION**					
Type of Course	**VAC**					
Course Code	**MCE6VACZGY300**					
Course Level	**300**					
Course Summary	This course is designed to provide students with a thorough understanding of reproductive health & sex education, covering biological, psychological & sociocultural aspects. The course aims to equip students with the knowledge and skills necessary to make informed decisions about their sexual health, foster healthy relationships & contribute to the promotion of sexual well-being in diverse communities.					
Semester	**VI**	**Credits**			**3**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	---	---	---	45
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Summarise the necessity of sex education, primary and secondary sexual characteristics, and reproductive health.	U	1,2,3,6
2	Describe teenage pregnancy, sexual harassment, sexual awareness, and policies related to adolescent sexual behaviour.	U	6
3	Appreciate the broad spectrum of sexual orientations and gender identities, equity, inclusivity, and healthy relationships.	U, Ap	7,8
4	Explain sexual health, sexually transmitted infections (STIs) and contraception methods.	U	6
5	Analyse safe sex practices, various options for reproductive choices, responsible parenthood and family planning	U, An	6,8
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Introduction to Sexual and Reproductive Health**	**17**	
	1.1	Definition of reproductive health and sex education, Importance of comprehensive sex education	3	1
	1.2	Cultural and societal perspectives on sexuality, Ethical considerations in sex education	3	1
	1.3	Primary and secondary sexual characters and puberty, Physical and emotional changes during puberty. Neural and hormonal peculiarities of male and female brain. Role of hormones in the development of secondary sexual characters.	5	1
	1.4	Personal hygiene and self-care during adolescence, Emotional well-being, self-esteem, and body image.	3	1
	1.5	Adolescent sexual activity, teenage pregnancy, sexual harassment, sexual awareness and policies (legal aspects)	3	2
2		**Healthy Relationships, Sexual orientations and gender identities**	**14**	
	2.1	Healthy relationships (Five Es-empathy, enthusiasm, empowerment, equality, energetics, Five As-acceptance, accommodation, appreciation, adaptability, agreement, Five Ls-love, loyalty, listening, laughter, lust, Five Ts-trust, talking, time together, tenderness, thoughtfulness), Consent, boundaries, and respect in relationships, Recognizing and respecting boundaries, sexual assault, harassment, and coercion and supporting survivors.	8	3
	2.2	Sex Determination in Humans, diverse sexual orientations and gender identities (LGBTQ), Addressing stereotypes and prejudices related to sexuality.	6	3
3		**Safe Sex, Reproductive Choices and Parenthood**	**14**	
	3.1	Importance of safe sex practices**,** Types of contraceptives (condoms, birth control pills, IUDs, Emergency contraception and its availability etc.)	3	4

	3.2	STDs and Prevention of sexually transmitted infections (STIs), Testing, treatment, and counseling for STIs	5	4
	3.3	Options for reproductive choices (parenting, adoption, abortion, surrogacy), Postpartum care and mental health.	3	5
	3.4	Responsible parenthood and family planning, Balancing career, education, and parenthood.	3	5
4		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, videos.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous and comprehensive assessment (CCA)** **Theory Total =25 marks:** Quiz, Test Papers, assignment
	B. End Semester Examination **Theory Total = 50 marks, Duration 1.5 hrs** Short Essays 5 out of 7 x4 =20 marks, Short questions- 10 out of 12 x2 =20 marks, Fill in the blanks 10x1 =10 marks

REFERENCES

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6. Tortora, G. J., & Derrickson, B. H. (2018). Principles of Anatomy and Physiology. John Wiley & Sons.

SUGGESTED READING

1. SOGIE handbook
2. https://www.lausd.org/cms/lib/CA01000043/Centricity/domain/156/pdfs/SOGIE%20Handbook.pdf
3. https://www.health.ny.gov/prevention/sexual_violence/docs/sogie_handbook.pdf

Semester-VII

Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**BIOPHYSICS, INSTRUMENTATION AND DIAGNOSTIC IMAGING TECHNIQUES**					
Type of Course	**DCC**					
Course Code	**MCE7DCCZGY400**					
Course Level	**400**					
Course Summary	To understand and interpret the basics of biophysics & facilitate an understanding of the principle, design, working & applications of various instruments & imaging techniques relevant to biology and medicine.					
Semester	**VII**	**Credits**			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	---	1	---	75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Explain the theoretical underpinnings of biophysics and bioenergetics.	A	2
2	Describe the concepts of radiation physics, radiation detection, & applications.	A	1
3	Compare the underlying principles, designs, and workings of different separation techniques, microscopes, analytical instruments, diagnostic imaging techniques, and electrophysiological methods.	An	2
4	Explain the utility of bio instruments and their importance in biology.	U	2
5	Apply skills in using the camera Lucida, TLC, micrometry, colorimetry, centrifuge, and pH meter.	A, S	2
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Foundation Concepts in Biophysics and Bioenergetics**	**7**	
	1.1	**Principles of Biophysics** Diffusion- Kinetics of diffusion, Fick's law and diffusion coefficient, Stoke-Einstein's law, Gibb's Donnan equilibrium, Biological importance of diffusion. Applications of diffusion process in Biology. Osmosis - osmotic concentration, osmotic pressure and osmotic gradient, Vant Hoff's laws, Electro-osmosis, Electrolyte and ionic balance in biological fluid. Biological significance of osmosis.	5	1
	1.2	**Bioenergetics** Laws of Thermodynamics, Reversible and Irreversible Thermodynamics, Entropy, Enthalpy, Gibb's Free energy, Carnot cycle, Chemical potential.	2	1
2		**Radiation Biophysics**	12	
	2.1	**Radiation Biology** Nature of radioactivity, Units of radioactivity. Interaction of radiation with matter. Ionising radiations, Cherenkov radiations. Radioactive isotopes. Radiation dosimetry. Biological effects of radiation.	3	2
	2.2	**Radiation detection** Ionization chamber, Liquid scintillation counter, Geiger-Muller (GM) counter, Semiconductor detectors	3	2
	2.3	**Applications :** Diagnosis and Radiotherapy, Radioimmunoassay, Autoradiography, Radio tracer techniques, Nuclear Medicine.	2	2
	2.4	R**adio-Ultrasound Imaging Techniques for diagnosis**: X-ray radiography**,** Angiography, PET, MRI, fMRI, CAT, Ultrasound Imaging.	4	3
3		**Instrumentation**	26	

	3.1	**Microscopy:** Light microscopy, Phase Contrast Microscopy, Fluorescence Microscopy, Confocal Microscopy, Electron Microscopy- Transmission Electron Microscope (TEM), Scanning Electron Microscope (SEM), STEM, Specimen preparation- shadow casting, Freeze fracturing, Freeze etching. Electron Cryo-Microscopy. Micrometry and Camera Lucida	5	3,4
	3.2	**Separation Techniques** Centrifuge- Principle and applications, high-speed centrifuge, Density gradient centrifuge, Ultracentrifuge, Decanter centrifuge. Chromatography-Principle and applications, Column Chromatography, Ion exchange chromatography, HPLC, Gas Chromatography. Electrophoresis- Principle and applications, Gel electrophoresis-SDS PAGE, 2D Gel electrophoresis, Disc electrophoresis, Agarose Electrophoresis, High voltage electrophoresis, Capillary electrophoresis, Electrophoretic mobility shift assay (EMSA), Isoelectric focusing. BRIEF ACCOUNT ONLY	8	3,4
	3.3	**Analytical Instrumentation** Colorimetry & Spectrophotometry. Beer-Lambert's Law Spectroscopy- Raman Spectroscopy, Circular Dichroism, Fourier Transform Infrared Spectroscopy (FTIR), Nuclear Magnetic Resonance (NMR) Spectroscopy Electron Spin Resonance (ESR) Spectroscopy, Mass Spectroscopy-MALDI-TOF, LCMS, Tandem Mass pH Meter, Flow Cytometry	10	3,4
	3.4	E**lectrophysiological methods** Single neuron recording, Patch-clamp recording, Tread mill test, Application of Deep Brain Stimulator and Pacemaker	3	3,4
4		**PRACTICALS**	30	
		1. Micrometry- Principle and measurement of microscopic objects. 2. Camera Lucida- Drawing of specimens using Camera Lucida 3. TLC using amino acids and calculation of RF values 4. Identification of absorption maxima of given sample by colorimetry		5

		5. Determine the pH of two prepared buffer samples 6. Separation of Casein from milk using centrifugation **7.** Demonstration/Institutional Visit for understanding the instrumentation and working of any three Techniques from Microscopy/ Spectroscopy/ Electrophoresis/Flow Cytometry/ Imaging Techniques and submit the report		
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, Group Discussion, Practical
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total =25 marks** Quiz, Test Papers, Seminar **Practical Total = 15 marks** Lab performance, record, Lab Test
	B. End Semester Examination **Theory Total = 50 marks, Duration 1.5 hrs** Short Essays 5 out of 7 x4 =20 marks Short questions 10 out of 12 x2 =20 marks Fill in the blanks 10x1 =10 marks **Practical Total = 35 marks, Duration 2 hrs** **Record 10 marks, Examination - 25 marks:** TLC/Micrometry – 15 marks Camera lucida/determination of pH/Casein separation – 4 marks Spotter identification (instruments) any 2 – 6 marks

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15. Roy, R.N. (2009). *Text Book of Biophysics*. Howrah: New Central Agency (P) Ltd.
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17. Subramanian, M.A. (2005). *Biophysics: Principles and Techniques*. Chennai: MJP Pub.
18. Thayalan, K. (2014). *The Physics of Radiology and Imaging*. New Delhi: Jaypee Brothers Medical Publishers (P) Ltd.

SUGGESTED READING

1. https://doi.org/10.1146/annurev-biophys-120121-074034
2. https://doi.org/10.1146/annurev-bioeng-081622-025405

Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**BIOSTATISTICS & RESEARCH METHODOLOGY**					
Type of Course	**DCC**					
Course Code	**MCE7DCCZGY401**					
Course Level	**400**					
Course Summary	Introduce students to key concepts in designing and conducting scientific studies. Modules include understanding the research process, exploring study designs, and learning data collection techniques. Students delve into descriptive and inferential statistics, with a focus on applying these principles in Biology related research. Practical skills are honed through hands-on experience with statistical software, and the course concludes with sessions on reporting findings & critically appraising research.					
Semester	**VII**	**Credits**			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	---	---	---	60
Pre requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Explain the basic concepts of biostatistics and research methodology.	U	2 ,3
2	Demonstrate skills to collect, organise, and present data for biological research.	S, I	2
3	Analyse biological data using appropriate statistical methods and software.	An	1,2
4	Demonstrate skills in scientific documentation and communication.	A	2,4
5	Test hypotheses in biological research with appropriate statistical tools and interpret the derived information to aid in the decision-making process.	S, C, E	1,2, 3
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Overview of Biostatistics and Descriptive Statistics**	15	
	1.1	Scope and application in life sciences. Steps in Statistical Investigation. Meta analysis. Data and Variable (Types, Sources). Data collection methods: Census and Sampling techniques, Sampling Errors. Organization of Data - Tabulation, Types, and characteristics of a Frequency table. Presentation of Data - Graphs and Diagrams.	4	1,2
	1.2	Measures of central tendency: mean, median, mode. Corrected mean.	5	3
	1.3	Measures of dispersion: Range, Quartile deviation, mean deviation, standard deviation. Corrected standard deviation. Skewness and kurtosis.	6	3
		ACTIVITY: 1. Preparation of frequency distribution table from raw data 2. Problems related to mean, median and mode (Individual, discrete and continuous series) 3. Problems related to range, Quartile deviation, mean deviation and standard deviation (Individual, discrete and continuous series) 4. Preparation of bar diagrams, pie diagram, line graph, frequency polygon, frequency curve, histogram and ogives. Computation of mean, standard deviation, correlation, regression equation, 't' test, ANOVA (Using MS Excel or any other package) **Note:** Use Clinical/Biological data for the problems		
2		**Correlation, Regression, Probability, Statistical Inference & Statistical Software**	25	
	2.1	Correlation Analysis: Types and methods of correlation analysis, Karl Pearson's correlation coefficient.	5	5
	2.2	Regression analysis: Graphic methods - Scatter method, Line of best fit; Algebraic method-Regression equations. Relationship between correlation and regression	6	5
	2.3	Classical definition of probability. Addition and multiplication theorems. Probability distributions: Binomial and Normal distribution.	5	5

	2.4	Testing of hypothesis - null and alternative hypothesis, test statistic, type-I and type-II errors, critical region, level of significance, p-value. Parametric Tests: t-test, Z test, ANOVA (one way). Non-parametric Test - Chi-square test.	7	5
	2.5	Statistical Software: SPSS, R, PRIMER (Brief account only)	2	3,5
		ACTIVITY: 1. Calculation and interpretation of corrected mean and corrected standard deviation 2. Calculation and interpretation of Pearson correlation coefficient. 3. Calculation and interpretation of regression equation (x on y & y on x) 4. Calculation and interpretation of Chi square test (2×2 table only) 5. Calculation and interpretation of 't' test 6. Calculation and interpretation of one-way ANOVA		
3		**Research: Types, Design , Literature review and Ethics in Research**	8	
	3.1	Types of Research – Deductive/Inductive, Descriptive/Analytical, Applied/Fundamental, Quantitative/Qualitative, Conceptual/Empirical. Defining and formulating the research problem.	2	1
	3.2	Research Design: Basic principles, Significance and features of good design. Types of research designs.	2	1
	3.3	Literature review - Importance of literature review in defining a problem, Critical literature review.	2	1
	3.4	Ethics in research - Plagiarism, Plagiarism checking software - Turnitin, Viper, Urkund. Citation and Acknowledgement	2	1
4		**Scientific Documentation and Communication**	12	
	4.1	Structure and components of Scientific Report. Types of Report – Technical Reports and Thesis/dissertations.	3	4
	4.2	Preparation of Project Proposal to Project funding agencies. Preparing Research papers for journals, Seminars and Conferences. SCOPUS, Web of Science, Impact factor, Citation Index, h-index. DOI. ISBN & ISSN.	5	4
	4.3	Conventions and strategies of authentication – Citation styles, bibliography, referencing and foot notes. Software for managing bibliographies – EndNote, Mendley. Global Information System – BIOSIS, Medline and Medlars, AGRIS, PubMed, Google Scholar.	3	4

		ACTIVITY: 1. Publish a scientific paper in any peer reviewed journal/ publish a book chapter / present a paper (Oral/Poster) in a seminar. (Any one compulsory) 2. Review a scientific article in Biology and submit the report 3. Prepare bibliography in APA format from the given details of a published scientific paper		
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Lecturing, problem solving, writing a review of any published article. Preparing a sample project proposal.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total = 30 marks** Quiz, Test Papers, Problems from module 1 &2, Activity from module 4
	B. End Semester Examination **Theory Total = 70 marks, Duration 2 hrs.** Short Essays 8 out of 10 x4 =32 marks Short questions 14 out of 16 x2 =28 marks Fill in the blanks 10x1 =10 marks

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BIOSTATISTICS

1. Chap, T. Le. (2003). Introductory Biostatistics. John Wiley & Sons, NJ, USA.
2. Daniel, W.W. (2006). Biostatistics: A Foundation for Analysis in the Health Sciences. John Wiley & Sons, New York.
3. Freedman, D. F., Pisani, R., & Purves, R. (2011). Statistics. Viva Books, New Delhi.
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8. Zar, J. H. (2008). Biostatistical Analysis. Pearson Education Inc., New Delhi

RESEARCH METHODOLOGY

1. Bordens, K., & Abbott, B. B. (2022). Research Design and Methods: A Process Approach. McGraw Hill.

2. Das, A. K. (2015). Research evaluation metrics. United Nations Educational, Scientific and Cultural Organization.

3. Davis, M., Davis, K. J., &Dunagan, M. (2012). Scientific Papers and Presentations. Elsevier Science.

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6. Kumar, R. (2018). Research Methodology: A Step-by-Step Guide for Beginners. SAGE Publications.

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8. Mishra, S. B., & Alok, S. (2017). Handbook of Research Methodology. Educreation Publishing.

9. Ranganatham, M., & Krishnaswamy, O. R. (2022).Methodology of Research in Social Sciences. Himalaya Publishing House.

Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**ADVANCED GENETICS**					
Type of Course	**DCC**					
Course Code	**MCE7DCCZGY402**					
Course Level	**400**					
Course Summary	The course is designed for students with a solid foundation in basic genetics who seek a deeper understanding of advanced topics and their practical applications. The course aims to prepare students for advanced studies or careers in research, healthcare, biotechnology, and related fields by providing a comprehensive understanding of the latest advancements in genetics.					
Semester	**VII**	**Credits**			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	--	--	--	60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Describe the molecular organization of the chromosome, linkage, recombination, and transposons.	K	2
2	Explain the role of chromatin remodeling complexes in modulating gene expression through epigenetic changes.	U	2
3	Describe the latest developments and advancements in the field of cytogenetics.	U	1
4	Explain the genetic basis of familial cancer and the implications for risk assessment and genetic counselling.	U	3
5	Analyze the ethical implications of HGP, GM crops, personal DNA data, and gene therapy.	An	2,6,8
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E),Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Molecular organization of Chromosome, Linkage, Recombination & Transposons**	**20**	
	1.1	Genome size and c-value Paradox. Molecular structure of centromere and telomere, telomere shortening and aging process, Repetitive nucleotide sequences in eukaryotic genomes - mini and micro satellites.	5	1
	1.2	**Linkage and recombination:** Crossing over as the physical basis of recombination, Molecular mechanisms of recombination (Holliday model), Recombination mapping with two-point and three - point test cross in *Drosophila*, Coincidence and Interference. Mitotic recombination. Genetic recombination in Phage, complementation test, deletion mapping, conjugation mapping.	10	
	1.3	**Transposable genetic elements:** Transposons in prokaryotes (IS elements, composite elements - Tn10, non-composite elements - Tn3) and eukaryotes (DNA transposons, Retrotransposons - SINE and LINE, Ac/Ds elements in maize).	5	
2		**A. Epigenetics & B. Cytogenetic techniques**	**15**	
	2.1	**A. Chromatin modifications and their mechanism of action:** Histone code hypothesis, Modification of histone proteins - acetylation, phosphorylation, methylation, ubiquitylation, SUMOylation, Chromatin remodeling, Genomic imprinting.	6	2, 3
	2.2	**Epigenetics in *Drosophila*:** Position effect variegation (PEV) and Polycomb Group Genes (PcG) in *Drosophila* model	3	
	2.3	**B. Cytogenetic techniques** Karyotyping - G-banding, C-banding, R-banding Sex chromatin analysis (buccal mucosa, hair bud), and COMET assay.	3	
	2.4	FISH (Fluorescent In-situ Hybridization), CGH (Comparative genomic hybridization), aCGH (Array comparative genomic hybridization)	3	
3		**Cancer Genetics**	**15**	
	3.1	Oncogenes, tumour suppressor genes, DNA repair genes and genetic instability, epigenetic & Post translational modifications.	5	4

	3.2	Role of proto-oncogenes in regulating cell growth and survival, mechanisms of activation of oncogenes, Cell cycle and Cancer.	3	
	3.3	**Familial cancers** (Retinoblastoma, Colorectal cancer and Breast cancer), Biomarkers and Cancer therapy: at cellular, gene and protein level. Chemotherapeutics for cancer; Advance therapies in cancer; Monoclonal antibody therapies for cancer.	7	
4		**Genetics and Society**	**10**	
	4.1	**Pedigree:** Analysis of Pedigree charts for different inheritance patterns, Consanguinity and its effects in the pedigree pattern.	2	4,5
	4.2	**Genetic counseling:** Components of genetic counseling - Physical examination, Patterns of inheritance, risk assessment and counseling, Indications for chromosomal testing.	4	
	4.3	**Human Genome Project (HGP):** Sequencing of the Human Genome, promises and achievements, ethical, legal, and social issues of the HGP. Areas of concerns in modern genetics (GM crops, personal DNA data, Gene Therapy)	4	
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing with ICT , Assignments/ Seminar, Group discussion/ Presentation**.**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total =30 marks** Quiz, Test Papers, seminar, Assignment
	B. End Semester Examination **Theory Total = 70 marks, Duration 2 hrs** Short Essays 8 out of 10 x4 =32 marks Short questions 14 out of 16 x2 =28 marks Fill in the blanks 10x1 =10 marks

REFERENCES

1. Allis, D., & Jenuwein, T. (2007). Epigenetics. Cold Spring Harbor Laboratory Press.

2. Brooker, R. (1999). Genetics: Analysis and Principles. Addison-Wesley, NY.

3. Gardner, J. E., Simmons, J. M., & Snustad, D. P. (2007). Principles of Genetics (8th edn). John Wiley, India.

4. Gilbert, S. F. (2006). Developmental Biology (9th edn). Sinauer Associates, Inc., Publishers, Massachusetts.

5. Griffiths, A., et al. (2002). Modern Genetic Analysis. W.H. Freeman, NY, USA.

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7. Hartl, L. D., & Jones, E. W. (2009). Genetics: Analysis of Genes and Genomes (7th edn). Jones & Bartlett Pub., Inc., MA, USA.

8. Pierce, B. A. (2012). Genetics: a conceptual approach. Macmillan.

SUGGESTED READING

1. Herskowitz, I. H. (1977). Principles of Genetics. Collier Macmillan.

2. Klug, W. S., & Cummings, M. R. (2009). Concepts of Genetics. Pearson Education, Inc.

3. Lewin, B. (2008). Genes (9th edn). Jones and Barlett Publishers Inc.

4. Russel, J. P. (2010). Genetics. Pearson International Edn.

5. Snustard, P., & Simmons, M. J. (2010). Principles of Genetics. John Wiley and Sons.

6. Strickberger, M. W. (1968). Genetics. Macmillan Publishing Co

Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**ECONOMIC ENTOMOLOGY**					
Type of Course	**DCE**					
Course Code	**MCE7DCEZGY400**					
Course Level	**400**					
Course Summary	Economic Entomology is a specialised field of study that focuses on the economic impact of insects on agriculture, forestry, and other human activities. This course typically covers a wide range of topics related to insect biology, ecology, and management strategies to mitigate their economic impact.					
Semester	**VII**	**Credits**			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	--	--	--	60
Pre requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Identify major insect pests and beneficial insects that are economically significant in agriculture, forestry, and urban settings.	K	1
2	Explain the life cycles, behaviour, and ecology of key insect pests and beneficial insects.	U	2
3	Describe the principles and practices of IPM.	An	3
4	Explain emerging trends and issues in forensic, medical, and industrial entomology.	I	9
5	Demonstrate skills to analyse complex pest management problems and propose practical solutions.	C, S	6,10

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Insects as pests**	**15**	
	1.1	Kinds of insect pests - Major pests, minor pests, sporadic pests, endemic pests, exotic pests, seasonal pests, occasional pests, regular pests, persistent pests. Causes of pest outbreak- deforestation, destruction of natural enemies, pest resurgence, secondary pest outbreak, intensive and extensive cultivation, introduction to new crops, hybrid varieties, introduction to new pests.	5	1
	1.2	Damages caused by selected insect pests and their management. (i) **Pests of Crops:** 1. Coconut Pests - *Oryctes rhinoceros* and *Rhyncophorus ferrugineus* 2. Paddy Pests - *Leptocorisa acuta* and *Spodoptera mauritia*. (ii) **Stored grain pests** - *Trogoderma granarium* and *Tribolium castaneum* (iii) **Pests of vegetables** - 1. Brinjal: *Leucinodes orbonalis* and *Euzophera perticella*, 2. Gourds: *Bactrocera cucurbitae* and *Anadevidia peponis*. (iv) **Pests of fruits:** 1. Citrus fruits - Citrus leaf miner (*Phyllocnistis citrella*) and Citrus psylla (*Diaphorina citri*) *2.* Banana Pests - *Cosmopolites sordidus* and *Pentalonia nigronervosa* 3. Mango Pests - Stem borer (*Batocera rufomaculata*) and Scale insect (*Chloropulvinaria polygonata, Aspidiotus destructor*) **ACTIVITY** 1. Insect collection and preservation: Collection and submission of insect pests of crops and vegetables and prepare an Insect Pest Box. 2. Collect & submit different pests of stored grains from the local provision shops or houses and prepare a power point presentation	10	1, 5

2		**Control of insect pests**	**15**	
	2.1	**Integrated pest management (IPM)** What is IPM? Need for IPM. Planning of IPM, Different techniques used in IPM;, Few examples and advantages of IPM. (Pest surveillance- Forecasting pest outbreaks and surveillance, short term and long-term forecasting, legal/Regulatory practices, cultural, physical, Mechanical, genetic, biological and chemical control)	3	3
	2.2	**Chemical Control:** i. Broad classification of insecticides. Inorganic insecticides (Arsenicals, Lime Sulphur, Mercury compounds, Fluorine compounds) , Fumigants (Para dichlorobenzene, Methyl bromide, Hydrogen cyanide) ii. Natural organics – oils, insecticides of plant origin (Pyrethrins, Nicotine, Azadiractin) Synthetic Organics – Chlorinated Hydrocarbons (BHC, Methoxychlor) Organophosphate (Malathion, Parathion, Dicrotophos, clorpyriphos) Carbamates (Carbaryl, Propoxur) and Pyrethroids (Allethrin, Cypermethrin). iii. Advantages and disadvantages of chemical control.	7	5
	2.3	i. **Biological control** by [predators, parasites and microbes (Bacteria, viruses), fungi, Nematodes]; Biological control Strategies - Introduction, Augmentation and Conservation ii. Use of Hormones and Pheromones. iii. Autocidal control - Sterile male technique, male confusion technique, genetic technique	5	5
3		**Beneficial Insects**	**15**	
	3.1	**Industrial Entomology:** Apiculture & Sericulture. Lac insects and Black Soldier Flies **ACTIVITY**: Set up a waste management unit involving Black Soldier Fly and submit report with geotagged photos.	8	4
	3.2	Importance of insect Pollinators with example- honey bee, wasp, butterfly Edible insects & human nutrition	2	4
	3.3	**Forensic Entomology**: Brief mention of Common insects of Forensic importance - Order Diptera- Calliphoridae, Sarcophagidae & Muscidae Order Coleoptera - Staphylinidae, Histeridae, Silphidae, Dermestidae & Cleridae	3	4

		Steps involved: i) Collection of entomological evidence during a death investigation. ii) Temperature and climatic records, iii) collection, preservation and handling of insects/maggots from the crime scene. iv) Analysis of entomological evidence and estimating PMI (Post Mortem Index) using Maggot age and Insect succession.		
4		**Medical Entomology**:	**15**	
	4.1	Pests of man and their management: Mosquitoes- *Anopheles, Culex, Aedes*, houseflies, bed bugs, head lice, house dust mites. Diseases caused by insects.	8	1,4
	4.2	Pests of domestic animals and their management: cattle, poultry, pet animals:- (bird louse, *Hypoderma*, screwworms, *Gasterophilus*) Diseases caused.	7	1,4
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning approach	**Classroom Procedure (Mode of transaction)** Lectures, virtual tours to observe and identify insect pests.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total =30 marks** Viva, Test Papers, Submission of pest box, Submission of report with geotagged photo of activity
	B. End Semester Examination **Theory Total = 70 marks, Duration 2 hrs** Short Essays 8 out of 10 x4 =32 marks; Short questions 14 out of 16 x2 =28 marks Fill in the blanks 10x1 =10 marks.

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3. Vijayakumaran Nair, K, Manju, K.G. and Minimol, K. C.(2015) Applied Zoology, Academia press, Thiruvananthapuram

Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**AQUAFARMING**					
Type of Course	**DCE**					
Course Code	**MCE7DCEZGY401**					
Course Level	**400**					
Course Summary	Course will help the students to understand the various aspects of Aqua farming					
Semester	**VII**	**Credits**			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	---	-----	-----	60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Identify the different aquaculture systems.	U	2
2	Demonstrate skills in advanced aquaculture technologies, aquarium management, breeding of ornamental fish, seed production of common cultivable species, and aquaponics.	U, S	2
3	Explain nutritional requirements and the processing and preservation of farming products.	A	2
4	Analyse the symptoms, diagnosis, and prevention/control of aquatic animal diseases.	An	2
5	Explain the effects of aquaculture methods on the environment.	A	3,8
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Introduction to Aquaculture**	**18**	
	1.1	Definition, scope, importance & types. Fin fish & shellfish culture. Different aquaculture systems: Pond, embankment pond, cage, pen, running water/race ways, extensive, intensive and semi-intensive culture systems, Integrated Multi trophic Aquaculture (IMTA)	3	1
	1.2	Pond preparation & management (Soil & Water quality management), Breeding & nursery rearing. Hatchery management. Prawn culture. Mussel culture - raft, pole.	10	1,2
	1.3	Nutritional requirements, Probiotics used in aquafarming. Types of feed, Methods and techniques involved in the formulation of fish feed. Processing & preservation of farming products **ACTIVITY** 1. Identify live fish food organisms & culture any one organism. 2. Survey of different feeds used in different hatcheries.	5	3
2		**Aquarium management, Integrated farming & Aquaponics**	**14**	
	2.1	Aquarium - water quality management, biological filter & aeration. Breeding of ornamental fishes - Angel, Gourami, Fighter and Guppy (live bearer), rearing, brood-stock management & transport	7	2
	2.2	Integrated farming: Fish-cum-livestock/poultry farming, paddy-cum-fish farming, Sewage-fed fish culture	5	1
	2.3	Aquaponic systems **ACTIVITY** Construct aquaponics systems at home & report submission (attach Geo-tagged photos)	2	2

3		**Advanced technologies and Health management practices in aquaculture**	**15**	
	3.1	Recirculating Aquaculture System (RAS) for the sustainable development of Aquaculture	3	2
	3.2	Monosex culture or Neo-female technology, GIFT (Genetic Improvement of Farmed Tilapia), Biofloc Technology	4	2
	3.3	Bio security & quarantine.	2	4
	3.4	Diseases (Viral, bacterial, fungal & parasitic) of fin fish & shellfish, treatment & prophylactic measures	5	4
	3.5	Predators **ACTIVITY** A survey of nearby aquaculture systems and report different diseases/parasites observed from farm	1	4
4		**Environmental impact of Aquaculture**	**13**	
	4.1	**Positive**: Utilization of waste from other farming systems in aquaculture Utilization of derelict water bodies for aquaculture. Weed control	3	5
	4.2	**Negative**: Environmental consequences related to hyper-nutrification, leaching of chemicals/ drugs into the environment, misuse of productive land. Introduction of exotic pathogens / diseases into the environment through indiscriminate/clandestine movement of fish seeds Remedial measures	5	5
	4.3	Aquacultural wastes and new developments in waste minimization. Enforcement of rules & regulations for sustainable aquaculture	5	4
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Classroom, videos of reputed farmers/institutions/processing units, success stories of aqua farmers.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment** **Theory Total=30 marks -** Quiz, Test Papers, one activity from module 1, report submission of activity from module 3
	B. End Semester Examination **Theory Total 70 marks, Duration - 2 hrs** Short Essays 8 out of 10 x4=32 marks; Short questions 14 out of 16 x2 =28 marks Fill in the blanks 10x1 =10 marks

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Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**LIVESTOCK AND POULTRY MANAGEMENT**					
Type of Course	**DCE**					
Course Code	**MCE7DCEZGY402**					
Course Level	**400**					
Course Summary	Livestock & Poultry Management focus on the basic techniques for rearing Cattle, Goat, Pig and Rabbit and poultry. Its emphasis on the shelter breeding, feeding and management of livestock and poultry.					
Semester	**VII**	**Credits**			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practicum	Others	
		4	---	--	---	60
Prerequisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Identify common breeds and diseases of rabbits, pigs, Indian goat poultry, quail, and ducks.	U	1,2
2	Differentiate the housing and nutritional requirements of rabbits, pigs, Indian goats, poultry, quail, and ducks.	A	1, 2,3
3	Select breeding stock for livestock, poultry, quail, and duck.	A	1, 2
4	Demonstrate skills in cuniculture, poultry, quail, duck, piggery, and dairy farming.	C	1, 2, 3, 6
5	Create health care plans for rabbits, pigs, poultry, quail, Indian goats, and ducks in order to prevent diseases.	C	1, 2,3
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Poultry Husbandry**	**15**	
	1.1	Introduction, Morphology of chick. Poultry breeds in India, Broilers and layers, Poultry Housing and Equipment. Poultry feed and its composition, mixing of feeds, different mills used (Hammer, mixture, pellet); premix preparation, raw materials, feed mill operation). Importance of egg production, Nutritive value of eggs and meat. Diseases and their control.	7	1, 2, 3,4, 5
	1.2	Quail farming (Coturnix coturnix) Introduction, care of quail chicks, care of adult quails, care of breeding quails, ration for quail, care of hatching eggs. Health care, use of quail egg and meat. Sources of quality chicks.	5	1, 2, 3,4, 5
	1.3	Duck farming Husbandry of ducks – Breeds in India, Advantages of duck rearing. Housing, feeding and management of ducks.	3	1, 2, 3,4, 5
2		**Dairy farming**	**19**	
	2.1	Definition and importance of cattle farming, Breeds of cattle.	3	1,3
	2.2	Housing for dairy cattle, Management of cross breed cows, Health management, Milk production	8	2,3,4, 5
	2.3	Introduction and Breeds of Indian Goat. Medicinal importance of goat milk. Avoidance of goatery odour in milk.	2	1,4
	2.4	Breeding Management- Fitness of purchase for first breeding – methods of detection of heat – Natural Service and artificial insemination – Care of the pregnant Animals – Breeding stock –Use of teaser – Culling.	3	3,4
	2.5	Feeding Management- Feeding habits of Goats, Nutritional requirement of goat, Housing, care of kids.	1	2

	2.6	Health Management- Management in the prevention and control of diseases, Deworming, Dipping, and spraying.	2	5
3		**Piggery (Pig Farming)**	**11**	
	3.1	**Piggery** : Piggery development in India, Breeds of Pigs, Advantages and disadvantages of swine keeping. Selection of quality adults, mechanism of reproduction, and management.	5	1,3
	3.2	Housing and Feeding Sanitation and hygiene of Pigs, Nutrition and Digestion in pigs.	4	2
	3.3	Diseases and prevention	2	5
4		**Cuniculture**	**15**	
	4.1	**Cuniculture** : Breeds of Rabbit: Common Breeds of rabbits (For wool production: Angora: For meat/Fur skin production (New Zealand white, White Californian, Soviet Chinchilla) For fancy/hobby purposes (Polish, Palmino, Havana, Beveren, New Zealand, Red, English Spot white, Dutch) Importance of rabbit for meat and fur production.	7	1
	4.2	**Rabbit production - Housing and Breeding** :	5	2,3,4,
	4.3	Health care and Management of young rabbits, managing broiler rabbits, managing wool rabbits, Feeding of rabbits.		5
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning approach	**Classroom Procedure (Mode of transaction)** Lecture, Videos, Farm visits..
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total =30 marks** Quiz, Test Papers, Seminar, Assignment
	B. End Semester Examination **Theory Total = 70 marks, Duration 2 hrs** Short Essays 8 out of 10 x4 =32 marks Short questions 14 out of 16 x2 =28 marks Fill in the blanks 10x1 =10 marks

REFERENCES

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<table>
<tr><td>Programme</td><td colspan="5">BSc (Honours) ZOOLOGY</td></tr>
<tr><td>Course Name</td><td colspan="5">SOLID WASTE MANAGEMENT</td></tr>
<tr><td>Type of Course</td><td colspan="5">DCE</td></tr>
<tr><td>Course Code</td><td colspan="5">MCE7DCEZGY403</td></tr>
<tr><td>Course Level</td><td colspan="5">400</td></tr>
<tr><td>Course Summary</td><td colspan="5">Principles, practices, and challenges associated with the management of solid waste, generation, collection, transportation, treatment, disposal, recycling and the environmental and public health implications of improper waste management, and the regulatory frameworks governing waste disposal. Students explore the importance of adopting sustainable waste management practices to minimize environmental pollution, conserve natural resources, and promote public health. They also examine the social, economic, and cultural factors influencing waste generation and management decisions.</td></tr>
<tr><td>Semester</td><td>VII</td><td colspan="3">Credits</td><td>4</td><td rowspan="2">Total Hours</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practical</td><td>Others</td></tr>
<tr><td>4</td><td>--</td><td>--</td><td>--</td><td>60</td></tr>
<tr><td>Pre requisites, if any</td><td colspan="5"></td></tr>
</table>

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain the types, sources, composition, and characteristics of solid waste, including hazardous and non-hazardous materials.	U	2,3
2	Describe waste management techniques, including waste reduction, recycling, composting, and landfill management, and the benefits and limitations of each approach.	U	2,3
3	Demonstrate skills in composting and thermal conversion methods.	A,S	2
4	Acquire skills in developing comprehensive and sustainable waste management plans tailored to specific contexts, considering factors such as waste generation rates, local regulations, community needs, and available resources.	A,S	2,8
5	Analyse landfill design, construction, operation, and closure procedures to determine their environmental impacts and propose mitigation measures for environmental sustainability.	An	1,8
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

Course Contents

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Introduction**	**15**	
	1.1	Definition, overview of solid waste management, types of solid wastes, sources of solid wastes, properties of solid wastes, Factors affecting the type and quality of waste, causes of solid waste generation, associated risks of solid wastes, Physical and chemical composition of municipal solid waste, hierarchy of waste management options.		1,4
2		**Solid waste management**	15	

	2.1	Key components of solid waste management, Generation, storage (containers), collection, transportation (human powered, animal powered and motorized) and disposal (Landfills, composting, incineration and pyrolysis), Recycling and resource recovery. Lay out of routes. Methods of handling and processing of solid wastes: separation, screening, size reduction, densification, baling, cubing, compaction, and pelleting.		2
3		**Landfilling**	**15**	
	3.1	Site selection criteria, landfill layout, landfill sections, Occurrence of gases and leachate in landfills: composition and characteristics, generation factors, initial adjustment phase, transition phase, acid formation phase, methane formation phase, maturation phase of gases and leachate, advantages and disadvantages.		5
4		**Composting and thermal conversion methods**	**15**	
	3.1	Composting: definition, types, process description, design and operational consideration of aerobic composting; process description, design and operational consideration of anaerobic composting. Vermicomposting: species of earthworms used. Black soldier flies for waste decomposition, Thermal conversion methods: incineration/combustion, pyrolysis and gasification, energy recovery system. **ACTIVITY**: Prepare a vermicomposting unit and submit report along with geo-tagged photos		3
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, Videos
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment** **Theory Total = 30 marks** Quiz, Test Papers, seminar, report submission of activity
	B. End Semester Examination **Theory Total = 70 marks, Duration 2 hrs** Short Essays 8 out of 10 x4 =32 marks Short questions 14 out of 16 x2 =28 marks Fill in the blanks 10x1 =10 marks

REFERENCES

1. Amrul N F et.al., A Review of Organic Waste Treatment Using Black Soldier Fly (*Hermetia illucens*), Sustainability 2022, 14(8), 4565; https://doi.org/10.3390/su14084565
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7. Liu, C.; Wang, C.; Yao, H. (2019) Comprehensive resource utilization of waste using the black soldier fly (Hermetia illucens (L.))(Diptera: Stratiomyidae). Animals , 9, 349
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13. Wang, G.; Peng, K.; Hu, J.; Yi, C.; Chen, X.; Wu, H.; Huang, Y. Evaluation of de-fatted black soldier fly (Hermetia illucens L.) larvae meal as an alternative protein ingredient for juvenile Japanese seabass (Lateolabrax japonicus) diets. Aquaculture 2019, 507, 144–154.
14. https://ncipm.icar.gov.in/Horticulture/PDF/Pest%20of%20Fruit%20Trees.pdf
15. Composting with Black Soldier Flies, Direct Compost Solutions, https://directcompostsolutions.com › composting-with black flies

Semester-VIII

Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**ADVANCED IMMUNOLOGY**					
Type of Course	**DCC**					
Course Code	**MCE8DCCZGY400**					
Course Level	**400**					
Course Summary	Covers concepts in immunogenetics, immunotherapy and the molecular basis of immune-related diseases. Students gain a deep understanding of cutting-edge research, including the role of immunology in cancer, autoimmunity, and infectious diseases. Practical applications in advanced areas such as vaccine development and emerging immunotherapies are also discussed. Overall, this course equips students with a comprehensive knowledge of advanced immunological principles and their relevance in modern biomedical research					
Semester	**VIII**	**Credits**			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	--	1	--	75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Describe fundamental understanding of Antigens and Antibodies¸ Antigen- Antibody reactions and their clinical applications¸ structure of Immunoglobulins¸ Hypersensitivity reactions	U	1
2	Assess the role of MHC and Complement system in immunological mechanisms	E	2
3	Differentiate autoimmune diseases and immunodeficiency disorders	An	3
4	Appraise the recent trends in vaccine production immunotherapy and transplantation immunology	E	3
5	Develop skills in performing immunological tests	S & I	4
Remember (K), Understand (U), Apply (A), Analyze (An), Evaluate (E),Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs.	CO No.
1		**Antigen, Antibody & Antigen-Antibody Interaction**	**17**	
	1.1	Antigens: Types - Haptens, Adjuvants, Epitopes (T cell and B cell Epitopes).	2	1
	1.2	Immunoglobulins: fine structure, classes and functions. Antigenic determinants of immunoglobulin – Isotype, Allotype and Idiotype. Mechanisms of antibody diversity (V(D)J recombination).	3	1
	1.3	Hybridoma technology. Monoclonal antibodies and clinical uses. Novel antibody engineering techniques	2	1
	1.4	Strength of antigen-antibody interaction- antibody affinity and avidity.	2	1
	1.5	Types of antigen-antibody reactions - Cross-reaction, Precipitation, Agglutination and Flocculation	2	1
	1.6	Immunological Techniques - ELISA, RIA, Immunoprecipitation, Widal, Coombs, VDRL and Radio-allergosorbent Test (RAST). Flow cytometry and fluorescence. Immunoelectron microscopy and Immunofluorescence.	6	1
2		**Complement system and MHC**	**8**	
	2.1	The Complement system and its activation pathways- Classical, Alternate and Lectin Pathways. Terminal sequence of complement activation (MAC).	2	2
	2.2	Regulation of complement activity and complement deficiencies.	3	2
	2.3	General organization and inheritance of MHC. MHC genes - HLA Complex in humans. MHC-peptide interaction. Expression of MHC molecules on different cell types. Biological significance of MHC.	3	2
3		**A. Immunodeficiency diseases, Autoimmunity and Hypersensitivity**. & **B. Vaccines and Transplantation Immunology**	**20**	
	3.1	**A. Immunodeficiency diseases, Autoimmunity and Hypersensitivity** Congenital immunodeficiency diseases. A brief account on SCID, Wescott-Aldrich Syndrome (WAS), Ataxia, Chronic Granulomatous Disease (CGD), Leukocyte Adhesion Deficiency (LAD). Acquired Immunodeficiency Disease (AIDS).	3	3
	3.2	Autoimmunity. Organ- specific autoimmune diseases (Hashimoto's thyroiditis) and Systemic auto-immune diseases (Pernicious Anemia).	2	3

	3.3	Acute and Chronic Inflammation. A brief account on Role of Chemokines and cytokines in immune system. Hypersensitivity. A brief account on different types with example. IgE- mediated (type- I) hypersensitivity (Anaphylaxis). Antibody- mediated cytotoxic (type- II) hypersensitivity (Transfusion reaction). Immune complex- mediated (type- III) hypersensitivity (Arthus reaction). Delayed type (type- IV) hypersensitivity (Mantaux test). Stimulatory (type V) hypersensitivity (Grave's diseases)	4	1
	3.4	B. **Vaccines and Transplantation Immunology** Types of Vaccines - Whole organism vaccines, Purified macromolecules as Vaccines, Recombinant vector vaccines, DNA, and mRNA vaccines. Synthetic peptide vaccines, Multivalent subunit vaccines. Therapeutic cancer vaccines.	3	4
	3.5	Vaccine Development Process - Preclinical research and animal testing, Clinical trial phases (I, II, III), Regulatory approval and post-marketing surveillance. Ethical aspects of vaccine research and distribution: Public perception and vaccine hesitancy, Balancing individual rights and public health	5	4
	3.6	Transplantation Immunology: Different types of Transplantations. Immunologic basis of graft rejection. Clinical manifestation of graft rejection. General and specific immunosuppressive therapy for transplant recipients.	3	4
4		**Practicals**	**30**	
	1	Differential leucocyte and total leucocyte count		5
	2	Histological study of Bone marrow, Thymus, Spleen and lymph nodes through slides/ Photographs		
	3	Principle and procedure of separation of lymphocytes from whole blood, showing videos of the experiment		
	4	Principle and procedure of separation of T and B lymphocytes, showing videos of the experiment		
	5	Virtual lab/Demonstration/Lab visit/ Short video of WIDAL Test, Western Blotting, ELISA, VDRL Test		
	6	Single diffusion in one dimension (Oudin test)		
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, videos, Interactive discussions and case studies
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total =25 marks -** Quiz, Test Papers, Seminar **Practical Total = 15 marks,**Lab performance, Record, Lab Test
	B. End Semester Examination **Theory Total = 50 marks, Duration 1.5 hrs** Short Essays 5 out of 7 x4 =20 marks Short questions 10 out of 12 x2 =20 marks Fill in the blanks 10x1 =10 marks **Practical Total = 35 marks, Duration 2 hrs** **Record 10 marks, Examination 25 marks:** Differential leucocyte count – 15 marks Separation of T and B lymphocyte/ Oudin test – 4 marks Spotter identification from module 2 & 5 (one each)– 6 marks

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Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**ANIMAL SYSTEMATICS**					
Type of Course	**DCC**					
Course Code	**MCE8DCCZGY401**					
Course Level	**400**					
Course Summary	Covers principles of classification, evolutionary relationships, and the development of taxonomic systems. Students learn to identify and classify organisms based on morphological, molecular, and ecological characteristics. Emphasis is placed on understanding phylogenetic relationships &the hierarchical structure of taxonomy, from species to higher taxonomic levels.Students explore the history of taxonomy, current methods, and the impact of technology on modern systematics. Practical aspects include fieldwork and specimen collection for species identification.					
Semester	**VIII**	**Credits**			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	---	1	----	75
Pre requisites if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1.	Understand the principles of taxonomy¸ Principles and application of Zoological nomenclature	U	1¸10
2.	Appreciate the role of taxonomy in biodiversity conservation and its significance in understanding and preserving natural ecosystems.	Ap	6
3.	Identify and classify organisms using taxonomic keys, molecular techniques and morphological characteristics.	E	2
4.	Understand the principles of phylogeny¸ recent trends and its applications	U	1,2
5.	Analyze and interpret phylogenetic trees to understand the evolutionary relationships among different species and their common ancestors.	An	1
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E),Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Fundamentals of taxonomy and systematics**	**12**	
	1.1	Taxonomy and Systematics – Definition¸ Significance. Linnaeus and taxonomy. Hierarchical system of taxonomy-taxon, category, taxonomic rank, stages in taxonomy.	5	1
	1.2	Species concept - types, sub species, deme and other intra specific categories, Polytypic and monotypic species (Brief account).	3	1
	1.3	Principles and applications of Zoological nomenclature: Zoological nomenclature - International Commission for Zoological Nomenclature - features, principles and rules, structure of ICZN code. Zoobank	**3**	1
	1.4	Scientific name - uninomial, binomial and trinomial.	1	1
2		**Taxonomic tools and techniques**	**20**	
	2.1	Taxonomic procedures: collection, preservation, curation and process of identification.	3	2
	2.2	Zoological type: Definition and significance of Holotype, Paratype, Allotype, Neotype, Syntype, Lectotype.	2	3
	2..3	Taxonomic keys: Different types of taxonomic keys - single access keys, synoptic keys, dichotomous, polytomous keys and computer aided keys. Merits and demerits of keys.	4	3
	2.4	Taxonomic publications: Types of taxonomic publications - atlas, catalogue, checklist, field guide, field book, hand book, manual. (Brief account). Encyclopedia of Life (EOL).	3	2
	2.5	**Modern trends in Taxonomy:** Approaches in taxonomy – Morphological, embryological, ecological, behavioural, cytological, biochemical, numerical, molecular approaches in taxonomy. e-taxonomy, Cybertaxonomy, Integrative taxonomy	**5**	4
	2.6	DNA Barcoding: steps involved in barcoding and applications of barcoding. Barcoding of life. International Barcode of Life (iBOL).	3	5
3		**Phylogenetics and Cladistics**	**13**	

	3.1	Phylogenetics: Phylogenetic tree - types (cladogram, phenogram, phylogram, dendrogram, curvogram, eurogram, swoopogram, chronogram), Molecular phylogeny – DNA markers (mitochondrial markers- Cyt b, Cyt C oxidase; nuclear markers – 16S rRNA, ITS, microsatellite repeats) (Brief description only). Molecular clock hypothesis. Phylocode. Tree of life.	8	2
	3.2	Cladistics: Clade (monophyletic, paraphyletic, polyphyletic) Phenotypic trait, ancestral versus derived characters - Plesiomorphy, apomorphy, synapomorphy and autapomorphy.	5	4
4		**Practicals**	30	
	1	Study of museum specimens - 25 invertebrates and 25 vertebrates.		1
	2.	Preparation of dichotomous key of 4 specimens up to family/order (Insects/Spiders/ Fishes/ Snakes - any three taxa).		
	3.	Comparative study across different species to identify similarities and differences (Mosquito, Ant, Butterfly, Moth, Honeybee, Earthworm, Prawn, Spider, Crab – minimum two species each from any five taxa).		
	4	Preparation of Cladogram based on the specimens provided (based on at least five museum specimens).		
	5	Visit to a Zoology Museum.		
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning approach	**Classroom Procedure (Mode of transaction)** Lecture, museum visit
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total =25 marks -** Quiz, Test Papers, seminar **Practical Total =15 marks -** Lab performance, record, Lab Test
	B. End Semester Examination **Theory Total = 50 marks, Duration 1.5 hrs** Short Essays 5 out of 7 x4 =20 marks; Short questions 10 out of 12 x2 =20 marks Fill in the blanks 10x1 =10 marks **Practical Total -= 35 marks Duration 2 hrs** **Record 10 marks, Examination 25 marks:** Dichotomous key preparation for 2 specimens – 14 marks; Cladogram – 6 marks; spotter identification – 5 marks

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Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**PANDEMIC SCIENCE**					
Type of Course	**DCE**					
Course Code	**MCE8DCEZGY400**					
Course Level	**400**					
Course summary	The course is designed to understand the history and outbreaks of major pandemics of the world, basics of epidemiology, parasitism and explains major diseases with itscausative organism.					
Semester	**VIII**	**Credits**			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	--	1	---	75
Prerequisite, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Describe the Global History of Epidemics & Pandemics Outbreaks, Epidemics and Pandemics in India	**U**	1,3,6
2	Distinguish Epidemics & Pandemics,epidemiology and their outbreak management	U	1,2,3,6, 10
3	Explain Parasitism,pandemics caused by bacteria, virus,fungi,protozoa and multicellular parasites	R, U, An	1,2,3, 10
4	Analyse the diseases by observing the symptoms	An	1,2
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Epidemiology**	**15**	
	1.1	Global History of Epidemics & Pandemics Outbreaks, Epidemics and Pandemics in India	3	1
	1.2	Definition of Epidemiology. Epidemiological methods (Public health surveillance, remote sensing), Measuring infectious disease frequency, Patterns of infectious disease in population, Emerging and re- emerging infectious disease and pathogens.	6	1
	1.3	Control of epidemics - Outbreak management including quarantine, isolation, contact tracing. Vaccines (Whole cell, Acellular, Recombinant vaccines, DNA vaccines and mRNA Vaccines). The Epidemic Diseases Act, 1897, 1977 and amendment in 2020. The Disaster Management Act, 2005 Act No. 53 of 2005	6	2
2		**Bacterial, Viral and fungal diseases**	**17**	
	2.1	Bacterial diseases: Diphtheria, Tuberculosis, Leprosy, Plague, Gastritis, Leptospirosis, Cholera, Botulism STDs Gonorrhea and Syphilis.(causative agent, mode of transmission, prophylaxis)	4	3
	2.2	Viral diseases: Covid 19, Influenza, Chicken Pox, Measles, SARS, Small pox, H1N1 Flu., Bubonic Plague, Poliomyelitis, West Nile fever, Dengue fever, Ebola (Viral Haemorrhagic fever), Nipah Virus, Chikun gunya, Rabies, AIDS, Common Cold, Genital Herpes, Hepatitis B**.** **Prion Disease –CJD** (causative agent, mode of transmission, prophylaxis)	10	3
	2.3	Fungal diseases: Mucormycosis (Black fungus), Cryptococcosis. (causative agent, mode of transmission, prophylaxis)	3	3
3		**Parasitism and Parasitic diseases**	13	
	3.1	Host- parasitic relationship, Ecological importance of parasitism, Pathogenicity, Stages ofdisease progression, Direct & Indirect means of disease transmission.	4	3
	3.2	Establishment of disease- Portal of entry & exit. Invasiveness & Virulence.	4	3
	3.3	Protistan diseases -Malaria, Trypanosomiasis. (causative agent, mode of transmission, prophylaxis)	3	3

	3.4	Multicellular Parasitic diseases- Taeniasis, Filariasis. Schistosomiasis (causative agent, mode of transmission, prophylaxis)	2	3
4		**Practicals**	**30**	
		Marking pandemic outbreaks on world map with year (Bubonic Plague/ Spanish flu/ Kuru /Nipah) and add an account.		3
		Pathogenic Bacterial and Parasite Identification- M*ycobacterium tuberculi, Leptospira, Wucheraria bancrofti, Trypanosoma, Schistosoma* (specimen/photographs)		
		Insect Vector Studies- *Xenopsylla cheopis, Aedes aegypti, Anopheles* mosquito, *Culex, Phlebotomus* (specimen/photographs)		
		Principle and procedure for Screening for pulmonary tuberculosis sputum ZN staining- procedure		
		Principle and procedure for Isolation and identification tests of pathogenic bacteria-like *Vibrio cholerae*		
		Principle and procedure of the Test for Virulence factors of bacteria- capsule staining		
		Principle and procedure of Serological tests used to detect viral & bacterial antigens		
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning approach	**Classroom Procedure (Mode of transaction)** Tutorial, Videos on Biology, Visit to any relevant research institution.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total = 25 marks -** Quiz, Test Papers, Seminar **Practical Total = 15 marks:** Lab performance, record, Lab Test
	B. End Semester Examination **Theory Total = 50 marks, Duration 1.5 hrs** Short Essays 5 out of 5 x4 =20 marks; Short questions 10 out of 12 x2 =20 marks Fill in the blanks 10x1 =10 marks **Practical Total = 35 marks Duration 2 hrs** **Record 10 marks, Examination 25 marks:** Parasitic identification, disease caused, mode of transmission & prophylaxis of any 2 – 12 marks, Marking of 2 pandemic outbreak on world map - 4 marks, Principle and procedure of disease diagnosis – 4 marks, spotter identification any 2 – 5 marks

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Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**DEVELOPMENTAL BIOLOGY**					
Type of Course	**DCE**					
Course Code	**MCE8DCEZGY401**					
Course Level	**400**					
Course Summary	Explore the fundamental concepts and mechanisms that regulate animal development from fertilization of the egg to formation of the adult organism. Encompasses the biology of regeneration, metamorphosis and growth and differentiation of stem cells.					
Semester	**VIII**	**Credits**			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	---	1	--	75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Discuss the genetic, cellular, and tissue control of development	*U*	1,6
2	Explain the sequence of events and the mechanism of fertilization in invertebrates and vertebrates.	*U, An*	2
3	Compare and contrast early developmental strategies of model organisms.	*An, E*	4
4	Understand integrated processes that transforms an amorphous mass of cells into a complete organ in the developing embryo	*U, An*	6
5	Analyse the different developmental stages of organisms like drosophila chick embryo and frog through the techniques like sectioning staining etc.	*U, An*	8

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**PATTERNS AND PROCESSES OF ANIMAL DEVELOPMENT**	**10**	
	1.1	**Levels of commitment** **Specification**-mechanism of developmental patterning Autonomous, Conditional and Syncytial specification **Determination**-mechanism of cell differentiation Differential gene expression and gene transcription Selective nuclear RNA processing Selective messenger RNA translation Differential protein modification	4	1
	1.2	**Cell-to-cell communication-mechanism of morphogenesis** Induction and competence **Paracrine signaling**: Morphogen gradients, Fibroblast growth factors, RTK pathway and JAK-STAT pathway, Hedgehog pathway, Wnt pathway, TGF-β superfamily and Smad pathway **Juxtacrine Signaling** :The Notch pathway: Juxtaposed ligands and receptors for pattern formation Brief account only	4	1
	1.3	**Stem cells:** Embryonic stem cells; adult stem cells; medical applications and ethical issues.	2	1
2		**FERTILIZATION & EARLY DEVELOPMENT**	18	
	2.1	**External Fertilization in Sea Urchins** Biochemical and molecular aspects of fertilization Species-specific sperm-egg recognition. Polyspermy: fast block and slow block	4	2
	2.2	**Internal Fertilization in Mammals** Translocation and capacitation Hyperactivation, thermotaxis, and chemotaxis The acrosome reaction and recognition at the zona pellucida Gamete fusion and the prevention of polyspermy Activation of the mammalian egg	4	2
	2.3	**Early development of Drosophila** Egg, cleavage, mid-blastula transition, gastrulation. Gene action in development of drosophila:- Maternal effect genes, zygotic genes, gap genes, pair rule genes, segment polarity genes; homeotic genes Anterior- posterior patterning in Drosophila; Dorsal-Ventral patterning; Left-right patterning.	5	3

		Dorsal protein gradient.		
	2.4	**Early development of Amphibia** Fertilization, Cortical Rotation, and Cleavage The mid-blastula transition: Preparing for gastrulation; Amphibian Gastrulation The dorsal-ventral and anterior-posterior axes formation Primary embryonic induction; Molecular Mechanisms of Amphibian Axis Formation Organizer and its functions; Nieuwkoop centre Molecular basis of mesoderm induction Neural induction and its regional specificity. Left-Right Axis formation	5	3
3		**ORGANOGENESIS & POST EMBRYONIC DEVELOPMENT**	17	
	3.1	**Vulva formation in *Caenorhabditis elegans*** Generation of vulval precursor cell Vulval cell induction and differentiation RTK pathway, Notch-delta and lateral induction Anchor Cell invasion Vulval morphogenesis	4	4
	3.2	**Tetrapod limb development** Limb Anatomy and Limb Bud formation Hox Gene Specification of Limb Outgrowth: Generating the Proximal-Distal Axis of the Limb The apical ectodermal ridge Specifying the Anterior-Posterior Axis Generating the Dorsal-Ventral Axis Cell Death and the Formation of Digits and Joints	4	4
	3.3	**Metamorphosis in Insects** Types, Hormonal control and molecular mechanism of insect metamorphosis	3	5
	3.4	**Amphibian Metamorphosis** Changes associated with amphibian metamorphosis Hormonal control of amphibian metamorphosis Regionally specific developmental programs	3	5
	3.3	**Regeneration** Types and histological processes Polarity and metaplasia in regeneration Lens regeneration in amphibians	3	5
4		**Practicals**	30	
	1	Developmental stages of Drosophila – Culturing method and larval instar identification		5
	2	Developmental stages of frog (egg, blastula, gastrula, neurula, tadpole, with external gill and internal gill) using permanent slides/Diagrams		
	3	Serial sections of embryo (tadpole/chick).		

	4	Vital staining of early gastrula of chick and tracing the development of stained parts - Window method.		
	5	Blastoderm mounting and age determination of chick embryo (18hr/ 24hr/ 33 hr/ 48 hr/ 72 hr) using vital stains.		
	6	Preparation of permanent slides of blastoderm of chick embryo- at least one (18hr, 24hr, 33 hr, 48 hr or 72 hr)		
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning approach	**Classroom Procedure (Mode of transaction)** Lecturing, videos, practical
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total = 25 marks -** Quiz, Test Papers, Seminar **Practical Total = 15 marks:** Lab performance-, record, Lab Test
	B. End Semester Examination **Theory Total = 50 marks, Duration 1.5 hrs** Short Essays 5 out of 5 x4 =20 marks; Short questions 10 out of 12 x2 =20 marks Fill in the blanks 10x1 =10 marks **Practical Total = 35 marks Duration 2 hrs** **Record 10 marks, Examination 25 marks:** Blastoderm mounting and age determination/ Larval instar identification – 15 marks, Vital staining – 4 marks, spotter identification – 6 marks

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SUGGESTED READING

https://web.as.uky.edu/Biology/faculty/cooper/Population%20dynamics%20examples%20with%20fruit%20flies/08Drosophila.pdf

Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**AQUATIC BIOLOGY**					
Type of Course	**DCE**					
Course Code	**MCE8DCEZGY402**					
Course Level	**400**					
Course Summary	Explores the biological principles governing life in freshwater and marine environments. Students delve into the diversity of aquatic organisms, their interactions with each other and their environment, and the ecological processes that shape aquatic ecosystems.					
Semester	**VIII**	**Credits**			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	--	1	--	75
Pre requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain of Aquatic Ecosystems**,** knowledge of the diverse range of aquatic habitats, their interconnectedness, and the processes that sustain life within them.	U	1,3
2	Infer the importance of preserving aquatic biodiversity by monitoring the basic standards of water.	U	1, 2, 3
3	Evaluate the anthropogenic interventions affecting the aquatic ecosystems .	E	2,3
4	Apply ecological principles to conserve aquatic environments, including nutrient cycling, energy flow, and trophic interactions.	A	2,3, 4, 6
5	Understanding of the physical and chemical characteristics of aquatic environments, such as water chemistry, hydrodynamics, and the effects of physical processes on aquatic organisms	A	6, 7, 11
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Aquatic Biomes**	15	1
	1.1	Brief introduction of the aquatic biomes: Freshwater ecosystem (lakes, wetlands,streams and rivers), estuaries, intertidal zones, oceanic pelagic zone, marine benthic zone and coral reefs		
2		**Freshwater and Marine Biology**	15	
	2.1	**Freshwater Biology** **Lakes**: Origin and classification, Lake as an Ecosystem, Lake morphometry, Physico–chemical Characteristics: Light, Temperature, Thermal stratification, Dissolved Solids, Carbonate, Bicarbonates, Phosphates and Nitrates, Turbidity; dissolved gases (Oxygen, Carbon dioxide). Nutrient Cycles in Lakes-Nitrogen, Sulphur and Phosphorous. **Streams:** Different stages of stream development, Physico-chemical environment, Adaptation of hill-stream fishes. **Ponds**	8	1,2
	2.2	**Marine Biology** Major divisions of marine environment; Physical properties of seawater - Thermal properties of seawater1 Chemical properties of seawater : Concept of chlorinity , salinity and density of seawater; Primary and Secondary Productivity of the coastal environment; Phytoplankton and Zooplankton - Classification, distribution, their role in coastal ecosystems and adaptations. Primary production and factors affecting primary production. Continental shelf, Adaptations of deep sea organisms, Coral reefs, Sea weeds.	7	
3		**Management of Aquatic Resources**	15	

	3.1	Causes of pollution: Agricultural, Industrial, Sewage, Thermal and Oil spills, Eutrophication, Management and conservation (legislations), Water pollution acts of India, Sewage treatment Water quality assessment BOD & COD		1,4
4		**Practicals**	**30**	
	1	Determine the area of a water body using graphimetric method.		5
	2	Identify the important macrophytes, phytoplanktons and zooplanktons present in a lake ecosystem.		
	3	Determine the amount of Turbidity/transparency, Dissolved Oxygen, Free Carbon dioxide, Alkalinity (carbonates & bicarbonates) in water collected from a nearby lake/ water body		
	4	Instruments used in limnology (Secchi disc, Van Dorn Bottle, Conductivity meter, Turbidity meter, PONAR grab sampler) and their significance.		
	5	Field study: Visit to a Sewage treatment plant/Marine bioreserve/Fisheries Institutes and submission of report		
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning approach	**Classroom Procedure (Mode of transaction)** Lecturing, Tutorial, ICT Enabled Learning. Experiential learning
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total = 25 marks -** Quiz, Test Papers, Seminar **Practical Total = 15 marks:** Lab performance-, record, Lab Test
	B. End Semester Examination **Theory Total = 50 marks, Duration 1.5 hrs** Short Essays 5 out of 5 x4 =20 marks; Short questions 10 out of 12 x2 =20 marks Fill in the blanks 10x1 =10 marks **Practical Total = 35 marks Duration 2 hrs** **Record 10 marks, Examination 25 marks:** Zooplankton identification, counting and graphical representation of abundance/ Oxygen estimation/ Carbon dioxide estimation – 12 marks Determination of area of a water body from the scaled map provided /Calculation of turbidity (providing values) – 8 marks Field study report – 5 marks

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Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**FISHING AND FISH PROCESSING TECHNOLOGIES**					
Type of Course	**DCE**					
Course Code	**MCE8DCEZGY403**					
Course Level	**400**					
Course Summary	Describes traditional and modern fishing techniques, ecological impacts, & sustainable management. Explores fish handling, preservation, & transformation into marketable products, emphasizing quality control, food safety & technological advancements. Through lectures, demonstrations, & field trips, students gain practical insights into industry challenges & opportunities, preparing them for informed decision-making in the seafood sector.					
Semester	**VIII**	**Credits**			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	--	1	---	75
Pre requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Describe various fishing methods, including traditional practices and modern technologies and their ecological impact and sustainability in the seafood industry.	U	2,3
2	Explain fish handling, preservation, and processing techniques, such as chilling, freezing, and canning, and the quality control standards and food safety regulations.	U	2,6,7
3	Apply the sustainable management strategies for fisheries, resource conservation, ecosystem health.	A	1,6,7
4	Evaluate the technological advancements of fish processing equipments,packaging materials for improving efficiency, product quality, and market competitiveness.	E	1,2,3
5	Compare different fishing methods, fish processing technologies, fishery by products and sustainability practices in the fisheries sector	A,E	1,6,7
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Fishing Technologies**	**15**	1
	1.1	**Fishing Crafts:** Classification of fishing crafts: Types of fishing crafts: traditional, motorized; different traditional fishing crafts of India. Outline of the method of construction of fishing boats in wood, fibre glass and Ferro cement and steel. Recent advances in fishing craft technology	5	
	1.2	**Fishing Gears:** Basic principles of gear design and capture mechanism. Fishing gear for closed water systems. Classification of gears: **Active** Gears - Design and operation of – trawls, purse seines, ring seines, beach / shore seine, boat seine, pole and line, squid jigs, trolling. **Passive** (low energy fishing) Gears - Design and operation of - gill nets, long lines, hooks, traps, stake net, dol net, Chinese dip nets, cast nets. Destructive fishing methods like electrical fishing, poisoning and use of dynamites. Prohibited fishing practices. Preservation of fishing gears. Fishing gear materials and their properties. Recent advance in fishing gear technology.Estimation of weight of netting.	5	
	1.3	**Advancements in fishing technology and responsible fishing** Fish aggregating devices and artificial reefs. Light fishing and Lantern fishing. Impact of artificial reefs on fish stock. Fish Finding Devices: Introductory information on echo-sounder, sonar, netsonde, global position systems, remote sensing, and potential fishing zones. Code of conduct of responsible fishing – Illegal, Unreported and Unregulated (IUU) fishing, Turtle Exclusion Devices (TED), By-catch Reduction Devices (BRD).	5	
2		**Fish Processing technology**	**20**	
	2.1	Principles of fish preservation. Precautions taken in handling fish in the fishing vessel, landing center and processing plant. Importance of hygiene and	3	

		sanitation in fish handling. Quality of water and ice in fish handling and processing. Common equipment and utensils used in the processing plant. Preparation of ice. Different types of ice used in the seafood industry and their merits. Preservation by refrigerated seawater and chilled sea water		2,4
	2.2	**Freezing** : Refrigeration, refrigeration load, refrigerants, cold storage of fish. Crystallization, freezing curves for purewater and water in fish, physical and chemical changes on freezing, effect of freezing on location and size of ice crystals **Technological aspects of freezing**: Slow freezing and quick freezing, Air blast freezing, tunnel freezing, fluidized bed freezing, spiral freezing, immersion freezing, contact plate freezing, cryogenic freezing and high pressure freezing. **Freezing on board fishing vessels**, IQF freezers, selection of a freezing method, cold store and cold storage, and chemical, physical and sensory changes during freezing and cold storage. Chemical treatment of fish prior to freezing, TTT and PPP factors, packing of frozen products, processing and freezing of frozen sea food products for export from India.	4	2,4
	2.3	Canning :Principles of canning: Heat transfer in canned fish, thermal destruction of bacteria, D and D_0value,F_0 value, Z value, determination of process time, cook value, Aseptic packing, containers for canning, unit operations, equipment used for canning, canning of sardine, tuna, and prawns. Retort pouch packaging. Waste management in canning industry, defects of canned product	5	4
	2.4	**Curing and drying:** Water content and water activity, water activity and microbial spoilage, drying of fish, constant rate and falling rate drying period, salting and salting methods, drying methods for fish, packaging and storage. Quality problems and solutions. Maillard reaction, lipid oxidation, microbial, fungal and insect'sinfestation. Packaging of dried products. **Smoking**: objectives, smoke production, smoke components, quality, safety and nutritive value, processing and equipment, Freeze drying of fish. Accelerated freeze drying. Packaging of freeze dried products. Hurdle technology.	5	

	2.5	Radiation: Radiation preservation, principles of radiation, ionizing radiations and their sources, units, applications ofradiation, Shelf life extension, radappertization, radurisation, radicidation and radiation doses for irradiation of different fish products. Safety of irradiated fish.	3	
3		**Other methods of processing**	**10**	
	3.1	**By-products**: Mince and surimi – Processing, packaging, freezing and storage. Fish protein concentrate, fish meal and oil, fish liver oil, fish hydrolysate, fish silage, Caviar, gelatin, glue, pearl essence, dehydrated jelly fish, squalene, fish maws and isinglass, Ambergris, Beche de mer. Chitin, chitosan, and glucosamine hydrochloride, Utilization of prawn waste and fish processing waste. Processing and extraction of algin, alginic acid, alginates, agar, manitol, and carragernan. Value added products: Coated fish products, batter, bread crumbs, and general procedure for preparation of battered and breaded products, objectives, packaging and storage, equipment for making coated products, quality ofcoated products. Types of coated products: coated fish fillets, fish fingers, coated shrimp products, moulded products, fishcutlets, fish balls, fish burger (patties).Seafood analogues and imitation products.		5
4		**Practicals**	**30**	
	1	Study of various fishing gears (10)		1,4,5
	2	Visit to net making factory, identify different types of nets and their operating mechanism and report submission. Netting twines, rope, netting, cutting, tailoring, mounting, design of nets.		
	3	Visit to boat building yard/institute – submit report: Boat building materials, back bone assembly, planking, and maintenance of fishing boats, traditionaland modern fishing vessels.		
	4	Conduct a survey on indigenous fishing technologies used in and around and submit an account with geo tagged photos and mode of operation		
	5	Biochemical and microbiological test for assessing the quality of fish. **The record must be a compilation of all the 5 above.**		
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, Experiential learning.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment** **Theory Total=25 marks -** Quiz, Test Papers, seminar **Practical Total = 15 marks -** Lab performance, record, viva
	B. End Semester Examination **Theory Total = 50 marks, Duration 1.5 hrs** Short Essays 5 out of 7 x4 =20 marks Short questions 10 out of 12 x2 =20 marks Fill in the blanks 10x1 =10 marks **Practical Total = 35 marks Duration 2 hrs** **Record 10 marks, Examination 25 marks:** Tests for assessing quality of fish – 9 marks Spotter identification (8) – 16 marks

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Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**BIOLOGICAL SPECIMEN PREPARATION TECHNIQUES**					
Type of Course	**DCE**					
Course Code	**MCE8DCEZGY404**					
Course Level	**400**					
Course Summary	Helps to acquire knowledge on preparation of laboratory specimens for display in Biology museums for study purpose and also as an entrepreneurship. Develops research aptitude by introducing frontier areas of biological science such as historic genetic analysis- a valuable tool for study and application of Conservation Genetics- of endangered species.					
Semester	**VIII**	**Credits**			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	---	1	--	75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domain*	PO No
1	Describe different animal collection techniques and their application	**U**	1¸2
2	Explain the methods of skeleton preservation blood and smear preparation	**U**	1¸2
3	Apply the knowledge acquired in preserving the specimens	**An**	9,10
4	Formulate innovative ideas to taxidermize a dead specimen	**C**	1¸10
5	Demonstrate skills in Alizarin preparation.	**S¸C**	1¸2
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Importance and applications of the specimen preparation techniques**	**10**	
		Introduction: importance and applications of the specimen preparation techniques – laboratory/ study purpose; museum display; entrepreneurial. Probable application in DNA extraction, Conservation Genetics.		1,3,5
2		**Collection and Preservation of animals**	**15**	
		Collection techniques for insects, fishes, and birds. Preservation methods for animals belonging to various taxa		1,2
3		**Preparation of museum specimens, permanent slides and blood smear**	**20**	
	3.1	Preparation of museum specimens, Display methods: - wet & dry.	4	2,4
	3.2	Skeletal techniques: - Articulated skeleton, general methods- Clearing- fleshing, maceration, boiling, degreasing, mounting. Staining techniques (alizarin preparations). Taxidermy	9	
	3.3	Preparation of permanent slides- whole mounts, various tissues, sections, stages of cell divisions	5	
	3.4	Preparation of thick and thin blood smear, & its significance	2	
4		**Practicals**	**30**	
	1	Whole mount preparation of small animals, tissues and sections of animals	10	2
	2	Alizarin preparation of small invertebrates and vertebrate skeletal system	5	
	3	Preparation of articulated skeletons	6	
	4	Demonstration of Taxidermy	9	
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, Hands on training, demonstration
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment** **Theory Total =25 marks -** Quiz, Test Papers, seminar **Practical Total = 15 marks -** Lab performance, record, Submission of alizarin preparation
	B. End Semester Examination **Theory Total = 50 marks, Duration 1.5 hrs** Short Essays 5 out of 7 x4 =20 marks Short questions 10 out of 12 x2 =20 marks Fill in the blanks 10x1 =10 marks **Practical Total = 35 marks Duration 2 hrs** **Record 10 marks, Examination 25 marks:** Whole mount preparations - submission of 5 slides. 5 slides-10 marks; Principle and procedure for the preparation – 6 marks, Alizarin preparation submission – 5 marks, Taxidermy Steps – 4 marks

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Programme	**BSc (Honours) ZOOLOGY**					
Course Name	**BIOINFORMATICS & COMPUTATIONAL BIOLOGY**					
Type of Course	**DCE**					
Course Code	**MCE8DCEZGY405**					
Course Level	**400**					
Course Summary	Applies computational methods to analyze large collections of biological data,to make new predictions or discover new biology. Familiarize with biological databases & construction of phylogenetic trees using appropriate software. Principles of conventional drug designing & computer aided drug designing introduced. Scope of AI in Biology is discussed.					
Semester	**VIII**	**Credits**			**4**	Total Hours
Course Details	Learning approach	Lecture	Tutorial	Practical	Others	
		3	-	1	--	75
Pre requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Understand the basics of biological databases & sequence analysis.	U	1,2
2	Discuss genomics and proteomics System Biology & Computational Biology	U, I	3,10
3	Apply bioinformatics tools to analyze molecular sequences	A, An	1,2,10
4	Understand different approaches in computational biology and the basic principles of computer aided drug design	U	2,3
5	Appreciate the role of Artificial Intelligence in Biology	Ap	3,6

*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1		**Biological Databases & Sequence Analysis**	20	
	1.1	Scope of Bioinformatics. Bioinformatics Resources - NCBI, EBI, ExPASy, RCSB, DDBJ.	2	1
	1.2	**Biological Databases** Classification of biological databases: Primary databases: Nucleotide sequence databases - GenBank, EMBL, DDBJ; Protein sequence databases – PDB, SWISS-PROT, TrEMBL, PIR; Secondary Databases: Pfam, PROSITE, UniProt K, CATH; Composite Databases – NDB, OWL. Sequence file format: FASTA, GenBank format.	5	1
	1.3	Genome Databases : Viral genome database - ICTV ; Bacterial Genome database - GOLD; Organism specific database - OMIM/OMIA, FlyBase; Sequence submission tool – BankIt, sequin.	3	1
	1.4	**Sequence Analysis** Basic concepts of sequence alignment; Pairwise sequence alignment: BLAST, types of BLAST - blastn, blastp, blastx, tblastn, tblastx; Global and local alignment. Multiple sequence alignment: CLUSTAL W and CLUSTAL Omega. Significance of sequence alignment.	4	1
	1.5	Phylogenetics: Distance based methods - UPGMA, NJ and Minimum Evolution methods, Character based methods - Maximum Parsimony (MP), Maximum Likelihood. Construction of phylogenetic tree – PHYLIP, MEGA. Bootstrapping.	6	1
2		Genomics and Proteomics	7	
	2.1	**Genomics**- Introduction, Structural, functional and comparative genomics. **Proteomics** – Introduction.	3	2
	2.2	**Protein modelling:** - Homology modelling; Threading, *ab initio* prediction, structure evaluation.	4	2
3		**Systems Biology & Computational Biology**	18	
	3.1	Fundamentals of Systems Biology, Definition and principles, Historical perspectives.	2	2
	3.2	Metabolomics, Metabolic pathway database - KEGG, Gene network, Synthetic Biology.	4	2
	3.3	Computational Biology - Introduction, Scope and Application.	2	2

	3.4	Artificial Intelligence**:** Applications and challenges of AI in Biology. Role of AI in Bioinformatics. Algorithms for Bioinformatics prediction: HMM (Hidden Markov Models) and Neural Network.	4	5
	3.5	Drug designing: Principles of Pharmacokinetics and Pharmacodynamics - ADME.	3	4
	3.6	High-throughput screening (HTS), Computer aided drug design (CADD). Molecular docking - Autodock.	3	4
4		**Practicals**	30	
	1	Data base search and data retrieval-using NCBI, PDB and Expasy		1,2, 4
	2	Pairwise sequence alignment –BLAST		
	3	Multiple sequence alignment - Clustal W		
	4	Construction of phylogenetic tree using MEGA		
	5	Protein structure visualization using RASMOL		
	6	Secondary structure prediction of protein - Chou-Fasman method		
		Protein motif & domain analysis: eMOTIF& Pfam		
		Homology modeling - SWISS-MODE		
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, virtual classes, You -tube videos
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment** **Theory Total=25 marks -** Quiz, Test Papers, seminar **Practical Total = 15 marks -** Lab performance, record, viva
	B. End Semester Examination **Theory Total = 50 marks, Duration 1.5 hrs** Short Essays 5 out of 7 x4 =20 marks Short questions 10 out of 12 x2 =20 marks Fill in the blanks 10x1 =10 marks **Practical Total = 35 marks Duration 2 hrs** **Record 10 marks, Examination 25 marks:** Experiment for Pairwise/ multiple sequence alignment – 12 marks Construction of phylogenetic tree – 8 marks Visualization of molecular model – 5 marks

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SCHEME OF EVALUATION FOR INTERNSHIP

A. INTERNAL EVALUATION - 15 MARKS

Sl.No	Head	Marks
1	Content & relevance of Dissertation as evidenced from work diary	8
2	Presentation	4
3	Viva	3

B. END SEMESTER EXAMINATION - 35 MARKS

Sl No	Head	Marks
1	Content & relevance of Dissertation as evidenced from work diary	20
2	Presentation	10
3	Viva	5

Project: MCE8PRJZGY400

EVALUATION OF PROJECT IN THE EIGHTH SEMESTER OF FOUR YEAR UNDER-GRADUATEPROGRAM

Evaluation of Project

The project should contain:

1. Title page/Front page (Certified by the HOD)
2. Declaration by the candidate
3. Certificate attested by the Supervising teacher
4. Acknowledgement, if any
5. Table of contents
6. Abbreviation, if any
7. Abstract
8. Introduction & Review of Literature
9. Methodology
10. Results and Discussion
11. Summary and Conclusion
12. References

The project report submitted must be duly attested by the Supervising Teacher and certified by the Head of the Department. There shall be a pre submission presentation and evaluation of the project in the middle of the eighth semester. **Mark for internal**

evaluation is 60.

Scheme for internal evaluation

Sl No	Component	Marks
1	Topic/Area selected (relevance)	5
2	Experimentation/Data collection	15
3	Punctuality	5
4	Compilation	10
5	Content	10
6	Presentation	15
	TOTAL	60

The end semester evaluation of the Project shall be according to the Scheme given below.

Sl No	Component	Marks
1	Originality of approach, Introduction & aim of the project/objectives, Organization and Precision of Printed work	10
2	Relevance of the Topic	10
3	Review of Literature	10
4	Methodology	20
5	Involvement	10
6	Result and discussion: tabulation of data, presentation of figure/graphs, clarity of explanations etc.	20
7	Bibliography in correct format	10
8	Conclusions/ Applications to the society	10
9	Presentation of Report and Viva voce	30
10	Exceptional quality of the project	10
	TOTAL	**140**